Final Report

Energy Efficient Local Government Programs: 2003 Evaluation

Prepared for:
KEMA

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quantec

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Executive Summary

KEMA, Inc., formerly known as XENERGY or KEMA-XENERGY, implemented the Energy Efficiency Local Government Program (EEGOV) beginning in 2002 and continuing through 2004. The program included two components:

- ***The Business Energy Services Team*** (B.E.S.T.) to promote energy-efficient lighting and other measures to hard-to-reach small business customers
- ***The Wastewater Treatment Plants Improvement Program*** (WWTPIP), which encourages wastewater treatment plant site-specific efficiency improvement and process optimization, particularly in small to medium size plants

B.E.S.T. was implemented in the Southern California Edison (SCE) service territory. WWTPIP was offered in both the SCE and Pacific Gas and Electric (PG&E) service area.

Evaluation Objectives

B.E.S.T

The evaluation of B.E.S.T. focused on verifying installation of the measures for which incentives were provided, estimating hours of operation for lighting measures using lighting loggers, verification of energy savings, and measuring participant and contractor satisfaction with the program experience. In addition, we provide recommendations for improving B.E.S.T. program implementation and a summary of lessons learned from the process evaluation.

Table ES.1 shows the various evaluation objectives of the CPUC, as outlined in the Policy Manual, and the aspects of our evaluation that address each.

Table ES.1: CPUC Objectives and the B.E.S.T. Evaluation

Objectives	B.E.S.T. Evaluation Approach
Measuring level of energy and peak demand savings achieved (except information-only)	Using IPMVP Option A, we field measured key project characteristics (installation of measures and lighting operating hours) to measure the energy and peak demand savings achieved.
Measuring cost effectiveness (except information-only)	We re-calculate B.E.S.T. cost effectiveness using actual program expenditures provided by KEMA and calculated the *ex-post* energy savings verified through this evaluation.
Providing up-front market assessments and baseline analysis, especially for new programs	While a comprehensive baseline market assessment was beyond the scope of this evaluation, we used the extensive baseline data collected by B.E.S.T. program contractors to measure energy savings impacts.
Providing ongoing feedback, and corrective and constructive guidance regarding the implementation of programs	We have maintained regular contact with KEMA and provided ongoing feedback and recommendations as necessary.
Measuring indicators of the effectiveness of specific programs, including testing of the assumptions that underlie the program theory and approach	The process evaluation assesses key program aspects, including effectiveness of program marketing, delivery and management.
Assessing the overall levels of performance and success of programs	Utilizing the impact and process evaluations together, we assess and comment on the overall level of performance and success of the program.
Informing decisions regarding compensation and final payments (except information-only)	The impact and process evaluations allow the CPUC to assess the achievement of the program and make an informed decision regarding compensation and final payments.
Helping to assess whether there is a continuing need for the program	The impact and process evaluations help to assess the performance of the program and the continuing need for it.

WWTPIP

The primary goals of this evaluation were to provide 1) a verification of energy savings and 2) an assessment of customer satisfaction with WWTPIP. The first goal was met through an impact evaluation, which included visits to sites that had implemented measures. The second goal was addressed through a process assessment, which relied on phone interviews conducted with participants at the same sites.

The scope of the process assessment was limited, and focused primarily on issues of customer satisfaction and major implementation issues. Table ES.2 shows the CPUC's evaluation objectives, how we dealt with them in this study, and the evaluation component that addressed them. The process assessment was conducted through three activities: review of WWTPIP materials, telephone interviews with staff from participating plants, and interviews with the KEMA WWTPIP manager and the primary contact with Brown & Caldwell.

Table ES.2: CPUC Objectives and the WWTPIP Evaluation

Objectives	WWTPIP Evaluation Approach	Evaluation Component
Measuring level of energy and peak demand savings achieved (except information-only)	Used the IPMVP Option B to measure the energy and peak demand savings achieved for every site that implemented measures.	Impact
Measuring cost-effectiveness (except information-only)	Re-calculated WWTPIP cost effectiveness using actual program expenditures provided by KEMA and the ex-post energy savings verified through this evaluation.	Impact, Process
Providing up-front market assessments and baseline analysis, especially for new programs	A comprehensive baseline market assessment was beyond the scope of this evaluation. Baseline energy usage estimates were determined from the monitoring data provided by KEMA.	Impact
Providing ongoing feedback, and corrective and constructive guidance regarding the implementation of programs	Maintained close contact with KEMA and provided ongoing feedback and recommendations as appropriate.	Process
Measuring indicators of the effectiveness of specific programs, including testing of the assumptions that underlie the program theory and approach	Developed explicit effectiveness indicators for the process evaluation.	Process
Assessing the overall levels of performance and success of programs	Utilized the impact and process evaluations together to assess overall level of performance and success of the program.	Impact, Process
Informing decisions regarding compensation and final payments (except information-only)	Provided information to permit the CPUC to assess the achievement of the WWTPIP and make an informed decision regarding compensation and final payments.	Impact, Process
Helping to assess whether there is a continuing need for the program	Findings from the evaluation provided an assessment of WWTPIP performance and the continuing need for it.	Impact, Process

Evaluation Approach and Findings

B.E.S.T.

Process Assessment. To assess the process of delivering B.E.S.T., Quantec conducted interviews with program staff, participating contractors, and participants. In addition, Quantec reviewed program marketing materials, databases, and the on-line tool that contractors used to access program materials and assess individual projects (https://websafe.kemainc.com/best/).

Impact Assessment. Quantec, in conjunction with kW Engineering, conducted 50 site visits with B.E.S.T. participants. As part of these site visits, our team verified the presence of qualified lighting technologies and installed data loggers to assess hours of operation of the lighting.

The lighting loggers were installed for approximately two weeks at each location visited. One to three loggers were installed depending on the size of the area and the presence of different zones, in which qualified lighting was installed. The loggers were used to determine hours of usage based on recorded lumen levels. Usage during the logging period was extrapolated to estimate annual hours of usage.

B.E.S.T. met its kWh targets and exceed its kWh targets. Table ES.3 compares the projected actual savings estimates reported in the CPUC spreadsheet to those calculated based on the more detailed project specifications using the on-line assessment tool. The greater granularity and project specifics result in more precise, but lower energy savings estimates. Demand impacts were higher using the B.E.S.T. software tool.

Table ES.3: B.E.S.T. Savings Comparison

	CPUC Workbook Gross Savings	CPUC Workbook Net Savings	B.E.S.T. Software (Projected Actual Gross Savings)
Energy Savings (kWh)	1,989,384	1,909,809	1,766,417
Demand Savings (kW)	525	504	528

As part of the evaluation of the B.E.S.T. program, we calculated realization rates to the savings estimates from the on-line assessment tool. Table ES.4 shows the calculation of realized net savings determined by applying the realization rate and the net-to-gross ration of 0.96.

Table ES.4: Calculation of Net Realized Actual Savings

	B.E.S.T. Software (Projected Actual Gross Savings)	Realization Rates	Net-to-Gross Ratio	Net Realized Actual Savings
Energy Savings (kWh)	1,766,417	95.7%	0.96	1,622,843
Demand Savings (kW)	528	96.2%	0.96	488

WWTPIP

Process Assessment. The WWTPIP process assessment had several purposes including providing inputs for the cost-effectiveness analysis; providing ongoing feedback and corrective guidance, as needed; assessing effectiveness indicators and the program theory; providing inputs to the overall assessment of WWTPIP performance; informing decisions regarding compensation; and informing the assessment of the continuing need for WWTPIP.

Before conducting the process assessment data collection, we developed indicators that were utilized to assess the effectiveness of WWTPIP.

Impact Assessment. The impact evaluation also had several purposes. These included verifying energy and demand savings; providing inputs for the cost-effectiveness analysis; providing inputs to the overall assessment of WWTPIP performance; informing decisions regarding compensation; and informing the assessment of the continuing need for the WWTPIP.

The results for the WWTPIP overall are shown in the tables below. All sites that implemented projects were evaluated. The projected actual savings are taken from the KEMA summary of WWTPIP activity.

Table ES.5: Gross WWTPIP Impacts – PG&E and SCE Territories

	Projected Actual Savings		Realized Actual Savings		Realization Rate	
	kWh/yr	kW	kWh/yr	kW	kWh/yr	kW
PG&E	1,273,676	1,498	1,207,171	1,543	95%	103%
SCE	938,038	162	940,735	167	100%	103%
Total	***2,211,714***	***1,660***	***2,147,906***	***1,710***	***97%***	***103%***

Table ES.6 shows the distribution of realized annual gross energy savings in two categories: 1) capital improvement or process optimization projects and 2) operations improvements projects.

Table ES.6: WWTPIP Realized Gross Savings

	Capital Improvements or Process Optimization (kWh/yr)	Operations Improvement (kWh/yr)
PG&E	922,429	284,743
SCE	940,735	0
Total	***1,863,164***	***284,743***

Net impacts are determined as the product of the gross impacts and the appropriate net-to-gross ratio. Net impacts are shown in Table ES.7.

Table ES.7: Net WWTPIP Impacts

	Realized Actual Savings	
	kWh/yr	kW
PG&E	971,892	1,236
SCE	752,587	133
Total	***1,724,479***	***1,369***

Aggregate Impacts and Cost-Effectiveness

Table ES.8 shows the aggregate net energy savings results for each service area and the Program overall.

Table ES.8: Aggregate Net Realized Energy Savings Results

	Annual Demand Reductions (Net kW)	**Annual Electricity Savings** (Net kWh)	**Lifecycle Electricity Savings** (Net kWh)
PG&E – WWTPIP	1,236	971,892	11,881,777
SCE – WWTPIP	133	752,587	11,288,820
SCE – B.E.S.T.	488	1,622,843	24,998,460
Total	***1,857***	***3,347,322***	***48,169,057***

Table ES.9 presents the Total Resource Cost test (TRC) results. Results shown for the SCE area include the WWTPIP and B.E.S.T. components since it was not possible to allocate the administrative costs to each separately. The Program was cost-effective in both service areas. The total overall Program was cost-effective, with a TRC of 1.21.

Table ES.9: TRC Cost Effectiveness Results

	Costs	**Benefits**	**Ratio**	**Net Benefits**
PG&E	$451,344	$574,881	1.27	$123,538
SCE	$1,417,289	$1,679,266	1.18	$261,977
Total	***$1,868,633***	***$2,254,147***	***1.21***	***$385,514***

Conclusions and Recommendations

B.E.S.T.

B.E.S.T. achieved considerable success, as evidenced by the following:

- Met its target for kWh savings and exceeded its goals for demand (kW) savings – B.E.S.T. achieved 100% of its energy savings goal and 113% of its demand savings goal
- Was implemented cost effectively and within budget
- Engaged multiple trade ally partners (contractors)
- Effectively reached hard-to-reach customers – 91% of program participants were part of the targeted hard-to-reach population and they accounted for 80% of total energy savings
- Achieved high levels of participant and contractor satisfaction

Achievement of Program Goals. B.E.S.T. exceeded its goals related to electric demand and energy (kW and kWh) savings. Because no HVAC or custom measures were installed, the Program did not achieve any natural gas savings.

Continued Need for the Program. B.E.S.T assisted customers who were unlikely to otherwise participate in programs (more than 80% had not participated in previous efficiency programs) or adopt energy-efficient technologies. We recommend that the Program be continued in order to:

- Reach additional hard-to-reach customers
- Address additional energy efficiency opportunities, including HVAC and custom measures
- Engage additional contractors
- Achieve additional cost-effective energy savings that would otherwise not be realized

Recommendations. To continue B.E.S.T. most effectively, we offer the following recommendations:

- *Additional Contractor Participation*. Since program activity was concentrated with a few contractors, encouraging broader participation among contractors may lead to additional measure and/or customer diversity among participants.
- *Contractor Oversight*. Some opportunities may exist to provide additional oversight of contractors to ensure their compliance with program processes and procedures. The limited negative feedback from participants was related to contractor performance. Ensuring that the contractors perform their work with minimal disruption to the participating business and provide adequate follow-up would eliminate the few customer complaints that were received.
- *Allocation of Incentives*. The quick commitment of incentives to lighting projects left no incentives available for other HVAC or non-lighting customer measures. KEMA has addressed this by allocating incentives to the different technology categories for the next round of implementation.

WWTPIP

The WWTPIP achieved mixed success in meeting its goals. Achievements of the WWTPIP included:

- Was implemented cost effectively
- Identified a large potential market for the services offered

- Successfully informed a substantial number of eligible facilities about the WWTPIP
- Provided well-received training to 10 facilities
- Conducted 10 site audits and delivered benchmarking studies
- Motivated five treatment plants to implement process optimization and three plants to implement capital improvement projects
- Achieved first-year annual (gross) energy savings of 1,207,171 kWh in the PG&E area and 940,735 kWh in the SCE area

For a number of reasons, however, the WWTPIP did not meet its overall participation and impact goals.

Achievement of Program Goals. KEMA successfully met its goal of developing a WWTPIP flyer, but the lengthy review process pushed back the delivery beyond its planned milestone date.

Because of the difficulty recruiting participants and the time required to implement projects, interim project and energy savings milestones were not met.

Continuing Need for Program. There were more than 100 plants eligible for the WWTPIP. Given the priorities, history, and organizational characteristics of facilities in this sector, it appeared that there were likely to be many opportunities for cost-effective efficiency upgrades.

In our view, this sector offers considerable potential for efficiency improvements. The WWTPIP revealed some of this potential and identified industry barriers and mechanisms to overcome them. Consequently, we believe there is a continuing need for a program such as WWTPIP.

Recommendations. We offer the following recommendations for the consideration of implementers interested in pursuing similar programs with municipal wastewater treatment plants:

- Design a program with a timeline that is compatible with the decision-making and budgeting cycles of these facilities
- Increase the amount of resources dedicated to follow-through with interested plants and personnel
- Build on the knowledge gained through the WWTPIP to identify and address organizational issues that hinder the implementation of efficiency improvements
- Promulgate case studies of successful efficiency upgrades so that prospective participants can see the potential benefits and how others

overcame implementation barriers and addressed issues such as risk and performance uncertainty

- Leverage the growing interest in understanding the relationship of energy costs and efficiency to co-generation.

I. Introduction

Program Components

KEMA, Inc., formerly known as XENERGY or KEMA-XENERGY, implemented the Energy Efficiency Local Government Program (EEGOV) beginning in 2002 and continuing through 2004. The program included two components:

- ***The Business Energy Services Team*** (B.E.S.T.) to promote energy-efficient lighting and other measures to hard-to-reach small business customers
- ***The Wastewater Treatment Plants*** *Improvement* ***Program*** (WWTPIP), which encourages site-specific efficiency improvement and process optimization, particularly in smaller waste water treatment plants

B.E.S.T.

B.E.S.T. was offered in the City of Long Beach from November 2002 and through 2003. The B.E.S.T. program promoted energy efficiency in the small and very small commercial customer market segment (100 kW or less) and offered full turnkey services, including:

- Energy education
- Site-specific energy analysis
- Financial incentives
- Equipment procurement
- Installation

This integrated marketing and implementation process takes customers quickly from interest and intent to actual installation of measures. The primary focus of this program was implementation of cost-effective, high efficiency lighting measures and some HVAC and customized measures. The incentives offered through B.E.S.T. (shown in Table I.1) are designed to cover an average of 75% of the measure costs.

Table I.1: B.E.S.T. Incentive Levels

Measure Type	Maximum Rebate Amount
Screw-In CFL	$250/kW*
Hardwired CFL	$750/kW*
All Other Lighting Retrofits	$750/kW*
Occupancy Sensors	$250/controlled kW
Programmable Thermostat	$15/cooling ton
Window Film	$2.50/sq ft of film
Economizer Control	$75/cooling ton
Custom Electric	$0.20/annual kWh saved
Custom Gas	$1/annual therm saved

* Connected kW

B.E.S.T. was promoted via a network of local service providers, primarily lighting, HVAC, or refrigeration contractors. Projects were completed in 103 small business facilities in the City of Long Beach. More than 6,300 energy-efficient lighting measures were installed with projected annual savings of more than 1.7 million kWhs per year.

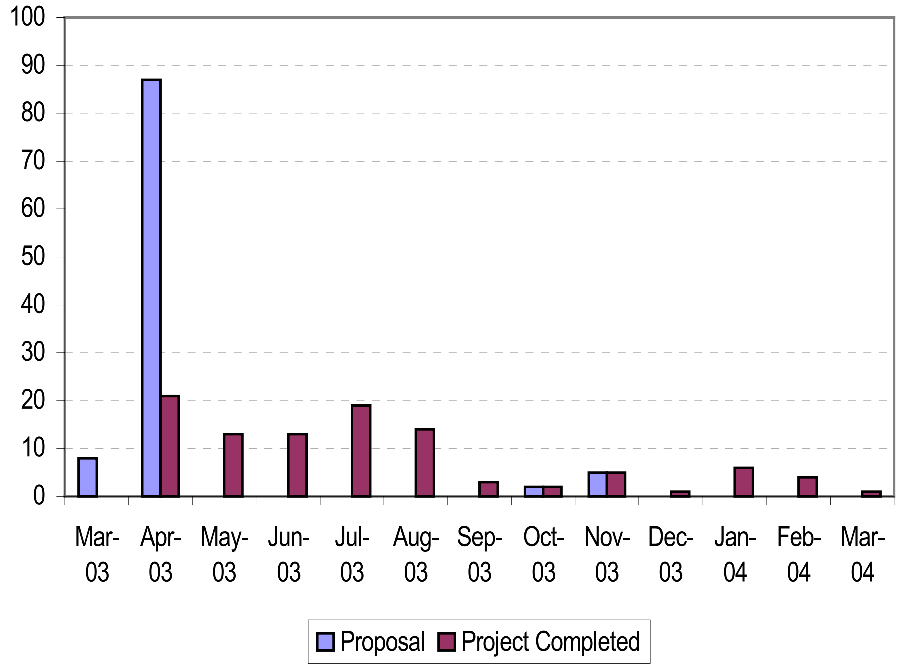
A total of $373,669 in incentives was distributed, ranging from a low of $547 to a high of $37,922, with an average of $3,628. The B.E.S.T. program served several types of small businesses, as illustrated in Table I.2.

Table I.2: Types of Business Served

Business Type	No. Projects Completed
Office/warehouse	3
Office, medium	3
Office, small	47
Other	2
Restaurant	4
Retail, large	2
Retail, small	33
School	3
Supermarket, mini-market	6
Total	***103***

While the available incentives for B.E.S.T. were fully allocated in a two-month period early in 2003, contractors had until the end of March 2004 to complete construction of the project. Figure I.1 shows the number of proposals accepted and projects completed each month of the program.

Figure I.1: Proposal Acceptance and Project Completion



WWTPIP

KEMA's Wastewater Treatment Plants Improvement Program (WWTPIP) was offered in both the Pacific Gas and Electric (PG&E) and the Southern California Edison (SCE) service areas. The evaluation was conducted in accordance with the requirements of the California Public Utilities Commission (CPUC).

WWTPIP was an energy efficiency audit, information, training, and incentive program targeted toward approximately 70 qualifying wastewater treatment plants operated by local government agencies in areas served by PG&E and SCE. The specific target market was medium-sized plants with design flows of 7 million to 30 million gallons per day (MGD).[1] KEMA delivered the WWTPIP in conjunction with services provided by Brown & Caldwell.

The WWTPIP focused on operator training, process control optimization, and efficiency upgrades. Services were provided in two phases. In Phase I, plants submitted an application for services, including a facility energy audit and benchmarking study, process optimization training, and assistance implementing process optimization. Plants that received the audit were

1 Larger plants were not completely excluded from participation, but priority was given to plants in the targeted size range.

allowed to apply for incentives in Phase II that paid for design and installation of equipment efficiency measures. Table I.3 below shows the WWTPIP services and incentives.

Table I.3: WWTPIP Services and Incentives

	Services	Incentives
Phase I	Facility energy audit	Up to $40,000 in services at no cost
	Operator training for process optimization	
	Assistance for implementing process optimization	
Phase II	Design assistance	Up to 40% of design cost
	Equipment purchase and installation incentive	$0.125/annual kWh savings, minus design incentive*

* Incentives were limited to a maximum of 50% of total project cost.

The original schedule called for all equipment to be installed with a completed inspection by December 31, 2003. Due to the amount of time needed for interested agencies to develop, fund, and implement projects, KEMA requested and obtained schedule extensions from the CPUC that eventually permitted agencies to complete their projects by October 31, 2004.[2]

2 Note that one plant continued final phases of installation until mid-November.

II. Business Energy Services Team (B.E.S.T.) Program Evaluation

Program Implementation Process

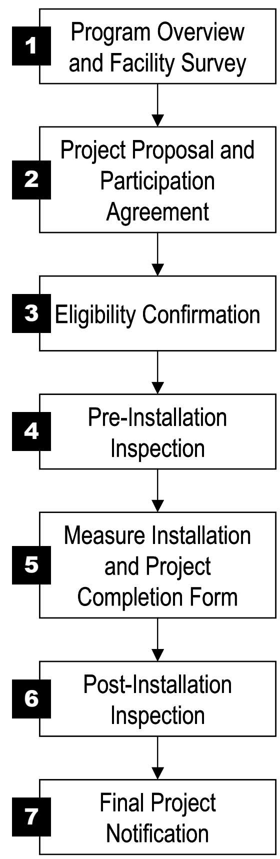
B.E.S.T. was designed to be marketed initially by KEMA and then turned over to be promoted by contractors. Private lighting contractors found B.E.S.T. to be an effective sales and marketing tool, and KEMA allowed them to both market the program and sign-up participants. The contractors leveraged their existing relationships and the ability to canvas neighborhoods where target customers were located to engage customers.

An initial assessment was performed in which appropriate upgrades were identified and proposed to the customer. Contractors used KEMA's B.E.S.T. on-line software tool to determine projected savings based on the baseline equipment and the hours of operation. The on-line tool also helped contractors determine the incentives the customer would qualify for and the related costs.

Customers were asked to enter into a participation agreement and to sign a release that allowed KEMA to obtain their billing records from SCE, the electric utility serving Long Beach. KEMA performed a pre-installation inspection for contractor-initiated projects to verify baseline equipment and hours of operation, in addition to the applicability of the proposed efficiency upgrades.

The contractors performed the installation of the approved measures and provided customers with information about equipment maintenance, warranties, and basic energy education.

Figure II.1:
B.E.S.T. Implementation Process



Once the installation was complete, contractors notified KEMA, and a post-installation inspection was performed. KEMA paid the incentives directly to the contractor, while the customer was responsible for paying the balance of the total project cost.

KEMA teamed with the City of Long Beach and worked with its Chamber of Commerce to implement B.E.S.T. in the City. This coordination served to bring name recognition and credibility to the program and to educate City employees on the potential for energy efficiency in their city. This was a successful coordination, supported by the fact that Long Beach invited KEMA to continue working in their city, and B.E.S.T. will be implemented for two more years.

Evaluation Objectives

The evaluation for B.E.S.T. focused on verifying installation of the measures for which incentives were provided, estimating hours of operation for lighting measures using lighting loggers, verification of energy savings, and measuring participant and contractor satisfaction with the program experience. In addition, we provided relevant recommendations for improving B.E.S.T. program implementation and a summary of lessons learned from the process evaluation.

Table II.1 shows the various evaluation objectives of the CPUC and the aspects of our evaluation that address each.

Table II.1: Evaluation Objectives

Objectives	B.E.S.T. Evaluation Approach
Measuring level of energy and peak demand savings achieved (except information-only)	Using IPMVP Option A, we field measured key project characteristics (installation of measures and lighting operating hours) to measure the energy and peak demand savings achieved.
Measuring cost effectiveness (except information-only)	We re-calculate B.E.S.T. cost effectiveness using actual program expenditures provided by KEMA and calculated the *ex-post* energy savings verified through this evaluation.
Providing up-front market assessments and baseline analysis, especially for new programs	While a comprehensive baseline market assessment was beyond the scope of this evaluation, we used the extensive baseline data collected by B.E.S.T. program contractors to measure energy savings impacts.
Providing ongoing feedback, and corrective and constructive guidance regarding the implementation of programs	We have maintained regular contact with KEMA and provided ongoing feedback and recommendations as necessary.
Measuring indicators of the effectiveness of specific programs, including testing of the assumptions that underlie the program theory and approach	The process evaluation assesses key program aspects, including effectiveness of program marketing, delivery and management.
Assessing the overall levels of performance and success of programs	Utilizing the impact and process evaluations together, we assess and comment on the overall level of performance and success of the program.
Informing decisions regarding compensation and final payments (except information-only)	The impact and process evaluations allow the CPUC to assess the achievement of the. program and make an informed decision regarding compensation and final payments.
Helping to assess whether there is a continuing need for the program	The impact and process evaluations help to assess the performance of the program and the continuing need for it.

Process Assessment

To assess the process of delivering B.E.S.T., Quantec conducted interviews with program staff, participating contractors, and participants. In addition, Quantec reviewed program marketing materials, databases, and the on-line tool that contractors used to access program materials and assess individual projects (https://websafe.kemainc.com/best/). The results and findings from these data collection and evaluation activities are discussed below.

Contractor Survey

Qualifying contractors were selected at the beginning of the program. They were required to be licensed contractors, have a City of Long Beach business license, have one million dollars in liability insurance, and provide three verified references. Participating contractors were also required to attend a program-training seminar.

B.E.S.T. was extremely successful in recruiting lighting contractors, but less successful in recruiting window film and HVAC contractors. There was one refrigeration contractor in the program, but no projects were completed. This may have been, in part, because the available incentives were committed to lighting projects, which are generally easier to identify and assess, early in the program.

There were seven lighting contractors involved in delivering services through B.E.S.T. though one contractor was responsible for over half of the projects initiated and more than 80% of the projects completed. . Three of the seven contractors had projects initiated but completed none.

Quantec conducted interviews with six contractors. These interviews addressed:

- B.E.S.T. program awareness
- Training effectiveness
- B.E.S.T. processes and procedures
- On-line database tool
- Customer communications
- Overall satisfaction with the program

B.E.S.T. Awareness and Marketing

Of the contractors interviewed, half learned of B.E.S.T. directly from KEMA, and two learned of it through other contractors. The contractor with the most significant activity learned of the program through the San Diego Regional

Energy Office (who implemented a similar B.E.S.T. program in San Diego County that began in December of 2002).

All of the contractors surveyed were comfortable with the application and screening process and felt that it ensured professional, quality work for the participants.

Training Effectiveness

KEMA provided training for each of the B.E.S.T. program contractors. The objectives of this training were to provide an overview of the program requirements, policies, and procedures and to provide instruction on the use of the on-line database and assessment tool. All but one of the contractors indicated that they were very satisfied with the training. Contractors felt that the overview of the on-line system and the review of customer service training were the most useful aspects of the training.

B.E.S.T. Processes and Procedures

The contractors expressed general satisfaction with B.E.S.T. policies and procedures, although it was noted that the process was lengthy and required significant paperwork (though the on-line system simplified that). All of the contractors were satisfied or extremely satisfied with KEMA's responsiveness to B.E.S.T. program questions. The one component they were dissatisfied with was the payment schedule; they all found it to be too cumbersome and time consuming. They felt it took too long to receive payment for completed jobs.

On-Line Database Tool

The contractors that had the most experience with B.E.S.T. (in terms of projects initiated and completed) were extremely satisfied with the database system. They found it to be useful and easy to navigate. The contractors would like to see the Web site updated on a regular basis to better track project status. Contractors also indicated an interest in using the system to automatically invoice for completed projects.

Customer Communications

All of the contractors with completed projects claimed to provide B.E.S.T. participants with information about maintenance, warranties, and general energy efficiency strategies. They discussed the importance of regular maintenance and cleaning of bulbs and fixtures. One contractor indicated that they left replacement stock (bulbs) with the customer. They provided written warranty information and emphasized it in the customer agreement. Energy efficiency education included discussion of the benefits of efficient technologies, calculation of savings, and reading of energy bills.

Overall Satisfaction

Overall, contractors were satisfied with the program and found it highly beneficial. Some contractors had limited activity through B.E.S.T. because the full incentive budget was allocated in a short period of time. These contractors requested that there be a mechanism to simultaneously inform all contractors regarding availability of the B.E.S.T. incentives, though KEMA sent program information and updates out via email on a regular basis.

Participant Interviews

Quantec also conducted 30 interviews with B.E.S.T. program participants, which covered the topics discussed below.

- B.E.S.T. program awareness and understanding
- B.E.S.T. program participation process
  - Pre installation
  - Installation
  - Post installation
- Propensity for energy savings actions
- Non-energy benefits
- Satisfaction with B.E.S.T. program services

B.E.S.T. Program Awareness and Understanding

Nearly all of the surveyed participants reported learning about the B.E.S.T. program from the contractor who came to their business. The majority of the B.E.S.T. program participants reported that they had a very clear understanding of the steps, requirements, and benefits of the B.E.S.T. program. Only one participant reported that he did not have a very clear understanding of the B.E.S.T. program.

Cost savings was the primary reason for participating in the B.E.S.T. program; other reasons for participating included need for improved lighting, energy savings, and opportunity to upgrade equipment. Customers relied mainly on the relationship with the contractor in their decision to participate. They had little awareness of the role of KEMA, although some regarded the endorsement of the City of Long Beach as influential in their decision to participate. The relatively low net cost of the upgrades to the small business owner was a definite factor in most decisions to participate.

B.E.S.T. Program Participation Process

Pre Installation. All but one of the surveyed participants indicated that the information presented regarding the proposed equipment upgrades, and the potential energy savings to be realized, was clearly explained.

A majority of program participants, 70%, reported that the B.E.S.T. program incentive was more than enough, whereas 20% reported that it was just enough.

A majority of the B.E.S.T. program participants reported that the requirement to sign a billing history disclosure was clearly explained. All of the B.E.S.T. program participants reported that the initial facility survey was conducted professionally and at a convenient time.

Installation Process. The majority of B.E.S.T. program participants (90%) reported that the installation of equipment was done at a convenient time. In addition, most reported that the installer completed the installation process in a reasonable length of time.

Of the participants surveyed, 60% expressed being very satisfied with the installed measures, while 33% reported being satisfied with most of the measures.

More than one-third of the B.E.S.T. program participants were unsatisfied, however, with the equipment maintenance information provided by the contractor. Dissatisfied participants most commonly reported that contractors provided little or no information on equipment maintenance. The remaining participants reported being satisfied with the maintenance information provided and had not experienced problems with the equipment.

Post Installation. The majority of participants reported that the post-installation inspection was conducted in a professional manner and at a convenient time for them. Two participants reported that they did not recall a post-installation inspection being conducted.

Most of the B.E.S.T. program participants reported that they were either very satisfied or satisfied with the entire B.E.S.T. program process. Dissatisfaction was reportedly due to difficulties with the contractors or lack of follow-up contact.

More than half of the B.E.S.T. program participants (60%) reported that they had noticed savings on the electric bills since installing the measures. Those that reported not being aware of savings claimed not to see the bills.

More than half of the B.E.S.T. program participants indicated that they had limited knowledge or understanding of how to improve energy efficiency in their business, while only a few indicated that they had a high level of understanding. Participation in the B.E.S.T. program increased their knowledge related to energy efficiency opportunities.

Propensity for Energy Savings Actions

Most of the participants reported that they would not have installed the equipment if the B.E.S.T. program had not been available. Primary reasons for not installing equipment included cost, lack of knowledge, and the participants' status as renters. The B.E.S.T. program effectively addressed those barriers through its full-service, turnkey approach and the substantial incentives.

Two-thirds of the B.E.S.T. program participants reported that no barriers or issues arose during the course of the project. Of those that reported barriers and/or issues, the primary concern was that the contractors broke items during installation and did not return to replace or repair them. Others were unhappy with the new lighting equipment (in particular, the quality or level of lighting provided) or felt that the process was too lengthy.

On-Line Assessment Tool

To facilitate the B.E.S.T. program, KEMA made available to contractors the on-line B.E.S.T. software tool that allowed contractors to:

- Download proposal forms
- Enter customer data and baseline equipment inventory
- Identify appropriate energy efficiency measures based on the existing equipment
- Assess the cost and impact of proposed upgrades (lighting and other)
- Track proposal status from initiation through completion

Contractors accessed the Web site with a log-in ID and password. As discussed in the contractor surveys, the contractors found this to be an effective tool for facilitating the B.E.S.T. program.

We reviewed the B.E.S.T. software tool and the underlying database and utilized the data for various evaluation purposes. We found the database to be comprehensive, capturing significant details on the customer and project characteristics.

The software contains an extensive database of lighting inventory and maps pre-existing customer inventories to retrofit recommendations, accepted incentive levels, and standard pricing. As long as contractors follow the recommendations from the software, the system can be used to quickly and efficiently develop customer proposals.

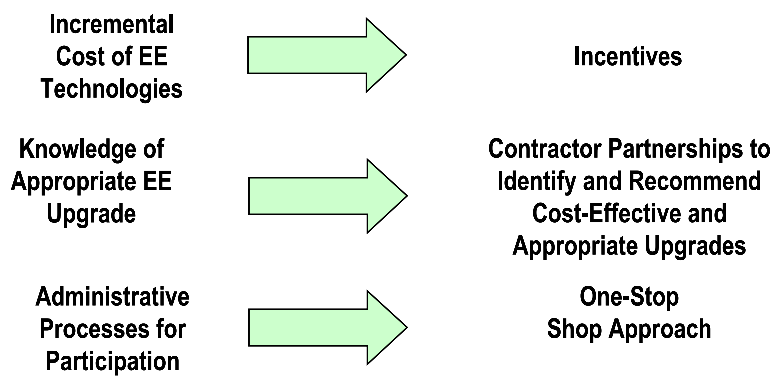
Effectiveness in Addressing Barriers and Reaching Hard-to-Reach Customers

B.E.S.T. addressed two of the most significant barriers associated with making efficiency upgrades: 1) lack of information and/or knowledge about the appropriate upgrades to make and 2) the cost of making those upgrades (particularly important in rented facilities).

The other significant barrier for small business owners or managers is the "hassle factor" that many perceive is associated with the B.E.S.T. program participation. B.E.S.T. addressed this through its turnkey approach.

Figure II.2 shows the program features that directly target the barriers to investment in energy-efficient technologies.

Figure II.2: Energy Efficiency Barriers and B.E.S.T. Features

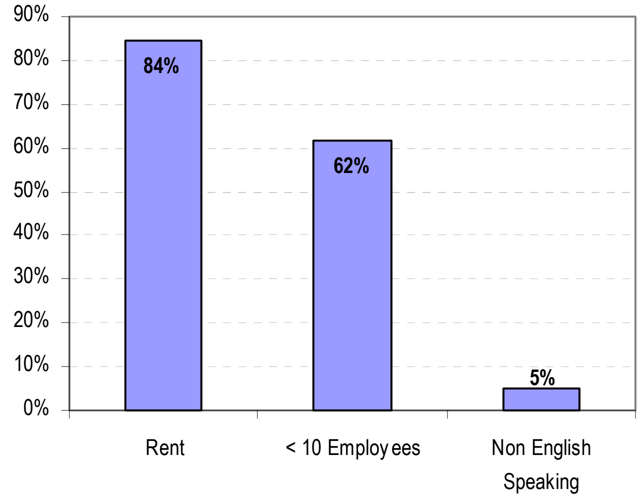


B.E.S.T. targets "hard-to-reach" small business customers. The hard-to-reach customers targeted by this program are those that met one or more of the following criteria:

- Business located in rented space
- Business with less than ten employees
- Business owned by a non-English speaking person

Of the B.E.S.T. participants, 91% met one or more of these criteria. Figure II.3 shows the percentage of B.E.S.T. participants in each hard-to-reach category.

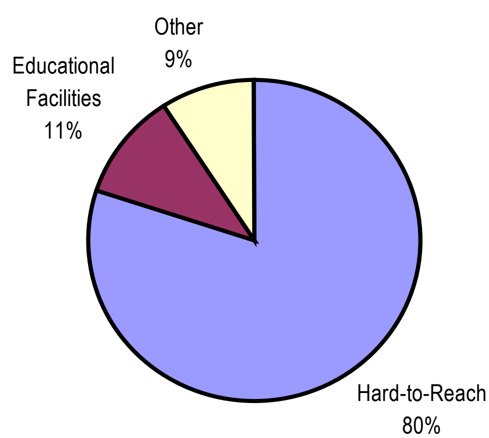
Figure II.3: Percent of Participants in Hard-to-Reach Categories



In addition to those customers in the CPUC-defined hard-to-reach categories, there were also four educational institutions participating in B.E.S.T. Many educational institutions face similar challenges in being able to adopt energy efficiency improvements in their facilities – in particular, the first cost of the equipment upgrades and the competing responsibilities and priorities for organizational managers.

Though we would expect that the hard-to-reach customers are typically smaller customers (within the small business customer group) with lower savings potential, they still accounted for 80% of the program savings. Figure II.4 shows the breakdown of savings across hard-to-reach customers, educational institutions, and other customers that do not fall in either category.

Figure II.4: Energy Savings by Customer Group



Lost Opportunities

Neither contractors nor B.E.S.T. participants felt that there were additional efficiency opportunities within their facilities that could or should have been addressed. However, this could be due to the nature of the contractors (lighting-focused) and the information that they provided to the customers. For the next round of B.E.S.T. program implementation, KEMA plans to earmark incentives for each group of technologies covered by the program so that all of the available incentives are not used up for one type of technology.

Of the B.E.S.T. participants surveyed, two had installed energy-efficient air conditioning since participating in B.E.S.T., and one had installed a high-efficiency water heater. More than 80% of the survey respondents had not participated in an energy efficiency program prior to B.E.S.T.

Site Visit Observations

During on-site visits, our auditors noted a few issues, including:

- Less common fixtures, such as F96T12s, 4' high output fixtures, and 2x2 U bends, were not retrofitted.
- Fixtures that are in poor operating condition ought to be replaced to avoid dissatisfaction with the lighting (e.g., yellowed lenses on existing fixtures).
- In a few cases, old lamps and ballasts were not removed from the customer's premises – which should be done to ensure they are not reinstalled and the contractors should be responsible for proper disposal of the lamps and ballasts (i.e., recycling).
- Higher-than-expected product failure was observed at two sites – participants were not aware of how to get defective lamps replaced or where to get replacements at the end of the bulbs useful life.
- Installers frequently used the old lamp sockets rather than the new ones that are usually provided with retrofit kits – many of the old lamp sockets were cracked or broken, and the new ones preclude use of any other bulb types.

Other than the use of the old lamp sockets, these situations were the exception rather than the rule, but could affect the customer satisfaction or persistence of savings. All of these issues were addressed in the contractor-training curriculum for the 2004-2005 program year.

Impact Assessment

Quantec, in conjunction with kW Engineering, conducted 50 site visits with B.E.S.T. program participants. As part of these site visits, our team verified the presence of qualified lighting technologies and installed data loggers to assess hours of operation of the lighting.

The lighting loggers were installed for approximately two weeks at each location visited. One to three loggers were installed depending on the size of the area and the presence of different zones, in which qualified lighting was installed. The loggers were used to determine hours of usage based on recorded lumen levels. Usage during the logging period was extrapolated to estimate annual hours of usage.

Savings were calculated for each type of fixture in each distinct area using the following formula:

$$\textit{Annual kWh Savings} = \left(\textit{kW demand of fixtures replaced} - \textit{kW demand of efficient fixtures} \right) \times \textit{Annual hours of operation}$$

To calculate the savings, we used the same kW demand estimates for the various fixture configurations as were used in the on-line assessment tool. Any differences in installed equipment or hours of operation noted through the on-site visits were used to calculate revised savings.

Our evaluation compares three estimates/sources of savings figures:

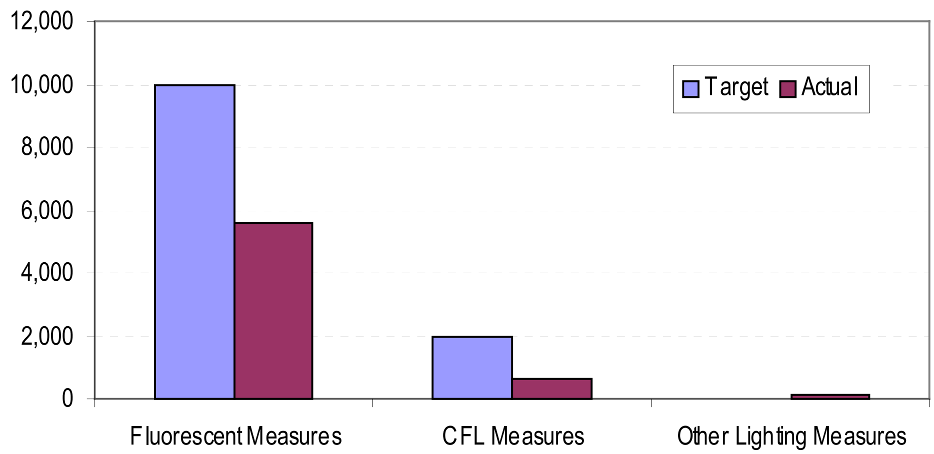
- Those derived from the project database using the lighting fixture characteristics and contractor inputs
- Our calculations – verifying the contractor inputs (hours of usage, number of fixtures) for the sample and extrapolating to all participants
- Projected B.E.S.T. program impacts based on the expected activity and measure installation

Table II.2 shows the quantities of measures installed. As shown in Figure II.5, however, fewer measures were installed than planned, even though savings exceeded the B.E.S.T. program kW and kWh savings goals. This is because the average saving per installed measure was higher than expected.

Table II.2: Measures Installed

Measure	Quantity
1 Lamp T8	104
2 Lamp T8	4,482
3 Lamp T8	163
4 Lamp T8	884
Screw-in CFL < 17 W	439
Screw-in CFL > 17 W	158
Hard-wired CFL < 17 W	8
Hard-wired CFL > 17 W	10
High Pressure Sodium	2
LED Retrofit	3
LED Other	94
Metal Halide	9
Custom Lighting	23
Total	***6,379***

Figure II.5: Measures Installed



No HVAC or non-lighting (custom) measures were installed through B.E.S.T.

Site Visits

Quantec conducted on-site visits of 50 of the 103 B.E.S.T. participants. The sites were chosen as a random stratified sample from a participant list provided by KEMA. Following is a description of the site-visit process we employed.

Collected Site-Specific Reports from KEMA. First, we collected the site-specific reports on installed measures from KEMA. These data included the quantity, existing fixture description, and post-installation fixture description for each type of fixture at the site as well as the hours of operation.

Conducted the On-Site Visits. The process for each site visit included:

1. *Verification of installed measures*. We reviewed the reported installed measures and verified that each had actually occurred. The results of the verification survey were used to estimate the proportion of measures in the tracking system that remained installed after the departure of the installation team.
2. *Installation of lighting loggers*. One to three loggers were installed during the site visits. The loggers were placed in each major area within the customers' facilities and were left in place for an average of two weeks.
3. *Establishment of an understanding of the operation in order to properly annualize the lighting energy savings calculations*. We gained an understanding of the business operating characteristics to ensure that we accurately assessed the annual operating hours based on the lighting logger data.

Analysis. While B.E.S.T. provided for the installation of lighting, HVAC, and customized measures, only lighting measures were installed, as noted above. Therefore, we utilized a single methodology for assessing measure savings.

We conducted data analysis of energy savings for all of the sample sites. The analysis complied with IPMVP Option A, "Partially Measured Retrofit Isolation." According to the IPMVP manual, when using Option A, "savings are determined by partial field measurement of the energy use of the system(s) to which an ECM was applied, separate from the energy use of the rest of the facility. Some but not all parameter(s) may be stipulated."

For our analysis, we used the following approach:

- Lighting fixture demand was stipulated – We used the same stipulated values as were used in the KEMA on-line tool. These values were reviewed and were found to be appropriate.
- Fixture counts were field verified for 50 of the 103 B.E.S.T. participants
- Lighting hours of operation were field measured for 50 of the 103 B.E.S.T. participants

By using lighting loggers to measure hours of operation, we eliminated the most significant source of uncertainty in the savings estimates. We collected on-site operating information to assist us in extrapolating the logger data to annual hours of operation.

Verification of Measures. Our site visits revealed that most of the equipment installed by the contractors was indeed installed and remained so. In 11 of the 50 sites visited, we found that some equipment had not been installed or had been removed. Compact fluorescent bulbs were the most common measure removed.

Hours of Operation. In 27 of the 50 sites visited, we found that actual hours of operation were less than what was estimated by the contractor. In 22 of the sites, we found hours greater than estimates. In total, field-measured hours of operation were 95% of the *ex ante* estimates of operating hours.

CPUC Workbook Savings vs. B.E.S.T. Software Tool Savings

The CPUC requires program implementers to submit on a quarterly basis a spreadsheet that reports program implementation progress, tallies program impacts, and calculates program cost-effectiveness. The CPUC spreadsheet relies on deemed savings estimates to determine energy and demand impacts using much broader measure categories than the B.E.S.T. software tool. The deemed savings considered:

- Demand impact of energy efficient technologies
- Hours of operation
- A net-to-gross factor

Table II.3 compares the savings estimates reported in the CPUC spreadsheet to those calculated based on the more detailed project specifications using the on-line assessment tool. The greater granularity and project specifics in the on-line tool result in more precise, but lower energy savings estimates. Demand impacts, however, were higher using the B.E.S.T. software tool.

Table II.3: Savings Comparison

	CPUC Workbook Gross Savings	CPUC Workbook Net Savings	B.E.S.T. Software (Projected Actual Gross Savings)
Energy Savings (kWh)	1,989,384	1,909,809	1,766,417
Demand Savings (kW)	525	504	528

Because of the greater detail it provided, we used the savings estimates from the B.E.S.T. software tool to determine realization rates and achieved savings.

Realization Rates

Based on the verification of lighting installations and the hours of operation, Quantec calculated realization rates for the reported savings. Table II.4 shows the realization rates for energy and peak demand savings. Figure II.6

compares the reported energy savings, the savings adjusted by the realization rates and the deemed net-to-gross ratio (0.96), and the B.E.S.T. program goals. Figure II.7 compares the demand savings estimates.

Table II.4: Realization Rates

	Realization Rate
Energy Savings	95.7%
Demand Savings	96.2%

Figure II.6: Energy Savings (Annual kWhs)

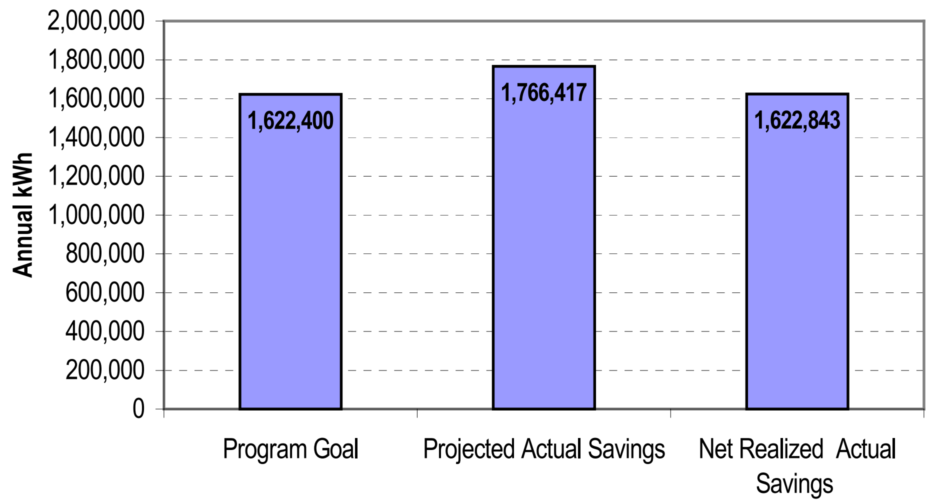
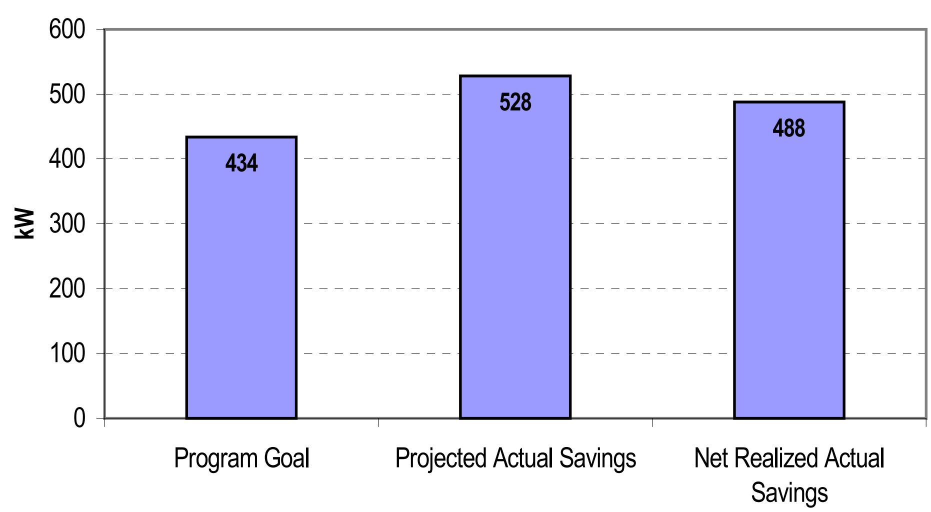


Figure II.7: Demand Savings (kW)



III. Wastewater Treatment Plants Improvement Program (WWTPIP) Evaluation

Program Description

WWTPIP was an energy-efficiency audit, information, training, and incentive program targeted toward approximately 70 qualifying wastewater treatment plants operated by local government agencies in areas served by PG&E and SCE. The specific target market was medium-sized plants with design flows of 7 to 30 million gallons per day (MGD).[3] KEMA delivered WWTPIP in conjunction with services provided by Brown & Caldwell.

WWTPIP focused on operator training, process control optimization, and efficiency upgrades. Marketing was implemented in conjunction with Brown & Caldwell and relied to a large extent on existing Brown & Caldwell contacts. Marketing included phone solicitations, flyers, faxes, and emails. Most marketing targeted existing Brown & Caldwell clients, and leveraged Brown & Caldwell's positive reputation in this field. In addition, presentations were made to plant operators and engineers through the primary industry association.

Services were provided in two phases. In Phase I, plants had to submit an application for services including a facility energy audit and benchmarking study, process optimization training, and assistance implementing process optimization. Plants that received the audit were allowed to apply for incentives in Phase II that paid for design and installation of equipment efficiency measures. Table III.1 below shows WWTPIP services and incentives.

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3 Larger plants were not completely excluded from participation, but priority was given to plants in the targeted size range.

Table III.1: WWTPIP Services and Incentives

	Services	Incentives
Phase I	Facility energy audit	Up to $40,000 in services at no cost
	Operator training for process optimization	
	Assistance for implementing process optimization	
Phase II	Design assistance	Up to 40% of design cost
	Equipment purchase and installation incentive	$0.125/annual kWh savings, minus design incentive*

* Incentives were limited to a maximum of 50% of total project cost.

The original schedule called for all equipment to be installed with a completed inspection by December 31, 2003. Due to the amount of time needed for interested agencies to develop, fund, and implement projects, KEMA requested and obtained schedule extensions from the CPUC that eventually permitted agencies to complete their projects by October 31, 2004.[4]

KEMA originally had planned to complete projects at 10 to 12 facilities. That target was modified in the revised work plan to have four implemented projects in the PG&E area and two in the SCE area. As shown in Table III.2, of the ten facilities that completed the audit process, five implemented either process or equipment measures as a result of WWTPIP participation. Six of the 10 audited facilities were served by PG&E and four were served by SCE. The plant capacity of the audited plants in the PG&E area was about 140 MGD and in the SCE area was about 53 MGD. KEMA targeted completing projects with 12 plants with two-thirds in the PG&E area and the remaining one-third in the SCE area. Of the three plants that implemented capital improvement projects, two were in the PG&E area and one in the SCE area.

4 Note that one plant continued final phases of installation until mid-November.

Table III.2: Summary Information on Participant Sites

Application Number	Project Name	Utility Service Area	Plant Size (Avg. MGD)	Measures Implemented*
1	Elsinore Valley Regional Treatment Plant	SCE	3	CI, PO
2	Regional Plant 1 – Ontario	SCE	33.5	None
3	Regional Plant 4 – Rancho Cucamonga	SCE	5	None
4	Moreno Valley Regional Water Reclamation Facility	SCE	11.2	None
5	City of Santa Cruz Wastewater Treatment Facility	PG&E	12	None
6	Monterey Regional Treatment Plant	PG&E	19	PO
7	Laguna Treatment Plant	PG&E	17.5	None
8	South Bayside Regional Treatment Plant	PG&E	15	CI, PO**
9	Oakland Treatment Plant	PG&E	71.5	CI, PO
10	Soscol Water Reclamation Facility, Napa	PG&E	6.5	PO***

* Capital Improvement (CI), Process Optimization (PO), or None

** The measures implemented at this site were categorized as Operations Improvements because the plant did not participate in Program training.

*** This plant was in the process of implementing equipment upgrades influenced by the WWTPIP, but did not apply for an incentive for these upgrades. Consequently, no CI savings were claimed for this site.

Overview of Evaluation Approach

The primary goals of this evaluation were to provide 1) a verification of energy savings and 2) an assessment of customer satisfaction with WWTPIP. The first goal was met through an impact evaluation, which included visits to sites that had implemented measures. The second goal was addressed through a process assessment, which relied on phone interviews conducted with the same five participants.

The scope of the process assessment was limited, and focused primarily on issues of customer satisfaction and major implementation issues. Table III.3 shows the CPUC's evaluation objectives as outlined in the Policy Manual, how we dealt with them in this study, and the evaluation component that addressed them. The process assessment was conducted through three activities: review of WWTPIP materials, telephone interviews with staff from participating plants, and interviews with the KEMA WWTPIP manager and the primary contact with Brown & Caldwell. For this evaluation, we conducted interviews with representatives from the five projects shown in Table III.2 that implemented either process or capital improvement projects.

Table III.3: CPUC Objectives and the WWTPIP Evaluation

Objectives	WWTPIP Evaluation Approach	Evaluation Component
Measuring level of energy and peak demand savings achieved (except information-only)	Used the IPMVP Option B to measure the energy and peak demand savings achieved for every site that implemented measures.	Impact
Measuring cost-effectiveness (except information-only)	Re-calculated WWTPIP cost effectiveness using actual program expenditures provided by KEMA and the ex-post energy savings verified through this evaluation.	Impact, Process
Providing up-front market assessments and baseline analysis, especially for new programs	A comprehensive baseline market assessment was beyond the scope of this evaluation. Baseline energy usage estimates were determined from the monitoring data provided by KEMA.	Impact
Providing ongoing feedback, and corrective and constructive guidance regarding the implementation of programs	Maintained close contact with KEMA and provided ongoing feedback and recommendations as appropriate.	Process
Measuring indicators of the effectiveness of specific programs, including testing of the assumptions that underlie the program theory and approach	Developed explicit effectiveness indicators for the process evaluation.	Process
Assessing the overall levels of performance and success of programs	Utilized the impact and process evaluations together to assess overall level of performance and success of the program.	Impact, Process
Informing decisions regarding compensation and final payments (except information-only)	Provided information to permit the CPUC to assess the achievement of the WWTPIP and make an informed decision regarding compensation and final payments.	Impact, Process
Helping to assess whether there is a continuing need for the program	Findings from the evaluation provided an assessment of WWTPIP performance and the continuing need for it.	Impact, Process

The impact evaluation was conducted using an approach based on IPMVP Option B, "Retrofit Isolation," applied to the sample sites. Our method involved assessing the accuracy of monitoring data collected by KEMA, verifying reported capital improvements and operating changes, and assessing the short-term and annual savings estimates calculated by KEMA. The required data and information were obtained through site visits and data exchanges with KEMA.

Our sampling strategy was planned to match the expected distribution of the projects, although the final distribution was determined by the census of actual projects.

Process Assessment

As shown in Table III.3, the process assessment had the following purposes:

- Provide inputs for the cost-effectiveness analysis

- Provide ongoing feedback and corrective guidance, as needed
- Measure effectiveness indicators and assess program theory
- Provide inputs to the overall assessment of WWTPIP performance
- Inform decisions regarding compensation
- Inform the assessment of the continuing need for WWTPIP

Before conducting the process assessment data collection, we developed indicators that were utilized to assess the effectiveness of WWTPIP. These indicators included:

- Customer satisfaction with marketing materials, recruiting process, and incentive levels
- Number of treatment plants that chose to not participate in the WWTPIP
- Number of audit/benchmarking studies conducted
- Number of process control improvement strategies implemented
- Number of equipment upgrades completed
- Number of incentives paid
- Total cost of implementation
- Efficiency of delivery, primarily measured by cost effectiveness

Review of WWTPIP Materials

Promotional Flyer. After a five-month iterative review process with the utilities and the CPUC, Brown & Caldwell developed and finalized a flyer for marketing purposes. Once the flyer was approved, 200 copies were printed for distribution and electronic copies were dispersed through email. Our participant phone surveys suggested that the flyers and emails were helpful in informing potential participants about WWTPIP and its requirements as well as aiding in their participation decision-making.

The delay in getting final approval for the flyer contributed to the overall delay in recruiting participants and conducting projects.

Training Materials. Once the participating plants signed a training agreement, Brown & Caldwell provided training sessions. Generally, the training materials and sessions involved discussion of the topics listed in Table III.4, though presentations were tailored to individual plant's concerns. For instance, one plant received a four-hour seminar on liquid stream optimization, while presentations at other plants spent only two hours on the topic. Additional, site-specific concerns were discussed during open-session, Q&A periods scheduled at the end of the training.

Table III.4: General Topics of Brown & Caldwell Training Program

Training Topics	Discussion Points
Energy Audits	Benefits, data collection, results and analysis, payback
Utility Bills	Electric and gas rates, power factor, demand, use, peak times costs
Energy Basics	Energy, energy forms, efficiency
Electric Motors	Types, efficiency, size, age
Pumps	Principles, pressure and elevation, head loss, maintenance, drive selection, soft start, variable frequency drives, cube law
Energy Utilization by Process	Headworks, primary, secondary, and advanced treatment, sludge processing, disinfection, cogeneration, lighting and HVAC
Aeration Systems	Oxygen requirements, transfer efficiency, equipment, operational modes, systems, recycle streams
Solids Processing and Dewatering	Anaerobic digester operation and performance, incineration, centrifuges, belt filter presses, dryers
Lighting	Considerations for more efficient lighting
Energy Management	Collecting and analyzing data, identifying targets, plan development and implementation

Policies and Procedures Manual. KEMA originally had planned to prepare a policies and procedures manual for the WWTPIP. As the program unfolded, however, they found that a formal document was unnecessary and did not prepare one.

Participant Phone Surveys

Based on the indicators we developed, Quantec designed a draft customer survey instrument and provided it to KEMA for review and approval. Phone surveys were conducted with the five participating facilities that both had an energy audit and had taken some action to improve plant efficiency.[5] Those actions were realized through process optimization, capital improvements, or both. The purpose of the survey was to gauge the level of participant customer satisfaction throughout their experience with the WWTPIP and to provide feedback relative to program effectiveness.

The survey questions focused on five main areas:

- WWTPIP awareness and the participation decision
- Process issues
- Operational improvements (if relevant)

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5 Four of the five participants were interviewed in April or May 2004. One participant was interviewed in October 2004 because this plant implemented process optimization actions during the Program extension period. One other plant was re-interviewed during November 2004 because it implemented capital improvement projects during the extension.

- Capital improvements (if relevant)
- Overall satisfaction

Although the number of surveys was small, the respondents represented all the projects that had been implemented after an audit was conducted. Three of the five plants surveyed had completed capital projects to increase energy efficiency at their site, and all respondents implemented at least one of the process optimization changes suggested through the initial site audit.

WWTPIP Awareness and Participation. Respondents became aware of the WWTPIP through different channels as follows:

- Two through Brown & Caldwell
- Two through their utility
- One through KEMA

The two respondents who first became aware of the WWTPIP through contact with Brown & Caldwell had both worked with Brown & Caldwell on previous facility projects and were interested to learn more about potential incentives for energy-efficiency improvements. The two participants who heard about the WWTPIP through the local utility were PG&E customers. The one who learned of the WWTPIP directly through KEMA had been working with them on a previous facility project. Of the four that recalled receiving marketing materials, either emails or WWTPI program flyers, all considered them to be "somewhat" to "very" useful for their decision-making process.

When asked why they decided to participate in the audit and benchmarking study, responses focused on the potential for energy savings or lower operating costs. One respondent answered that the opportunity to learn about ways to reduce energy use was important because "power, people, and chemicals" were their three largest expenses. Another respondent noted that he was the energy coordinator at the plant and that it was his responsibility to take advantage of promising programs like this one. Another mentioned that better information about efficiency opportunities was key to their facility because of the mix of old and new equipment.

The respondents identified different aspects of the WWTPIP as the most effective for recruitment. Two specifically mentioned financial aspects; the incentives for capital projects and the no-cost technical assistance for process improvements were also significant factors. One respondent stated that the promise of training was the most effective. Finally, one respondent mentioned their previous working relationships with Brown & Caldwell, while another mentioned the marketing materials.

Two respondents said that the WWTPIP deadline was the least effective recruitment aspect of the program. One noted that the amount of time required for staff to support implementation was a significant participation obstacle. Two participants were unable to identify any specific aspect as least effective for recruitment.

Audit and Training Process. All surveyed participants said that the audits were conducted professionally and at a convenient time and thought that the information provided in the resulting benchmarking report was very clear. One respondent felt that the audit overstated the likely energy savings, but the others either thought the estimates were about right or had no opinion.

Four of the plants received education and training services from Brown & Caldwell on process optimization and rated it either "somewhat" or "very" useful; however, none rated it "extremely" useful. One respondent noted that the training brought everyone else on the staff up to speed on energy issues.

Process Optimization. When we conducted our surveys, four of the five facilities had implemented, or were in the process of implementing, some of the operational improvements suggested in the site audit report. One facility was initiating a process change, but it was too soon for them to provide feedback.

Representatives from the four facilities said that they were "mostly satisfied" with the process optimization and thought Brown & Caldwell's assistance in implementing these operational improvements was "very useful." However, they had yet to know if the changes reduced their overall energy use.

Capital Improvements. Three of the five participants completed capital improvement projects, as follows, through the WWTPIP:

- One installed premium efficiency motors
- One completed a lighting retrofit
- One performed piping, pumping, and other major modifications to allow an oxidation train to take all of the plant's load

One completed the upgrades using in-house staff, while one respondent that used an outside contractor was "very satisfied" with the work performed by the contractor. The respondent who had the lighting retrofit did not indicate who performed the installation or whether they were satisfied. One said that they were "mostly satisfied" with the equipment, while another stated that they were "very satisfied." All stated that the post-installation inspection by KEMA was conducted professionally and at a convenient time. In addition to the upgrades that received WWTPIP incentives, one respondent completed a lighting ballast replacement as a result of interest the WWTPIP generated in energy savings, but did not receive an incentive for the upgrade.

With respect to potential free-ridership, two of the three who made capital improvements said that they were "somewhat likely" to have installed the same equipment within a year without the WWTPIP. The third, who used in-house staff for installation, said that they were "very likely" to have installed the equipment without the WWTPIP.

Ratings of the significance of the incentive in their decision-making process ranged from "significant" to "not at all significant." A respondent who did not complete their project in time to receive the incentive stated that the possibility of getting an incentive was the motivating force behind their drive to make improvements; even without being able to receive the incentive, they planned to complete the upgrade.

For all respondents, there were capital improvements recommended in the audits that had not been implemented. The main reason given by all respondents for not implementing these improvements was that participants could not meet the installation deadline. Two other contributing reasons were that insufficient funds were available and that existing equipment was adequate. Even though they had yet to complete these projects, all but one thought it was "likely" or "very likely" that they would do so within the next two years, even without the WWTPIP incentive. The one respondent who said it was "not very likely" they would implement the main recommended measures was already in the design phase of, and going ahead with, a fan retrofit, which would have qualified had the deadline been met.

Energy-Efficiency Knowledge and Spillover. Three participants said that their organization had participated in previous energy-efficiency programs, with two having participated in multiple programs. All five participants considered their knowledge of energy efficiency to be "good" or "fair" before participating in the WWTPIP. Three of the five said the WWTPIP had helped them to increase their knowledge.

Two participants said that their organization had no existing goals or incentives for proposing efficiency improvements, while the remaining three said that their organization did. None stated that participation in the WWTPIP was likely to change the rewards or encouragement provided to make efficiency recommendations.

Participant responses suggested that the WWTPIP was likely to have a spillover effect by increasing the chances that efficiency improvements would be made in the future at these facilities. Four participating sites had already made other changes that would improve energy efficiency (including adding sub-metering, which would allow better tracking of energy use); three said the WWTPIP had a "large influence" and one said a "small influence" on the decision to make these changes. In all cases, the respondents said that participating had increased the likelihood of implementing future improvements either "some" or "a lot."

Overall Satisfaction. When asked how satisfied the participants were with the WWTPIP overall, four of the five replied “very satisfied.” Only one said he was “mostly satisfied,” stating that the timing and funding of the WWTPIP could have been better.

None of the participants had been able to observe or measure energy savings as a result of their projects, but they typically felt that not enough time had passed to record energy savings. They had, however, seen other, related benefits through the WWTPIP. Three specifically mentioned that their awareness of energy usage had increased, including a greater knowledge of peak demand reduction strategies. One respondent stated that she appreciated the support that the WWTPIP gave her in the sense that it backed up her savings estimates and reinforced energy saving behaviors among employees.

A general concern expressed by participants was that the WWTPIP did not allow enough time to implement significant capital improvement projects. One respondent quantified their process: “It usually takes one to one-and-a-half years to plan a large-scale project and nine months to two years to implement it.”

Interview with KEMA WWTPIP Manager

An email and phone interview was conducted with KEMA’s Program Manager to gauge both the successes and failures of the WWTPIP and to identify areas for possible improvement. The interviews focused on seven main areas:

- WWTP program theory
- Marketing strategy and training
- Decision-making process and identification of key players
- Barriers and steps to address them
- Role of co-generation
- Achievement of desired outcomes
- Continuing need for WWTPIP

WWTPIP Program Theory. The target market was publicly owned wastewater treatment plants of medium to large capacities (7 MGD to 30 MGD design capacity). It was noted that participation was not strictly limited to plants in this size range (as can be seen from Table III.2). In several cases, plants were not operating at their design capacity either. For instance, Lake Elsinore has a design flow rate of 8 MGD, which was in the target size range, but it had been operating closer to an average of 3 MGD during the year prior to the WWTPIP.

Primary WWTPIP activities were described as marketing, auditing plants, training, and providing incentives to implement both process optimization measures and capital improvements. Once the audit was completed, a report was drafted for and presented to the staff at the operating level in the plant. The operators provided feedback on the report and any corrections on how operations were characterized. KEMA then revised the report and finalized the findings and recommendations. It was then turned over to the plant, where it was expected the operators would "sell it up the line."[6]

The anticipated initial outcome after the audit was the identification and recognition of many opportunities for energy-efficiency improvements. Participants were expected to "jump on the most cost-effective measures." In the intermediate and long term, the WWTPIP was expected to produce a "culture change that would result in an atmosphere of continuous improvement leading to future energy-efficiency improvements."

Marketing Strategy and Training. Although KEMA conducted their own direct outreach, marketing relied heavily on the participation of Brown & Caldwell, known for their design and operation capabilities in the wastewater field. Due to their reputation, wide client base, and list of contacts, KEMA believed interest would be generated and supported by Brown & Caldwell's participation. In the two utility service areas covered by the WWTPIP, KEMA used Brown & Caldwell's plant list to identify plants as potential participants. About half the participants were existing Brown & Caldwell customers.

KEMA developed a flyer, and approximately 200 of them were handed out at meetings, while the rest were distributed by e-mail or fax; in addition, Brown & Caldwell posted the flyer on their website. Presentations were also made to plant operators and engineers at California Water Environment Association, CWEA, chapter meetings.

Brown & Caldwell was responsible for training plant personnel.[7] Training addressed the audit recommendations and included information on energy utility rates and how they affected the plant's economics. In addition, KEMA relied on Brown & Caldwell to provide technical support to analyze complex process measures.

Decision-Making Process and Identification of Key Players. All the participating plants were run by a governing board responsible for final decisions on funding appropriations and spending. Each plant had a general manager who reported to the board. In general, the plants had three organizations: operations, engineering, and maintenance. In some cases,

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6 This was the general model in cases of larger plants with different organizations and management levels. In some cases, the manager was also responsible for operations.

7 In one case, the plant used its existing contractor to conduct the training.

individuals wore more than one hat within a plant. It was found that most plants had someone identified as the person to handle energy and energy-efficiency issues and this person could be in any one of the different internal organizations.

KEMA tried to identify a champion within each facility who had a genuine interest in increasing efficiency and would provide the push required to move projects ahead. The WWTPIP was targeted to staff at the operating, as opposed to management, level; however, champions could be in any part of the organization. General managers and governing boards were not a target in this program based on the implementers' belief that key decision makers in the plants would refer the issue back to the operations staff for assessment anyway before they would offer their support.

Barriers and Steps to Address Them. A number of barriers to energy-efficiency upgrades and to WWTPIP implementation were either anticipated during program design or identified during the implementation process. These barriers included the following:

- Cost of efficiency improvements and lack of financing
- Lack of comprehensive analysis of energy costs
- Lack of systematic analysis of energy-efficiency options
- Lower priority for energy efficiency relative to meeting water quality requirements
- Organizational impediments or resistance to change

Originally, the cost of efficiency improvements was anticipated to be the major barrier that the WWTPIP had to overcome. To address this barrier, the WWTPIP was designed to provide generous incentives that would "make the program irresistible." As noted earlier, the implementers expected the organizations to "jump on" the efficiency improvements when the cost effectiveness and incentives were explained.

KEMA's prior experience with wastewater treatment plants suggested that they typically did not have the tools to comprehensively analyze the economics of the energy they used. Although most plants had made several efficiency improvements over the years, this sector, with some exceptions, has not conducted systematic analyses of energy-efficiency options. Consequently, the plants would be expected to have incomplete knowledge of energy-efficiency operating and equipment options. The WWTPIP addressed these issues by providing the system audit along with training on recommended options and energy costs. The relatively large incentives along with this "soup-to-nuts" service were expected to motivate high participation levels.

When the WWTPIP was fielded, however, it became apparent that less anticipated barriers were impeding widespread participation and most of these barriers were associated with the organizational objectives, structure, and operations of these facilities. A major barrier was the fact that the first priority of these facilities was compliance with pollution regulations. One consequence was that, if this priority was being met, “there was little incentive to improve energy performance.” Although the Program Manager did not specifically identify it during our interview, another potential consequence was that energy-efficiency improvements could be resisted because they might be perceived to introduce risks that would affect the plant’s ability to meet its first priority. We believe that the significance of plants giving priority to meeting pollution regulations was not fully addressed during WWTPIP development and that there were not any specific aspects of the WWTPIP that mitigated this barrier directly.

Another significant barrier was the length of the budgeting cycle for these facilities. In general, budget cycles typically required two to three years to go from initial studies to budget approval and funding allocations. As a result, “the selling cycle [for the WWTPIP] was prolonged, and the WWTPIP deadlines were out of sync with plant budgeting cycles.” The schedule for the WWTPIP was limited by the original requirements placed on it, but KEMA requested and obtained extensions that allowed participants to implement additional projects. However, it was likely that some projects never materialized because certain plants felt from the beginning that they had no way of completing projects within the original timeframe. Another implication was that it could have been productive to dedicate additional resources to marketing and customer interactions. The Program Manager felt that it would have been useful to have at least one full-time marketing representative available to monitor, support, and follow up with the plants as they worked through the funding and decision-making process. He also noted that Brown & Caldwell used up their original marketing budget and dedicated their own resources to more extensive marketing.

A related barrier was the nature of the decision-making process at these facilities. Generally, several parties had to be involved and the culture led to individual risk aversion. Consequently, it was important to spend the time and effort to get buy-in from diverse groups and individuals and to address any concerns about the risk associated with efficiency improvements. As noted above, steps were taken to methodically get the appropriate staff buy-in, but there was not much evidence that potential risks were recognized as a key barrier and addressed directly.

Another barrier that was encountered was skepticism or general resistance to recommendations provided by outside consultants. This occurred in a few isolated cases. KEMA’s prior experience in this market and Brown & Caldwell’s familiarity with the plants helped overcome this barrier. However, there were still cases where plants chose not to participate because they had their own consultants or were resistant to consultant recommendations. Similarly, the Program Manager anticipated that recommending efficiency upgrades might suggest that plant operators had not done an adequate job keeping costs down. The approach of working with and gaining the support of operating staff generally overcame this potential barrier.

Role of Co-Generation. Many California wastewater treatment plants take advantage of the digester gas produced to generate electricity and provide thermal energy. Although this program provided incentives only for efficiency improvements, not generation, there were interesting synergies between the WWTPIP and the plants' interest in co-generation.

In one case, KEMA had already been assisting the plant with energy rate studies relevant to co-generation decisions. This led to the plant's decision to participate in the WWTPIP. In other cases, the WWTPIP helped plants better understand their options and make more informed decisions about operations.

Achievement of Desired Outcomes. In all cases, the plant audits produced a set of both operating and capital equipment options for improving energy efficiency. The audit reports and training appeared to be effective at increasing recognition of the opportunities available for efficiency improvements.

In several cases, plants did "jump on" the identified process optimization changes to improve efficiency. However, the capital equipment changes happened on a much more limited scale. This was due to the barriers discussed above, but they were most limited by the WWTPIP schedule, which was incompatible with the length of the typical budgeting cycle.

There was some evidence that the WWTPIP was producing its desired longer-term outcome, i.e., "a culture change that would result in to an atmosphere of continuous improvement leading to future energy-efficiency improvements." Comments from the Program Manager suggested that the audits and training had made staff at several plants much more aware of how energy was used in their plant and the interactions among the various systems in the plants.

Continuing Need for the WWTPIP. The Program Manager indicated that a large number of wastewater plants would fit the WWTPIP's qualification criteria. The audits conducted through the WWTPIP revealed that there was likely to be a significant potential for both process and capital equipment efficiency improvements throughout this sector.

The barriers discussed above, along with a pervasive "set it and forget it" operating philosophy, provided solid evidence that the types of efficiency improvements sought by the WWTPIP will not be forthcoming without further external efforts. In combination, the remaining energy savings potential and industry barriers provided support for a continuing need for a program directed at this sector.

Interview with Brown & Caldwell Program Manager

An email and phone interview was conducted with Brown & Caldwell's Program Manager. He provided the combined responses of several knowledgeable company staff. The purpose of the interviews was to gain insight into aspects of the WWTPIP that Brown & Caldwell were especially knowledgeable about. The interviews focused on six main areas:

- Brown & Caldwell's role
- Training process and effectiveness
- Marketing barriers and improvements
- Participation barriers
- Capital improvement barriers
- Continuing need for the WWTPIP

Brown & Caldwell's Role. Brown & Caldwell had a large responsibility for marketing activities within the WWTPIP. In addition to targeting the WWTPIP, developing a flyer, and arranging initial meeting times, Brown & Caldwell also performed the following tasks:

- Developed the basic training plan
- Assisted with joint meetings upon WWTPIP sign-up
- Developed site-specific training plans
- Performed on-site training for each facility
- Reviewed energy savings within the context of maintaining plant operations and compliance

Training Process and Effectiveness. Basic training materials were "prepared to cover areas common to most wastewater treatment plants (WWTPs)." For example, a trainer might have had up to four "packaged presentations," which were used as appropriate; some sites would view all four, while other sites would view one or two. Additionally, site-specific materials were tailored for each plant based on the findings of the energy audits. Presentations emphasized process optimization, and encouraged "suggestions for further energy savings in each WWTP."

A common theme that emerged throughout the training sessions was a general lack of understanding of billing and demand charges. While participants had an awareness that these charges existed, "most . . . did not really comprehend the magnitude of the effect of demand charges." It was further conveyed that this lack of awareness was "pretty universal and represents a grand problem with wastewater treatment plants, but also . . . a grand opportunity."

Though the training was thought to "accomplish the goals of the WWTPIP," improved graphics and the inclusion of "expert" speakers would have been a useful enhancement. Additionally, in the long-term it was uncertain whether the training would impact plant operation. With some exceptions, it was questionable whether "the material was acted (upon) after the trainers left the plant site," and "as is often the case with wastewater treatment plant(s) . . . the effect the training had was pretty much limited to the time that the training was being delivered." However, Brown & Caldwell offered that, "as a general observation, it seems that the level of interest in energy savings has increased."

Marketing Barriers and Improvements. A general lack of time, which touched many areas of the WWTPIP, impacted the effectiveness of program marketing. Early on, the preparation time required for the development of the flyer was underestimated, and the flyer was unavailable for six months as it went through the revision process. This delay in approval created a sort of domino effect, which cut into the amount of time left for all other aspects of the WWTPIP.

Knocking on doors and making presentations at CWEA meetings were found to be effective means for reaching participants, but again, additional time would have been an improvement. Another holdback, resulting from a lack of time and planning, was the inability to get in on November and December CWEA meetings; thus, two months of missed opportunities generated further setbacks to participant outreach. "It just . . . took more time than the WWTPIP allowed."

Participation Barriers. Brown & Caldwell noted that many factors came into play when addressing barriers to participation within this program. In addition to the usual time constraints and budgeting issues, it was also difficult to identify the real energy "champions" at each plant. This made it hard to achieve the necessary commitment from plants because the WWTPIP would involve taking up valuable time. "It seems that most staff feel overworked these days."

In addition, some plants had already participated in previous programs. As a result, some qualifying plants did not contain any real energy-efficiency opportunities. In one case, the previous experience had been a sour one for the plant that caused them to be unwilling to participate in this program.

Another barrier resulted from an unanticipated conflict generated by the involvement of Brown & Caldwell. At least one plant was unwilling to participate in the WWTPIP, fearing that the relationship they had "with their consultant would suffer if any other consultant did work with them." It was difficult or impossible to "get past the false perception that we were trying to displace their incumbent engineer." In the future, a solution to this might be addressed within the Phase II component of WWTPIP implementation, which could be tailored more to plants with existing consultants. Phase I could consist of marketing and training provided by Brown & Caldwell, while Phase II could allow the actual implementation process to be achieved by the house engineer.

Capital Improvement Barriers. Time limitations and uncertainties created the greatest barriers to capital improvements. As mentioned in discussions with KEMA, the financial incentives were designed to overcome hesitations anticipated from the plants. However, as Brown & Caldwell stated:

> The public agencies have to jump through so many bureaucratic hoops [that] they can't even buy equipment with free money . . . .The capital improvement process for most plants is a two-year process. Funding needs to be approved far in advance of making changes at the plant. Due to the slow start in getting the marketing approved, not enough time was left to make significant changes at the plants.

In addition, there was a level of uncertainty imbedded in the incentives, which were designed to pay benefits based on the annual kWh savings. With no guarantee of benefits, the plant would take a loss if a piece of equipment did not realize the projected savings. The plant would be stuck paying for a more expensive piece of equipment, wouldn't get the anticipated savings, and wouldn't receive the economic incentive upon which the capital improvement was based.

Continuing Need for the WWTPIP. In general, it was found that many plants were excited to receive audits with the hope of operating "smarter without any cost to the facility." Smaller plants, in particular, seemed ready for the extra attention and know-how, based partially on an overall lack of resources.

Three general energy-efficiency barriers were identified as "1) provincialism, 2) lack of technical knowledge, and 3) unwillingness to think outside the box." Brown & Caldwell's participation was probably most effective addressing the second barrier since it was thought that those plants participating in the training would evaluate future equipment purchases "with an eye toward energy efficiency." The plants that had participated already tended to be extremely conscious of energy saving. Given these three fundamental barriers, Brown & Caldwell's view was that "there is still a lot to be done with energy conservation at wastewater treatment plants."

Impact Evaluation

As shown in Table III.3 above, the impact evaluation included the following purposes:

- Verify energy and demand savings
- Provide inputs for the cost-effectiveness analysis
- Provide inputs to the overall assessment of WWTPI program performance
- Inform decisions regarding compensation
- Inform the assessment of the continuing need for the WWTPIP

Approach

Data Collection. Our plan was to collect data on half the 12 projects that KEMA expected under the WWTPIP. As noted earlier, a total of ten treatment plants participated in at least the audit phase. Information for these plants is presented in Table III.2.

Of the ten sites that received audits, four were served by SCE and six by PG&E. One of the sites that implemented measures was in the SCE area and the remaining sites were served by PG&E.

Prior to contacting these participants, we received and reviewed the energy audits prepared by KEMA. We also reviewed the Site Verification visit reports prepared by KEMA. Metering data were not available until after the site visits were performed.

We collected most energy analysis and verification data from these sites between May and June 2004. Our initial data collection was performed later than originally planned because we had to wait until the participants had taken their planned actions and KEMA was able to conduct their follow-up activities. Since it was not known if the schedule extension request would be granted at the time of the site visits, they were completed to assure that the original deliverable schedule could be met in the event that the extension was not granted. We conducted four site visits with WWTPIP participants numbered 1, 6, 8, and 9 in Table III.2 to gather verification data; verbal verification of the measure was obtained during a telephone interview with Site 10. We conducted a follow-up telephone interview for Site 1 in November 2004 because it was known to have implemented additional measures during the WWTPIP extension period.

The on-site and telephone impact data collection focused on the following issues:

- Assessing accuracy of monitoring data

- Verifying major capital improvements
- Verifying other actions taken due to process optimization consultation and education
- Developing an understanding of the wastewater treatment process in order to properly annualize the monitoring results

Data Analysis. After collecting and verifying the necessary operations and equipment characteristics, we conducted an analysis of energy savings for each site. The analysis described below complies with IPMVP Option B, "Retrofit Isolation." According to the IPMVP manual, when using Option B "savings are determined by field measurement of the energy use of the systems to which the energy conservation measure (ECM) was applied, separate from the energy use of the rest of the facility. Short-term or continuous measurements are taken throughout the post-retrofit period." Direct short-term system-level kW measurements were used to inform our savings analysis. In most cases, measures involved turning equipment off, and KEMA performed only pre-implementation metering in these cases. We assessed all relevant energy-efficiency measures that were documented.

Review Engineering Models. At the time we prepared the evaluation, measurement, and verification (EM&V) plan, we anticipated that KEMA would create two distinct types of models for each facility – an *ex ante* engineering-based model relying on site audits and an *ex-post* model using monitoring data. In the audits prepared for each participant, savings were estimated for each ECM based on engineering models that included variables such as motor kW, pump lift, and motor efficiencies. Pre-installation metering was used by KEMA to determine inputs to these engineering models.

As noted above, many measures involved turning equipment off, and KEMA performed only pre-implementation metering in these projects. *Ex-post* metering-based models were not created by KEMA in these cases. One large capital measure (Site 1) involved a change in load between pre-and post-installation, and metering was performed in both periods by KEMA for this measure.

Review Monitored Data. We reviewed the raw monitoring data and the steps used by KEMA to reduce the data into annual savings estimates. We assessed the engineering models to judge whether they were appropriate and reasonable and whether the monitoring data had been properly applied. In most cases, the monitoring data were "spot" measurements. We reviewed, based on input from site operators, whether the measurements would represent annual impacts adequately.

Conduct Baseline Analysis. At the time we prepared the EM&V plan, we anticipated that KEMA would concentrate on regression-based baseline analyses as part of the original site audits. Instead, baselines were characterized by KEMA primarily through benchmarking of energy use and through descriptions in the audits of the pre-implementation operating conditions. The baseline operating conditions were verified as part of the evaluation though discussions with site operators.

Estimate Site-Specific Energy Savings. Savings were calculated for every measure implemented under the WWTPIP. Savings analysis relied heavily upon verification of the calculations prepared by KEMA. For most sites, the metered data were used to inform the estimated annual electricity energy and demand savings of the measures.

Estimate Site-Specific Demand Savings. Demand impacts were evaluated for most measures based on the energy savings in the peak period divided by the hours in the peak period. A number of measures were load-shifting measures with no energy savings. In these cases, the demand impact was the estimated change to the summer peak demand. Note that slightly more than half of the demand savings is for one measure at Site 9 in which savings occur for only one summer month per year. A peak demand event is shifted from a summer to a winter month.

Determine Realization Rates. For each site, separate realization rates were determined for demand (kW) and energy (kWh). Specifically, we determined the ratio of the KEMA -estimated demand and energy savings to the *ex-post* savings estimates.

Estimate WWTPIP Energy and Demand Savings. All sites that implemented projects were analyzed. The WWTPIP impact was calculated as the sum of the five site-specific impacts.

Site-Specific Analyses

The basic method for determining achieved savings was to sum the savings for the five sites that implemented projects. All five sites were evaluated.

The results for each of the sites that implemented projects are shown in Table III.5 below. For each site, separate realization rates were determined for demand (kW) and energy (kWh). Specifically, we determined the ratio of the KEMA-estimated demand and energy savings to the evaluation realized savings estimates.

Table III.5: Summary of Savings Results for Sample Sites

Site	Incentive	Actual Savings				Realization Rate (%)	
		Projected		Realized			
		kWh/yr	kW	kWh/yr	kW	kWh/yr	kW
1	$60,000	938,038	162	940,735	167	100%	103%
6	---	174,324	20	159,432	18	91%	91%
8	---	343,956	165	284,743	161	83%	97%
9	$4,808	742,624	1,312	750,224	1,363	101%	104%
10	---	12,772	2	12,773	2	100%	100%
Total	***$64,808***	***2,211,714***	***1,660***	***2,147,906***	***1,710***	***97%***	***103%***

Note that slightly more than half of the demand savings is for one measure at Site 9 in which savings occur for only one summer month per year. A peak demand event is shifted from a summer to a winter month.

Our analysis and findings for each site are described in the following subsections.

Site 1

Site 1 is located in the SCE service territory. Annual baseline energy use and costs for the facility were 7,600,000 kWh and $1,000,000. The total energy use was 4,247 kWh/million gallons (MG) treated. This was high relative to other facilities in the WWTPIP program and in a previous benchmarking study, but there are mitigating factors that make a direct comparison difficult for this site. A new treatment unit, Train B, was installed and the historical utility data includes the period during which both the old and new trains operated in parallel. This increased energy use significantly, and was exacerbated by the fact that the UV sterilization equipment in the original train cannot be run at partial load. The average daily flow was 3.9 MGD while the plant's design capacity was 8.0 MGD.

Baseline. The largest loads in the plant are the two oxidation ditches with their associated Ultraviolet (UV) disinfection exposure chambers. The UV alone accounts for about 200 average kW and 22% of site energy. Other large loads are twelve 50-HP brush aerators in Train A and ten 75-HP brush aerators in Train B. The basecase average kW of the aerators was determined by KEMA from spot amp readings.

Influent pumping is performed by three 150-HP pumps. They lift influent from a wetwell to the headworks elevation. Each pump is VFD controlled and typical operation is one pump at part speed. The average kW of the pumps (25.2 kW) was determined by KEMA from spot amp readings. The influent wetwell is maintained at 3' from the bottom of the 21' deep wetwell.

Oxidation trains A and B each include 2 ditches that are operable, and each ditch includes two mixers. The mixers in Train A ditches are 4.9 HP and the mixers in the Train B ditches are 6.5 HP. The mixers operate on timers. The basecase average kW of the mixers was determined by KEMA from spot amp readings.

Solids are prepared for shipping by dewatering sludge in either of a pair of belt presses. The power draw of the presses is 5.7 kW as determined by a spot kW measurement. The presses run an average of 6 hours per day in the basecase according to the audit report.

Measures. Six measures were identified in the WWTPIP audit. Two measures were implemented. Incentives totaling $60,000 were provided for one measure, with a total measure cost of $595,567.

Metering Available. Baseline metering performed by KEMA consisted of taking spot amp and kW readings on numerous motors. Amp readings were taken with a portable meter. Post-installation metering was performed on the Oxidation ditch trains since one train would be turned off as one of the measures, but the new load on the other train could not be determined without metering. Savings were adjusted based on the inspected and reported changes to the projects.

Table III.6: Site 1 – Savings Summary (Gross Impacts)

Energy Efficiency Measure	Projected Actual Savings		Realized Actual Savings		Notes
	kWh/yr	kW	kWh/yr	kW	
1. Shut Down Train A	898,979	162	898,979	162	
2. Influent wetwell at higher elevation	39,059	0.0	41,756	5	Savings adjusted for operator-reported changes in wetwell levels
Total	***938,038***	***162***	***940,735***	***167***	

Site 6

Site 6 is located in the PG&E service territory. Baseline annual energy use and costs for the facility were 12,400,000 kWh, 351,000 therms, and $830,000. Gas is used to supplement cogeneration. The electric use that is reported is the combined purchased and produced kWh, so the electric using side of the plant is being compared consistently to sites without cogen plants. The total electricity energy use was 998 kWh/MG-treated and secondary process electricity use was 794 kWh/MG-treated. Both figures were better than average for the facilities in the WWTPIP and in a previous benchmarking study. The facility's average daily flow was 20.8 MGD while the plant's design daily dry weather flow is 29.6.

Baseline. There are four pumps of 300 HP each that pump water from a wet well to the trickle filters. Typically, one runs at a time, but pumping occurs continuously according to site operators.

There are three pumps of 350 HP each that pump water from a wet well at the effluent station. Typically two operate continuously, based on flow demand.

There are four primary clarifiers and six secondary clarifiers. Each primary clarifier is equipped with an arm that circulated slowly spraying water to clean surfaces. The water spray is generated by the pressure in the process water distribution system.

Measures. Eleven measures were identified in the original audit. Two measures were implemented. Incentives were provided for no measures.

Metering Available. Baseline metering utilized by KEMA consisted of spot motor amp readings for a significant fraction of the motors. No post-installation metering was performed. Savings were adjusted based on the inspected and reported changes to the projects.

Table III.7: Site 6 – Savings Summary (Gross Impacts)

Energy Efficiency Measure	Projected Actual Savings		Realized Actual Savings		Notes
	kWh/yr	kW	kWh/yr	kW	
1. Raise SVRP wet well level	148,920	17	134,028	15	Adjusted for total of 4.5 feet change rather than 5 feet
2. Shut down clarifier spray	25,404	2.9	25,404	2.9	
Total	174,324	20	159,432	18	

Site 8

Site 8 is located in the PG&E service territory. Baseline annual energy use and costs for the facility were 10,176,000 kWh and $954,000. The total energy use was 1,641 kWh/MG-treated and secondary process electricity use was 804 kWh/MG-treated. Both figures were lower than average for comparable facilities according to KEMA. The average daily flow was 19.5 MGD, while the plant's design daily dry weather flow was 24 MGD.

Baseline. Basecase kW demand for the motors that were replaced was taken from the energy balance prepared as part of the WWTPIP audit. The kW was calculated from amp measurements.

Dewatering involves a centrifuge train consisting of a main 100-HP drive and a 30-HP backdrive, both of which ran continuously in the basecase according to the operators. One of two 5-HP sludge feed pumps also ran. Demand was calculated based on the VFD speed observed by KEMA and a cubic relationship between speed and power.

Dual media filters were backwashed for 20 minutes, about 10 times per day according to the operators. One of the 125-HP pumps would run at a time. In the basecase, backwashing occurred during all shifts, regardless of time-of-us electricity rates. The basecase kW was based on a motor load factor of 83%.

Site operators confirmed that the trickling filter reactor units originally ran continuously. Demand for each unit was the sum of a pair of 20 HP-fans and a single 75-HP feed pump. Demand for the pump was based on a motor load factor of 83% and the fan kW was calculated from spot amp measurements.

Measures. Seven efficiency measures were identified in the WWTPIP audit and seven measures were implemented. The measure count would be four if the motors were counted as a single measure (as shown in Table III.8). An additional measure to increase cogeneration output was implemented, but the site's electricity purchase reductions could not be claimed as program savings because of the terms of the WWTPIP. Incentives were provided for no measures. For evaluation purposes, all measures were defined as Operations Improvements because the site did not participate in Program training.

Metering Available. Baseline metering performed by KEMA consisted of taking spot amp readings on numerous motors. Amp readings were taken from site meters, where available, and with a portable meter, when necessary. Savings were adjusted based on the inspected and reported changes to the projects.

Table III.8: Site 8 – Savings Summary (Gross Impacts)

Energy Efficiency Measure	Projected Actual Savings		Realized Actual Savings		Notes
	kWh/yr	kW	kWh/yr	kW	
1. Premium Motors	19,931	2.4	18,010	2.1	One motor efficiency found to be different than proposed
2. Shut down centrifuge train	108,748	69.71	51,456	66	Savings adjusted for one less pump operating and for savings occurring during summer only
3. Shut down backwash pump	0	92.6	0	92.6	
4. Shut down reactor train	215,277	0	215,277	0	
Total	***343,956***	***165***	***284,743***	***161***	

Site 9

Site 9 is located in the PG&E service territory. Baseline annual energy use and costs for the facility were 43,700,000 kWh; 666,000 therms; and $1,500,000. Gas is used to supplement cogeneration. The electric use that is reported is the combined purchased and produced kWh, so the electric using side of the plant is being compared consistently to sites without cogen plants. The total energy use was 1,620 kWh/MG-treated and secondary process electricity use was 794 kWh/MG-treated. Both figures were better than average for comparable facilities according to KEMA. The average daily flow was 72.6 MGD while the plant's peak capacity was 160 MGD.

Baseline. The basecase lighting in the lab building consisted primarily of 4-foot T12 fluorescent lamps and magnetic ballasts.

Sludge dewatering was accomplished with four centrifuge trains. The baseline demand of the centrifuge trains was 57.7 kW per train, based upon measurements in a previous load survey. In the basecase, three trains operate continuously, as confirmed by site operators.

There were eight oxygen-activated reactor basins (trains). Each train had four mixers, but only three typically operated. The baseline energy use of each reactor basin was 143 kW for the sum of the three reactor turbines. KEMA took the average kW for the motors from measurements performed by site operators for a previous study. In the basecase, all reactor basins and their respective turbines operated continuously.

The oxygen production facility included four 1250-HP air compressors. All compressors were originally identical, but one has been modified to produce 88 tons per day of oxygen rather than the original 77 tons. In the basecase, the site stored liquid oxygen for emergency use, but did not use it to supplement the output of the oxygen compressors as a peak demand reduction strategy. As a result, the larger capacity compressor was sometimes used during peak periods. One month a year the site changed over from one cryogenic oxygen separation tower to the other tower. This involved using both towers for a period of time, which established a high peak demand for the month. Historically, this occurred in May, which is a summer load month for electricity. Max kW for the oxygen plant was 2058 kW according to the WWTPIP audit.

Measures. Eight measures were identified in the WWTPIP audit. Five measures were implemented. An incentive of $4,808 was provided for the lighting measure, for a total measure cost of $31,941.

Metering Available. Baseline metering performed by KEMA consisted of a number of onsite readings from permanent kW meters. Most baseline kW values in the KEMA audit report were taken from several previous studies provided by the site. Savings were adjusted based on an independent analysis of trend log data of compressor plant kW.

Table III.9: Site 9 – Savings Summary (Gross Impacts)

Energy Efficiency Measure	Projected Actual Savings		Realized Actual Savings		Notes
	kWh/yr	kW	kWh/yr	kW	
1. Lighting retrofit in Lab Building	38,466	9.8	38,466	9.8	Retrofit confirmed
2. Shut Down 2 Centrifuge Trains	135,018	115.4	142,618	115	Savings adjusted, slightly longer daily shut-down period
3. Shutdown Reactor Basin	569,140	143	569,140	143	Commitment from operators confirmed
4. Supplement Aeration with LOX	0	100	0	143	Savings revised based on metering
5. Switch oxygen plant in April.	0	944	0	952	Savings revised based on metering
Total	***742,624***	***1,312***	***750,224***	***1,363***	

Note that much of the reported demand savings is for Measure 5 in which savings occur for only one summer month per year. A peak demand event is shifted from a summer to a winter month.

Site 10

Site 10 is located in the PG&E service territory. Baseline energy use and costs for the facility are 6,900,000 kWh, 68,000 therms, and $700,000. Gas is used to supplement cogeneration. The electric use that is reported is the combined purchased and produced kWh, so the electric using side of the plant is being compared consistently to sites without cogen plants. The total energy use was 2,190 kWh/MG treated which is lower than the average for the facilities in the WWTPIP and in a previous benchmarking study. The plant's design daily dry weather flow is 8 MGD.

Baseline. While many other measures were recommended, only a measure affecting a conveyer was implemented. In the basecase, the 2 HP conveyer motor operated continuously.

Measures. Five measures were identified in the original audit. One process improvement measure was implemented. Incentives were provided for no measures.

Metering Available. Baseline metering was not used to support the calculation for the single implemented measure. No post-installation metering was performed.

Table III.10: Site 10 – Savings Summary (Gross Impacts)

Energy Efficiency Measure	Projected Actual Savings		Realized Actual Savings		Notes
	kWh/yr	kW	kWh/yr	KW	
1. Conveyer Belt Timer	12,772	1.5	12,773	1.5	Calculations found to be reasonable
Total	***12,772***	***1.5***	***12,773***	***1.5***	

Aggregate Impacts

The results for the WWTPIP overall are shown in the table below. All sites that implemented projects were evaluated. The projected actual savings are taken from the KEMA summary of WWTPIP program activity. The realization rate was determined from the analysis of the five sites shown in the preceding section.

Table III.11: Gross WWTPIP Impacts – PG&E and SCE Territories

	Projected Actual Savings		Realized Actual Savings		Realization Rate	
	kWh/yr	kW	kWh/yr	kW	kWh/yr	kW
PG&E	1,273,676	1,498	1,207,171	1,543	95%	103%
SCE	938,038	162	940,735	167	100%	103%
Total	***2,211,714***	***1,660***	***2,147,906***	***1,710***	***97%***	***103%***

Table III.12 shows the distribution of annual gross energy savings in two categories: 1) capital improvement or process optimization savings and 2) operations improvement savings.[8] This categorization accounts for the fact that the assumed life of both capital improvement and process optimization measures is assumed to be 15 years (except for 16 years for the lighting retrofit) and the life of operations improvements is assumed to be 3 years.

Table III.12: WWTPIP Realized Gross Savings

	Capital Improvements or Process Optimization (kWh/yr)	Operations Improvement (kWh/yr)
PG&E	922,429	284,743
SCE	940,735	0
Total	***1,863,164***	***284,743***

8 KEMA determined that the savings from Site 8 should be classified as Operations Improvement, rather than Capital Improvement or Process Optimization since the site did not participate in training. The main implication is that the resulting energy savings for this site were deemed to have a shorter effective life.

Net impacts are determined as the product of the gross impacts and an assumed net-to-gross ratio of 0.80.[9] Net impacts are shown in Table III.13.

Table III.13: Net WWTPIP Impacts

	Realized Actual Savings	
	kWh/yr	kW
PG&E	971,892	1,236
SCE	752,587	133
Total	***1,724,479***	***1,369***

9 A net-to-gross ratio of 0.96 was applied to the lighting retrofit conducted as part of one project.

IV. Cost Effectiveness

Cost effectiveness was calculated for the Energy Efficiency Local Government Program overall and by utility service area.[10] All non-incentive B.E.S.T and WWTPIP costs are reported together for the SCE area. The methodology specified by the CPUC and implemented in its 2002-2003 Program Reporting Workbook, April 2004, was used in our calculations. The energy savings used in our calculations were the realized actual savings from our EM&V analysis.

Based on information provided by KEMA, we allocated measures implemented through the WWTPIP to either Operations Improvements or Capital Improvement/Process Optimization with effective useful lives of 3 or 15 years, respectively. Measure lives for lighting measures were those used by KEMA.

Table IV.1 shows the aggregate net energy savings results for each service area and the Program overall.

Table IV.1: Aggregate Net Realized Energy Savings Results

	Annual Demand Reductions (Net kW)	**Annual Electricity Savings** (Net kWh)	**Lifecycle Electricity Savings** (Net kWh)
PG&E – WWTPIP	1,236	971,892	11,881,777
SCE – WWTPIP	133	752,587	11,288,820
SCE – B.E.S.T.	488	1,622,843	24,998,460
Total	***1,857***	***3,347,322***	***48,169,057***

Cost effectiveness results are shown in Table IV.2 using the Total Resource Cost test (TRC). Results shown for the SCE area include the WWTPIP and B.E.S.T. components since it was not possible to allocate the administrative costs to each separately. The Program was cost-effective in both service areas. The total overall Program was cost-effective, with a TRC of 1.21.

Table IV.2: TRC Cost Effectiveness Results

	Costs	Benefits	Ratio	Net Benefits
PG&E	$451,344	$574,881	1.27	$123,538
SCE	$1,417,289	$1,679,266	1.18	$261,977
Total	***$1,868,633***	***$2,254,147***	***1.21***	***$385,514***

10 We used the calculation procedures specified in the CPUC spreadsheet workbook and final data provided by KEMA to do our calculations. We could not apply the spreadsheet directly because it did not provide the flexibility required to accommodate some of the differences between the original Program planning assumptions and actual projects.

Table IV.3 presents the comparable results applying the Participant Test. The Program was cost-effective to participants in both service areas and overall.

Table IV.3: Participant Test Cost Effectiveness Results

	Costs (Measure-Incentive)	Benefits	Ratio	Net Benefits
PG&E	$27,133	$717,793	26.5	$690,660
SCE	$539,388	$2,292,707	4.25	$1,753,320
Total	***$566,521***	***$3,010,500***	***5.31***	***$2,443,979***

V. Conclusions and Recommendations

B.E.S.T.

B.E.S.T. achieved considerable success, as evidenced by the following:

- Met its target for kWh savings and exceeded its targeted kW savings – B.E.S.T. achieved 100% of its energy savings goal and 113% of demand savings goal
- Was implemented cost effectively and within budget
- Engaged multiple trade ally partners (contractors)
- Effectively reached hard-to-reach customers – 91% of program participants were part of the targeted hard-to-reach population and they accounted for 80% of total energy savings
- Achieved high levels of participant and contractor satisfaction

We offer the following conclusions and recommendations for the consideration of the Program implementers as they continue and expand the program.

B.E.S.T. Participation

While the program anticipated 200 participants, only 103 projects were completed. This was primarily because the average project size, and associated incentives, was larger than anticipated. A total of 204 projects were initiated through the program, half of which were completed. Projects were not completed for a variety of reasons, but primarily because of customer decision to discontinue participation or the fact that incentives were no longer available. Customers interested in continuing participation, but for which incentive funding was unavailable, would be eligible to participate in the next round of program funding.

Installation of Target Technologies

B.E.S.T. was designed to include various efficiency technologies applicable in small commercial facilities, including:

- Lighting
- HVAC (including setback thermostats)
- Custom measures (e.g., refrigeration)

The Program was aggressively marketed by the participating lighting contractors, and program incentives were fully subscribed in a short period of time for lighting measures (March and April 2003).

Achievement of Program Goals

The program exceeded its goals related to electric demand and energy (kW and kWh) savings. Because no HVAC or customer measures were installed, the Program did not achieve any therm savings.

Contractor Involvement

Contractor involvement is key to the success of the program. Contractors served as the primary marketing and delivery agents for B.E.S.T.

The concentration of activity amongst the few contractors was likely a function of the speed with which the participants subscribed to the program. With the continued participation of the contractors from the first year of implementation, each begins the new round of implementation with existing program knowledge. This should contribute to a more even distribution of activity and opportunity.

Effectiveness of Program Marketing, Delivery, and Management

As the program substantially met its goals in terms of energy and demand savings, fully utilized the available incentive budget, and did so with high levels of satisfaction amongst participants and contractors, we find the program implementation to be very effective.

While we make a few recommendations for process enhancements for the program, we find the overall design and deployment to be sound and successful.

Continued Need for the Program

The Program assisted customers who were unlikely to otherwise participate in programs or adopt energy-efficient technologies. Also, once the Program incentives were fully allocated in the first year, there were several potential participants left unserved. We recommend that the Program be continued in order to:

- Reach additional hard-to-reach customers
- Address additional energy efficiency opportunities, including HVAC and custom measures
- Engage additional contractors
- Achieve additional cost-effective energy savings that would otherwise not be realized

Recommendations

In the continuation of the B.E.S.T. program, we offer the following recommendations:

- ***Additional Contractor Participation***. As mentioned, program activity was concentrated with a few contractors. Encouraging more even participation amongst contractors may lead to additional measure and/or customer diversity amongst participants.
- ***Contractor Oversight***. Some opportunities may exist to provide additional oversight of Contractors to ensure their compliance with program processes and procedures. The limited negative feedback from participants was related to contractor performance. Ensuring that the contractors perform their work with minimal disruption to the participating business and provide adequate follow-up would eliminate the few customer complaints that were received.
- ***Allocation of Incentives***. The quick commitment of incentives to lighting projects left no incentives available for other HVAC or non-lighting customer measures. KEMA has addressed this by allocating incentives to the different technology categories for the next round of implementation.

WWTPIP

The WWTPIP achieved mixed success in meeting its goals. Achievements of the WWTPIP included:

- Was implemented cost effectively
- Identified a large potential market for the services offered
- Successfully informed a substantial number of eligible facilities about the WWTPIP
- Provided well-received training to ten facilities
- Conducted ten site audits and delivered benchmarking studies
- Motivated five treatment plants to implement process optimization and three plants to implement capital improvement projects
- Achieved first-year annual energy savings of 1,207,171 kWh in the PG&E area and 940,735 kWh in the SCE area

For a number of reasons, however, the WWTPIP did not meet its overall participation and impact goals. Specific accomplishments and challenges are discussed below. We also provide our findings related to a continuing need for the WWTPIP or similar program and offer several recommendations.

Participation

KEMA had originally planned to enroll 12 treatment plants as participants. In the revised plan, KEMA targeted completing four projects in the PG&E area and two in SCE's area. Audits were completed for ten plants, four of which implemented energy saving processes or hardware changes.

The main impediments to participation and implementation of efficiency projects included the following:

- The decision-making and budgeting cycle in these plants was not compatible with the planned length of this program. Plants typically required 18 months or more to make and implement significant investment decisions, but the time between when the WWTPIP flyer was approved and the original completion deadline was less than 18 months.
- Specific organizational characteristics were difficult to overcome. The culture in these plants led to resistance to change and risk. The number one priority was meeting pollution regulations and anything that might jeopardize that objective or detract from it was perceived as risky or lower priority. Plants, in some cases, were resistant to involve new consultants or accept the recommendations of outside experts.

The WWTPIP addressed the schedule issue by requesting and obtaining a schedule extension. However, some plants still could not implement projects in the allowable timeframe. The significance of organizational impediments was not fully appreciated during program design and identification of them was one of the key lessons learned.

Marketing, Training, and Delivery Effectiveness

A detailed program theory was not developed for the WWTPIP, but the simplified process can be described as follows:

1. Plants become aware of the WWTPIP and request audit
2. Audit is conducted and benchmarking study and training are provided to plant
3. Plant identifies operation and capital improvement measures to implement
4. Measures are implemented
5. Plant staff increase awareness and understanding of efficiency options and benefits
6. Plants implement on-going efficiency improvements, communicate benefits to other plants, and other plants adopt similar measures

Generally, the marketing strategy appeared to be effective. In combination with Brown & Caldwell, KEMA developed a comprehensive list of potential participants and leveraged existing contacts and other mechanisms to inform plants about the WWTPIP. The promotional materials appeared to be informative and well received. The progress of the projects and feedback from the implementers, however, strongly supported the need to dedicate more effort and resources to providing continued support to the plants to ensure that projects were carried to fruition.

The audits, benchmarking studies, and training received high marks from the plant representatives we interviewed. The participants said that all the services were delivered in a professional and convenient manner.

There was evidence to support the program theory objective of establishing increased awareness and on-going implementation of efficiency improvements. Several plant respondents indicated that the WWTPIP had increased their awareness of energy use and energy costs and stated that the WWTPIP increased their understanding and the likelihood of future efficiency upgrades.

Customer Satisfaction

The overall level of customer satisfaction with the WWTPIP was high. With the exception of one detail, customers were satisfied with the WWTPIP.

The area where most participants felt the WWTPIP could be improved was the timeline. As noted above, it was difficult to make the necessary budgeting and implementation decisions in the time that was available.

Program Goals

KEMA successfully met its goal of developing a WWTPIP flyer, but as discussed earlier, the review process pushed back the delivery beyond its planned milestone date.

Because of the difficulty recruiting participants and the time required to implement projects, interim project and energy savings milestones were not met.

Total energy savings were a little less than 40% of the savings goal. Total demand savings, however, exceeded the goal by about 100%. In the PG&E area, energy savings were about 32% of the goal; in the SCE area, they were 43% of the goal.

Continuing Need for Program

There were more than 100 plants eligible for the WWTPIP. Given the priorities, history, and organizational characteristics of facilities in this sector, it appeared that there were likely to be many opportunities for cost-effective efficiency upgrades. There was little evidence to suggest that this sector would begin systematic efforts to improve efficiency without outside facilitation.

In our view, this sector offers considerable potential for efficiency improvements. The WWTPIP revealed some of this potential and identified industry barriers and mechanisms to overcome them. Consequently, we believe there is a continuing need for a program such as WWTPIP. Our main suggestion is to take the lessons learned from the WWTPIP and craft a modified version that builds on the positive features of the program and addresses the gaps that were identified.

Recommendations

We offer the following recommendations for the consideration of implementers interested in pursuing similar programs with municipal wastewater treatment plants.

- Design a program with a timeline that is compatible with the decision-making and budgeting cycles of these facilities.
- Increase the amount of resources dedicated to follow-through with interested plants and personnel.
- Build on the knowledge gained through the WWTPIP to identify and address organizational issues that hinder the implementation of efficiency improvements.
- Promulgate case studies of successful efficiency upgrades so that prospective participants can see the potential benefits and how others overcame implementation barriers and addressed issues such as risk and performance uncertainty.
- Leverage the growing interest in understanding the relationship of energy costs and efficiency to co-generation.