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IMPACT AND PROCESS EVALUATION FINAL REPORT

for

CALIFORNIA URBAN WATER CONSERVATION COUNCIL 2004-5 PRE-RINSE SPRAY VALVE INSTALLATION PROGRAM (PHASE 2)

(PG&E Program # 1198-04; SoCalGas Program 1200-04)

Submitted to

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Background

The California Urban Water Conservation Council's (CUWCC) Pre-Rinse Spray Head Distribution Program installs high-efficiency pre-rinse spray heads in food service establishments throughout the natural gas service areas of Pacific Gas & Electric (PG&E) and SoCalGas (SCG). Replacing old heads with this type saves energy by reducing the gas and electric energy required to heat hot water.

The first phase of the program, completed in during 2002-2003, installed nearly 17,000 efficient heads throughout most of California. The second phase of the program covered the natural gas service areas of Pacific Gas & Electric and SoCalGas only. It was completed in between 2004-2005. The goals in Phase 2 were to achieve 8.27 million therms/year of gas savings by installing 24,700 spray heads. A third phase began in 2006.

This evaluation, measurement, and verification effort covers Phase 2 of the program. It is very similar to the Phase 1 evaluation, and accomplishes multiple objectives, including assessing energy savings achieved, measuring program cost-effectiveness, providing ongoing feedback on program implementation, and assessing overall performance, success, and continuing need for the program.

Methodology

This evaluation relied on a variety of techniques and data sources to assess the energy savings and effectiveness of the program. These included short-term metering, one-time measurements, observations, and interviews at installation sites, as well as telephone surveys. We randomly selected 4% of the spray head installations (659 of them) for site visits. For all selected installations, we observed whether the efficient head was still in place, and verified that the program had indeed visited the site. At 195 of these installations, we also measured flow rates and water temperatures, and interviewed staff about satisfaction with the valves. Lastly, at 29 installations, we installed flow meters to record water use for over a month with the efficient head. At 19 of these, we also recorded comparable water use with the original head.

The evaluation team also conducted 12 in-depth interviews with program managers and installers, and spray head manufacturers and distributors. We developed a protocol for these interviews, and analyzed the information obtained through them to assess program effectiveness and areas for improvement, as well as the program net-to-gross ratio (that is, the rate at which program participants might have installed efficient spray heads even had the program not existed). Furthermore, we added a follow-up process evaluation to determine why quality control procedures broke down, resulting in discrepancies between reported and actual spray head installations. This task featured in-depth interviews with four individuals involved with the program.

Results

The program claimed installation of 16,682 spray heads, the majority of which were installed in SoCalGas service territory. The revised program gas savings claim is about 5,588,000 therms/year, 68% of the program gas savings goal of 8,274,500 therms/year. Our field verifications of 659 installations showed that 98.3% of the claimed heads were actually installed. We determined that about 21% of all installations took place at groceries, even though the program apparently intended to exclude them from the program.

Verification measurements taken at 195 installations showed average pre and post flowrates of 2.23 and 1.12 gallon per minute, respectively. It is important to note that while the post flowrate matches results from the evaluation of Phase 1, the pre flowrate is significantly lower. Possible explanations for this include different populations being served in this phase with a different mix of spray head manufacturers, or inaccuracies inherent in the process of extrapolating lab flow measurements to field conditions, as was done for Phase 1.

Mixed water temperatures averaged 98ºF and 107ºF at groceries and non-groceries, respectively. Daily hours of spray head use averaged 0.08 (pre) and 0.10 (post) hours per day at groceries, and 0.54 (pre) and 0.73 (post) hours per day at non-groceries. These values are all lower than Phase 1 results, and additionally, the methodology for this evaluation showed that post hours of use increased by over a third.

We found that about 90% of non-grocery installations had gas domestic water heating, as expected, but about 8% had electric heat and another 2% had other heat sources, such as refrigeration waste heat recovery. This situation was more pronounced at groceries, where nearly 12% of the installations used the latter.

Consequently, all of these factors worked together to dramatically reduce the unit savings for each spray head, compared to those reported in the Phase 1 evaluation. Gross gas savings per head are 45 therms/year for non-groceries, and 5 therms/year for groceries. Incorporating the evaluated first-year retention rate of 95% and the net-to-gross ratio of 96%, and normalizing for the number of heads claimed by the program as well as the gas/electric water heating split, we obtain net savings per head claimed by the program of 28 therms/year, 51 kWh/year, and 18 gallons/day (9 CCF/year). The cost-effectiveness for each utility's portion of the program is shown below.

	PG&E		**SoCalGas**	
	Program proposal	Evaluated	Program proposal	Evaluated
Total Resource Cost benefit-cost ratio	7.50	0.80	7.50	0.69
Total Resource Cost net benefits	$4,300,000	($110,000)	$10,000,000	($322,000)

Conclusions

Phase 2 of the Pre-Rinse Spray Head Program is providing energy savings, although far less than originally expected. These savings are on the order of 459,000 therms of natural gas and 846,000 kilowatt-hours of electricity annually, and 193 kW of average peak demand reduction. As a result, the program does not appear cost-effective. This is a particularly surprising conclusion, since the evaluation of Phase 1 of this program showed that phase to be highly cost-effective. A wide variety of disparate factors, however, conspired to reduce the Phase 2 unit savings per spray head from the Phase 1 results. These included (a) over 20% of the installations occurring at groceries, which generally have minimal spray head use, (b) program implementer quality control issues, which led to slightly fewer heads being installed than were claimed, and (c) a more rigorous evaluation methodology in Phase 2 that made significant downward adjustments to savings for non-gas water heating and the increased spray head use with efficient heads. The improved methodology also showed that the pre flowrates obtained from lab tests and the mixed water temperatures provided by the program implementer in the Phase 1 evaluation may have been inaccurate, resulting in savings being overstated.

The process portion of our evaluation revealed these key findings:

A. By far the greatest challenge program implementers faced is language barriers. Installers were often faced with presenting the program to restaurant managers/employees that either did not speak English or only broken English. Asian and Hispanic dialects are the most common language barriers to overcome.

B. It may be difficult to recruit and hire multilingual program installers and match those installers to specific communities, although this would help overcome the language barrier. Providing multilingual marketing materials and program printed materials will assist in overcoming this hurdle.

C. Some prospective participants are suspicious of the program, because the service and equipment are provided free of charge. They feel like there has to be a catch.

D. Letters of referral from water authorities, utilities, or the state will provide program installers with credibility to overcome prospective participants' skeptical or suspicious positions regarding the "free" resource efficient spray valve.

E. Poor performance perceptions are noted most often as the reason restaurant owners install standard pre-rinse spray valves instead of resource efficient valves. Poor experiences with other water saving fixtures have influenced these perceptions.

F. Limited access to resource efficient spray valves through suppliers and maintenance contracts on leased equipment remove the option for restaurant owners/managers to install resource efficient pre-rinse spray valves.

G. Few restaurant owners/managers are aware that resource efficient pre-rinse spray valves are available. Program installers estimate that only 5% to 25% of the restaurant operators they approach are aware of these valves prior to receiving the program information.

H. Ease of participation is mentioned most often as the greatest strength of the program. Participants need only agree to the installation of the resource efficient spray valve—there is no paperwork for participants to complete, no rebates to collect, etc.

<u>Recommendations</u>

Several possibilities exist for future programs to address the low cost-effectiveness from an energy perspective.

1. Aggressively limit installations to those likely to yield highest energy savings (that is, sites that have high hours of spray head use and employ warm water for pre-rinsing). According to program managers, such steps have already been taken in the Phase 3 program.

2. Find practical ways to reduce the cost per installed valve ($129/ valve in the Phase 2 program, of which $97/valve was included in the TRC benefit-cost calculation) through operational efficiencies.

3. Reexamine the allocation of program costs between the water utilities and energy utilities (through the California public goods charges). If energy entities are paying a disproportionately high portion of the overall program cost, this could drive down the energy benefit-cost ratio.

In addition, we recommend a number of changes to future programs to prevent breakdowns in the quality control procedures governing installers.

4. Revise the installer compensation format. Systems where installers are paid on commission, with rates tiered according to their installation rates, can prompt installers to cut corners so that they can maximize their income.

5. Strictly adhere to improved valve reconciliation procedures, and improve storage of old valves. These steps will dramatically reduce the possibility of installers claiming falsified installations.

6. Enhance in-house verification policies and adopt standardized program quality control procedures. These will improve all parties' understanding of safeguards and expectations, and facilitate identifying problems more quickly.

7. Increase management oversight. Programs must dedicate adequate resources to quality control and field supervision to ensure that procedures are effective.

Program managers have claimed that many of the flaws of the Phase 2 program have been addressed in the Phase 3 program that succeeded it. Future evaluations of the latter program need to confirm that this was indeed the case. To that end, we recommend that future evaluations accomplish the following:

8. Verify the program better targeted facilities with high potential for energy savings, consistent with Recommendation #1.

9. Confirm that program efforts to improve quality control, including those in Recommendations #4 through #7, indeed eliminated the problems observed in Phase 2.

10. Determine how the 2006 California state law mandating efficient spray valves has altered the marketplace by increasing the percentage of efficient valves that would be installed even without programs.

1. Introduction

1.1 Program Description

Pre-rinse spray valves (or spray heads) are ubiquitous in food service establishments. They are used by kitchen staff to remove food particles prior to the cookware or dishes entering the wash cycle, which can be hand washing or by dishwasher. Typically, both hot and cold water supply lines feed the spray head, and the operator can adjust the mixed water temperature leaving the spray head. Low-flow, high-efficiency pre-rinse spray heads are available that produce a fan-like spray pattern that removes the food particles just as effectively as standard heads. These high-efficiency heads generally have a much lower flow rate than standard models. Replacing old heads with this type saves energy by reducing the gas or electric energy required to heat the hot water.

The California Urban Water Conservation Council's (CUWCC) Pre-Rinse Spray Head Distribution Program installed high-efficiency pre-rinse spray heads in food service establishments. Replacing old heads with this type saves energy by reducing the gas and electric energy required to heat hot water. The program implementer relied on direct installation of these heads by trained field staff. At participating establishments, the installer removed the old head and replaced it with a high-efficiency unit, free of charge to the establishment. The first phase of the program, completed in December 2003, covered the natural gas service areas of the three largest investor-owned utilities in the state. The second phase of the program (which is the subject of this report) covered the natural gas service areas of Pacific Gas & Electric and SoCalGas only, with a goal of installing 24,700 spray heads. It was completed in December 2005. Program objectives are summarized in Table 1-1.

Table 1-1: Program Objectives

Utility service area	Spray heads replaced	Annual therms saved*	Lifetime therms saved**
PG&E	7,463	2,500,105	12,500,525
Southern California Gas	17,237	5,774,395	28,871,975
ALL	**24,700**	**8,274,500**	**41,372,500**

* Based on 335 therms/head/year of gas savings, determined from the Phase 1 program evaluation[1].
**Based on five-year spray head life.

In developing program proposals and estimating cost-effectiveness, CUWCC relied on values provided by the California Public Utilities Commission (CPUC)[2] for the *effective useful life* of the measures, as well as the *net-to-gross ratio*. These are as follows:

- Effective useful life = 5 years (for "Efficient Dishwashing" in Table 4.1 of the CPUC manual)
- Net-to-gross ratio = 1.0 (for "Non-Residential Food Services Equipment Retrofit" in Table 4.2 of the CPUC manual).

[1] *Evaluation, Measurement & Verification Report for the CUWCC Pre-Rinse Spray Head Distribution Program*, SBW Consulting, Inc., May 3, 2004.

[2] From the CPUC *Energy Efficiency Policy Manual*, Version 2, prepared by the Energy Division and issued August 2003.

1.2 Program Theory

Small and mid-sized commercial food service establishments are often struggling economically, and lack the time and knowledge to make changes to improve their energy and water efficiency. Because of their relatively low overall energy consumption, heterogeneity, and other market barriers, efficiency programs have traditionally underserved such customers.

This program actively targeted "hard to reach" customers by canvassing them door-to-door, and delivering services to them free of charge. By having trained, and in some cases, bilingual, installers personally explain the program and its benefits, and by installing efficient spray heads on the spot, the program aimed to overcome the market barriers that keep customers from installing these heads themselves.

1.3 EM&V Objectives

This study was conducted at the request of the California Public Utilities Commission, and was managed by SBW Consulting, Inc. It was funded through the public goods charge (PGC) for energy efficiency. Our Evaluation, Measurement, and Verification (EM&V) effort for Phase 2 of the Pre-Rinse Spray Head Distribution Program was designed to meet the objectives listed in the California Public Utility Commission Energy Efficiency Policy Manual[3]. These objectives, and the manner in which we achieved them, are as follows:

1. **Measuring level of energy and peak demand savings achieved**.

   The primary objective of the EM&V effort was to verify net gas and electric energy savings, as well as electric demand reduction, from this program for each energy utility service territory. Based on International Performance Measurement and Verification Protocol (IPMVP), Option B – Retrofit Isolation, which calls for short-term metering at the device level, we measured pre- and post-installation warm water usage, collected data on other performance parameters such as flow rates and temperatures, assessed the retention rate for the efficient spray heads, and determined the domestic hot water heating sources. These data informed estimates of gross savings, to which a net-to-gross ratio was applied to calculate net savings. This ratio was determined through in-depth interviews of installers, program managers, manufacturers, and distributors, supplemented with field information from participating facilities. The in-depth interviews provided understanding, from experts in the industry, of the naturally occurring installation rate of efficient pre-rinse spray heads—installations that would have occurred in the absence of the program—which provided a basis for calculating the net-to-gross ratio.

2. **Measuring program cost-effectiveness.**

   We developed estimates of verified energy and demand savings, so that the CUWCC could re-assess program cost-effectiveness—that is, compute new total resource cost (TRC) values using the workbook developed for the program implementation plan (PIP).

[3] Version 2, prepared by the Energy Division, and released in August 2003.

3. **Providing ongoing feedback, corrective/constructive guidance regarding implementation of programs.**

   After each round of sampling except the last, we provided interim summaries to the program manager[4]. These summaries reported spray head retention rates, customer levels of satisfaction with spray head performance, and preliminary estimates of energy savings for that round on an unweighted basis.

4. **Providing up-front market assessments and baseline analysis.**

   As with Phase 1, the program implementer performed ongoing market assessments as the installers conducted their fieldwork. They adjusted their marketing approach based on these assessments, and the final assessment at the conclusion of Phase 2 can serve as a basis for defining the market for future phases. The results of the Phase 1 EM&V effort established baseline conditions for the Phase 2 proposal. The Phase 2 EM&V effort further refined estimates of baseline conditions. In particular, this effort provided robust values for baseline spray head flowrates, water temperatures, and daily hours of use, as well as domestic hot water fuel type.

5. **Measuring indicators of effectiveness of the specific programs, including testing of the assumptions that underlie the program theory and approach.**

   Information collected during our process evaluation, as well as during onsite data collection, provided insights into how well the program approach worked.

6. **Assessing the overall levels of performance and success.**

   Our impact evaluation of retention rates, savings per head, and program savings and cost-effectiveness provided a complete assessment of the program's performance and success from an energy perspective. Our process evaluation—featuring in-depth interviews of key program stakeholders including installers, program managers, manufacturers, and distributors—assessed the non-energy measures of performance and success.

7. **Informing decisions regarding compensation and final payments.**

   To the extent that the CPUC finds these EM&V results to be useful, the EM&V efforts satisfied this objective.

8. **Helping to assess whether there is a continuing need for the program.**

   Phase 1 of the program installed nearly 17,000 spray heads, and Phase 2 installed nearly 17,000 more. Combined, these account for about a third of the 102,000 hot water spray heads that the program estimated exist in the state of California. The results of this evaluation provide information about potential savings, customer satisfaction, and market barriers that might exist in subsequent phases, thus helping the CPUC assess whether continuing the program would be worthwhile.

[4] For the purposes of this document, "program implementer" is defined as the contractor hired by CUWCC to install new spray heads, and "program manager" is defined as CUWCC staff and the agents hired by CUWCC to oversee the program implementer and manage the program overall.

1.4 Report Overview

The report is organized as follows:

Chapter 2:	Describes the sources of data used in the evaluation, and the methodology for developing samples, determining spray head retention rates, and calculating savings at the head, site, and program levels.
Chapter 3:	Presents evaluation findings on spray head performance, retention rates, per head savings, and program-level savings. Also documents program cost-effectiveness and market barriers.
Chapter 4:	Provides conclusions based on the analysis results.
Chapter 5 (Appendix):	Contains details of field data and savings calculations, field forms, and survey instruments.

This document is available for download at www.calmac.org.

1.5 Contacts

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2. Methodology

2.1 Overview

This evaluation relied on a variety of techniques and data sources to assess the net energy savings and effectiveness of the program. These include short-term metering and one-time measurements at installation sites. They also include industry standards and engineering calculations. The evaluation methodology was designed to answer the following questions:

1. **What is the average energy savings per spray head?** Estimates of average energy savings per head were developed from onsite inspections of 195 randomly selected spray head installations, and bolstered by pre and/or post metering at 29 of these installations.

2. **What is the retention rate for efficient pre-rinse spray heads?** Preliminary data were gathered in the first two rounds of onsite metering visits to provide early feedback to the program manager. Supplemental verification of 465 spray head installations also collected information on whether the efficient spray heads were installed and whether they were retained. Data from all four rounds of metering visits, all four rounds of the verification visits, as well from the supplemental verification were combined to estimate the overall retention rate for the program.

3. **What is the ratio of net savings to gross savings?** We determined a net-to-gross ratio to apply to gross savings estimates to calculate net savings. This ratio was primarily determined through in-depth interviews of installers, program managers, manufacturers, and distributors. As experts in the industry, these individuals were best suited to lend insights into the naturally occurring installations of efficient pre-rinse spray heads. These insights were used to net out those program effects that would have occurred in absence of the program.

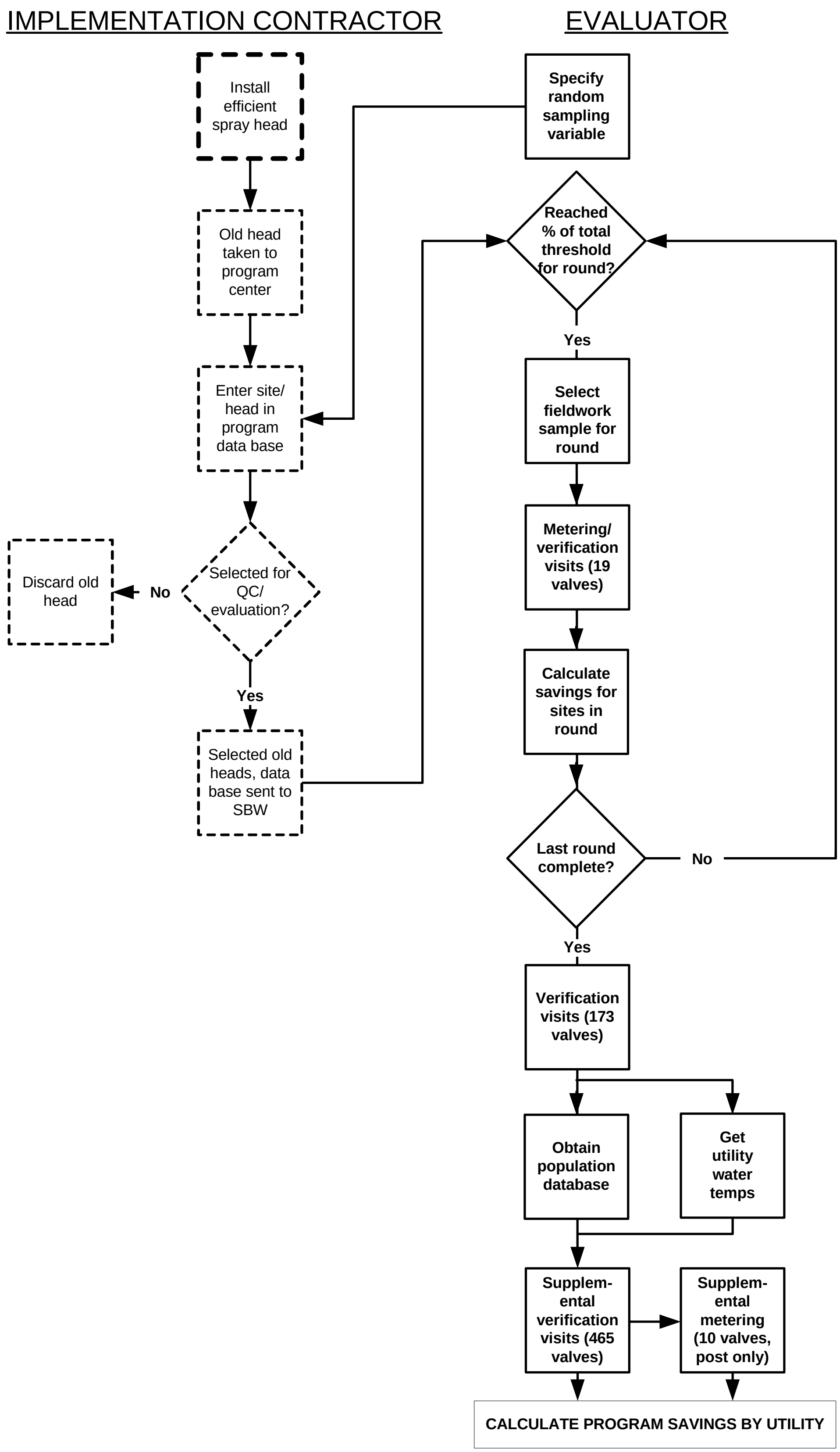
4. **What is the total program energy savings for each of the energy utility service areas served by this program?** The retention rate, average unit savings, domestic hot water heating source, and net-to-gross ratio results from the first three questions above were extrapolated to the total installed spray head counts for each utility area to calculate net annual kWh and therm savings for the program by utility.

5. **What is the program's cost-effectiveness?** The verified unit savings and retained units were entered in the program implementer's PIP workbooks, and new TRC values were calculated to determine cost-effectiveness.

6. **How well overall has the program performed, and how might it improve in the future?** The in-depth interviews of key stakeholders conducted for the process evaluation shed light on program strengths, weaknesses, and areas of improvement for subsequent rounds. During the verification process we discovered that some sites claimed for the program never had an efficient spray head installed. A supplemental verification process of 465 spray head installations provided installation realization rate. A parallel investigation conducted by the Glacier Consulting Group analyzed the installation policy and procedure to identify flaws that allowed fraudulent installations.

This EM&V methodology is consistent with the requirements of the IPMVP Option B: Retrofit Isolation. Savings were based on direct measurements of the affected hot water end use for a random sample of participants. Figure 2-1 illustrates major steps in the evaluation process.

Figure 2-1: Overview of Evaluation Process



2.2 Sources of Data

Our evaluation relied on six key data sources, each of which is described below:

A. **Implementer program database** listing all sites at which at least one spray head was installed, along with the number of heads installed, address, phone number, contact information, gas utility, and water service provider. The implementation contractor provided a final version of this database, dated February 16, 2006 (Excel filename "Final Report.xls").

B. **Supplemental field verifications** of 465 valves at 350 sites. These visits confirmed that installations listed in the implementer program database were indeed still present. In cases where efficient valves were not present, we investigated the reasons for discrepancies.

C. **Evaluation field measurements** of spray head flow rates, water temperatures, and hot water heating type at 195[5] randomly selected locations. We derived this number of locations for field measurement from a rigorous statistical analysis, which was intended to yield program savings estimates at 10% precision within the 90% confidence interval. In addition, at 29 of these locations, we also metered spray head mixed water usage for over a month, first with the efficient head, then with the old head. Ideally, we would have liked to have obtained water usage measurements for all locations where we collected flow rate and temperature measurements, but budget constraints precluded this.

   Table 2-1 and Table 2-2 provide details of the information collected to analyze baseline and efficient usage, respectively.

D. **Water providers' average supply temperatures**, for which program administrators attempted to obtain the best available data on annual water supply temperatures for all regions of California. These temperatures served as estimates of average annual cold-water temperature that the hot water heater serving the spray heads actually "sees." The quality and availability of this information varied widely. The primary information used in this study is identical to that in the Phase 1 evaluation.

E. **FSTC gas and electric water heating system efficiencies.** The Food Service Technology Center provided their standard assumptions about the overall system fuel conversion efficiency for gas and electric domestic water heating systems. Their conservative estimates of 70% and 90%, respectively, included idling losses, line losses, and heater efficiencies. These values are consistent with efficiency ranges published by the U.S. Department of Energy / NREL. The information used in this study is identical to that in the Phase 1 evaluation.

F. **In-depth telephone interviews** of program installers, program managers, pre-rinse spray valve manufacturers, distributors to collect information relevant to establishing a net-to-gross ratio and evaluating the program process.

[5] Initially, 192 installations were selected for verification. 7 installations were identified as situations where the efficient spray head likely was never installed. The implementation contractor removed these installations from the final database. Lastly, we selected 10 additional installations for supplemental metering. Hence the final verified sample includes 195 spray head installations.

Table 2-1: Baseline Measure Information

Baseline Information	**EM&V Source**
A. Average flow rate for old spray head	Evaluator measurements at 185 installations. Measurements were made by temporarily reinstalling the old spray head into the faucet. The old heads for some installations were misplaced and not available for measurement. Additionally, some installations were inaccessible. Pre flow measurements were available for 148 of the 185 sites.
B. Average daily usage (gallons per day) with old spray head	Evaluator metering for at least one month at 19 installations. The meter at one installation failed during measurement of the pre daily usage, and a meter at another installation was stolen. Thus valid average pre daily usage was collected for 17 of the 19 metered sites.
C. Typical mixed water temperature exiting spray head D. Temperatures of hot and cold water supplies to spray head	Evaluator measurements (once at 166 installations, three times at the 19 metered installations). Mixed water temperatures were obtained by first not disturbing existing settings on the cold and hot water faucets, then allowing the water from the fixture to run until the temperature stabilized (generally anywhere from 15 seconds to two minutes or more). Once this occurred, field technicians measured and recorded the water temperature. It was not collected at installations where these faucets had been completely turned off or where the spray head was inaccessible.
E. Average annual cold water supply temperature	Best available data from applicable water agencies.
F. Domestic hot water fuel type	Evaluator observations at 185 verified installations and 465 supplemental verification installations. The hot water fuel type was not collected where the site contact was unable to lead the inspector to the hot water heater or where the site was accessible.

Table 2-2: Efficient Measure Information

Measure Information	EM&V Source
A. Average flow rate for efficient spray head	Evaluator measurements at 195 installations. The efficient spray head had been removed at some of the installations. A few of the installations were not accessible for verification. Post flow measurements were available for 183 of the 195 sites.
B. Average daily usage (gallons per day) with efficient spray head	Evaluator metering for at least one month at 29 installations. The meter at one installation was stolen and measurements were not available. Average post daily usage was collected for 28 of the 29 metered sites.
C. Retention rate of efficient spray heads	Evaluator observations at 195 verified installations and 465 supplemental verification installations. The owners at some installation sites denied access to the inspector. Some installation sites were shut down or were closed on the day of the site visit.

Section 2.5 describes how the above data were used to calculate baseline and efficient pre-rinse hot water energy consumption.

2.3 Sampling Approach

A critical aspect of our evaluation methodology was establishing an appropriate sample size for the expected population of over 16,000 spray valves, and, once this size was established, specifying a mechanism for selecting the sample.

2.3.1 Sample size

We based our sample size analysis on the engineering data and algorithms employed for the Phase 1 evaluation. Most physical quantities usually cannot be measured in a single direct measurement but are instead found in two distinct steps. First, we measure one or more quantities that can be measured directly and from which the quantity of interest can be calculated. Second, we use the measured values of these quantities to calculate the quantity of interest itself. When measurement involves these two steps, the estimation of uncertainties also involves two steps. We must first estimate the uncertainties in the quantities measured directly and then determine how these uncertainties propagate through the calculations to produce an uncertainty in the final answer. This is the situation we faced in determining the sample size of spray heads in this evaluation.[6]

The objective of our sampling analysis was to estimate the expected coefficient of variation (CV) surrounding therm savings. This CV was a key input to the number of spray heads to be randomly sampled to achieve a level of precision of 10% error at a 90% confidence level. From the Phase 1 evaluation, Equation 2-1 was used to calculate therm savings.

[6] Key references used to develop this approach include: (a) Taylor, John R. (1997). An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements. Sausalito, CA: University Science Books. (b) Lohr, Sharon L. (1999). Sampling Design and Analysis. New York: Duxbury Press.

Equation 2-1: Calculate Therm Savings

*Therm Savings = Constant * (Pre-Flow – Post-Flow) * (% Hot Water Used) * (Mixed Temp - Cold Temp) * Hours*

However, with the exception of *Constant* and *Cold Temp*, which are fixed and have no uncertainty, the CV for therm savings is the result of uncertainty surrounding each of the terms in Equation 2-1. This uncertainty propagates through Eq. 1 to produce the uncertainty surrounding estimated therm savings, an uncertainty that is eventually captured in the CV.

The uncertainty surrounding each of these terms has been estimated from Phase 1 evaluation results. Table 2-3 presents this data.

Table 2-3: Inputs to CV Calculation for Therm Savings

VARIABLE	PRE FLOW	POST FLOW	MIXED TEMP	HOURS
Standard Error of Mean	0.10	0.07	3.55	0.23
N	171	19	19	18
Variance	1.81	0.09	239.35	0.98
Standard Deviation	1.35	0.30	15.47	0.99
Mean	3.21	1.11	108.57	1.27

These uncertainties are used to model the propagation of errors so that a more accurate estimate of the CV can be produced.

There are two basic operations in Equation 2-1: (a) subtraction, and (b) multiplication. Each operation requires a somewhat different approach. First, we estimate the uncertainty surrounding the difference between *Pre Flow* and *Post Flow*. Equation 2-2 is used to calculate this uncertainty.

Equation 2-2: Uncertainty between Pre Flow and Post Flow

$$\delta q = \sqrt{(\delta x)^2 . + (\delta y)^2 + . \; . \; . (\delta z)^2}$$

where,

δq = The standard error of the mean for the variable of interest, i.e., the difference between *pre flow* and *post flow*.

δ = The standard error of the mean for any given variable involved in addition or subtraction, i.e., *pre flow* and *post flow*.

Next, we take the absolute uncertainty, δq, from Equation 2-2 and convert it to a fractional uncertainty, and then incorporate it into Equation 2-3 with *Mixed Temp* and *Hours* to produce the standard error of *Therm Savings*.

Equation 2-3: Standard Error of Therm Savings

$$\delta p = \sqrt{.\left(\frac{\delta q}{|q|}\right)^2 + \left(\frac{\delta a}{|a|}\right)^2 + . \; . \; . \; . \; . \left(\frac{\delta b}{|b|}\right)^2}$$

where,

δq = The standard error of the mean for the variable of interest, i.e., *therm savings*

δ = The standard error of the mean for any given variable involved in addition or subtraction, i.e., *pre flow/post flow* difference, *mixed temp*, and *hours*.

$| \; |$ = Indicates the absolute value of the mean for any given variable involved in addition or subtraction.

This standard error was then converted into a CV of 0.85. We then used this CV and along with the 90/10 (i.e., z=1.645, e = 0.10) level of precision in Equation 2-4 to calculate the required sample size.

Equation 2-4: To Calculate required Sample Size

$$n = \frac{z^2 CV_y^2}{e^2 + \frac{z^2 CV_y^2}{N}}$$

This approach yielded a required sample size of 192 valves to obtain a statistically valid estimate of the average savings for the population of Phase 2 spray heads at 10% precision within the 90% confidence interval.

2.3.2 Sampling mechanism

The program implementer assigned tracking numbers using their established system at the time they logged in the old spray heads removed after efficient heads were installed. This login process occurred each month. The evaluation team specified a random sampling mechanism to accommodate the implementer system. For each month, implementer staff would pull every 85th head, beginning after a starting point (a number between 1 and 9) that the evaluation team provided each month. For example, for a month when the starting point was "2," the implementer would pull the 2nd, 87th, 172nd heads, and so on, until the monthly population was exhausted. The program implementer then shipped selected heads to us, and discarded all remaining heads. We adjusted the sampling ratio to every 10th valve for the final two months of the program, so that the sample would be sufficiently large to permit us to complete the required 192 verification and/or metering visits. We disposed of the old spray heads after verification and metering activities were complete.

The sample selection was done in six rounds. Sample frames in the first four rounds consisted of the randomly selected installations for which old spray heads were retained, grouped by installation month and utility service territory as the program proceeded. The sample frame for the fifth round (supplemental verification) consisted of the entire population, excepting a few geographical outliers and those sites already visited in the first four rounds. The sample frame for the sixth round (supplemental metering) consisted of all Southern California installations not already treated in the prior rounds. Once data were collected, we applied appropriate sample weights to obtain results representative of the entire population.

2.3.3 Full and Supplemental Verification

Our evaluation featured two levels of onsite verification activity. The first level, *full verification*, focused on collecting engineering data to support robust estimates of savings per valve. During these visits, we measured post-installation flowrates and pre-installation flowrates (by briefly reinstalling the old head). Measuring flowrates required a calibrated bucket and stopwatch. We took at least two measurements to confirm accurate readings. Using a calibrated thermometer, we recorded hot, cold, and mixed water temperatures at the spray head, after allowing full flow for a sufficient interval for temperatures to stabilize. In addition, we verified by inspection the hot water heating type, and that the program spray head was still installed and had not been tampered with. If either condition was no longer true, then we probed for reasons why not. Evaluation field inspectors also collected information about customer satisfaction, decision-making, spray head performance, hours of operation by day of week, and seasonal variation in business activity.

While performing full verification at a number of reported installations, we discovered that the efficient spray heads were never installed at some sites. These suspect sites were brought to the attention of the program manager, who ordered the program implementer to conduct an internal investigation. Because of this, a *supplemental verification* process was added to the study, where we visited an additional 350 randomly selected sites (containing 465 spray head installations) to verify whether the efficient spray heads were originally installed, as well as whether they were still in place.

All verification visits took place at least 45 days after program installed the efficient spray head. The data collection forms for the two types of verification can be found in the Appendix.

2.3.4 Metering of Water Usage

The evaluation team metered actual water usage at 29 sites. Of these, 19 were verification sites for which old heads were available. The remaining 10 were selected at the end of the evaluation to supplement the initial data.

Initial metering

At the 19 verification sites, we performed short-term metering of both old and new spray head performance. We recruited sites to participate in the metering portion of the study by calling the manager listed in the program tracking database, explaining the metering process, and offering a $100 cash incentive payment to the business to compensate for the inconvenience and lost utility savings associated with reinstalling the old spray head for a short time. We performed three rounds of metering, in which we randomly selected eight, eight, and three spray valve installations. Data collection commenced at least 45 days after the program had installed new spray heads.

At the first visit, the evaluation technician installed an in-line turbine-type flow meters (SaMeCo Model WFU20) to measure mixed water use through the water supply riser behind the spray head above the counter/sink. A typical metering setup is shown in Figure 2-2. Prior to installation, we verified the accuracy of the meters by comparing the metered water volume to the actual volume in a calibrated container for a variety of operating scenarios (continuous flow, and pulses of 5-, 15-, and 25-second duration). Metered results fell within ±1.5% of actual values, except in the 5-second pulse case, where the accuracy was within 5.5%.

After installation, the technician recorded the initial meter reading, date, and time. After at least a month, the technician re-read the meter and re-installed the old head, so that we could develop corresponding mixed water usage in the base case. After another month or more passed, the technician re-read and removed the flow meter, and then re-installed the efficient head. At each visit, the technician recorded the observed hot, cold, and mixed water temperatures. At one site the technician found significant seasonal variation between the December holiday and non-holiday season. For this site measurements were taken for both off and peak season, and a weighted average was calculated.

Supplemental Metering

For the 10 supplemental sites, we randomly selected potential metering installations from the pool of valves installed at non-grocery establishments in the greater Los Angeles metropolitan area. These Los Angeles-area valves accounted for about 60% of all installed valves, and initial results found no evidence that excluding Northern California installations would bias estimates of hours of use. These supplemental installations were metered in a similar manner to the first 19 installations. First, we recruited sites to participate by calling the manager listed in the tracking database and explaining what is involved. If the site agreed and the efficient valve was still in place, we metered post-installation as was done at the initial metering sites.

2.3.5 Savings per valve

To calculate unit energy savings, we used the same engineering assumptions about electric and gas domestic water heating system efficiencies (90% and 70%, respectively) provided by the Food Service Technology Center in the previous phase of the spray head program. We also applied the average annual water supply temperatures determined from water agency information from the previous phase.

We developed a spreadsheet that applied the determined weighted average values for temperatures, flowrates, hours of use, and other key factors. Where appropriate, these averages were calculated by gas utility and by establishment type (grocery and non-grocery), and applied to the corresponding subgroup of the population. Key equations for calculating pre- and post-installation energy and water usage are listed below.

Figure 2-2: Metering setup for determining hours of use

1. *Daily mixed water use (gallons/day/head) = Metered mixed water usage (gallons) ÷ elapsed metering time (days)*

2. *Annual mixed water use (gallons/year/head) = Daily mixed water use (gallons/day) * equivalent annual operating days (days/year)*

3. *Daily hours of use (hours/day/head) = [Daily mixed water use (gal/day)] / [(60 minutes/hour) × (Spray head flowrate (gal/min))]*

4. *Annual energy use (therms/year/head) = Annual Mixed water use * [Mixed Water temperature (°F) – Cold Water temperature (°F)] * Density (8.33 lb/gal) ÷ Domestic hot water efficiency ÷ 100000*

   *Annual energy use (kWh/year/head) = Annual Mixed water use * [Mixed Water temperature (°F) – Cold Water temperature (°F)] * Density (8.33 lb/gal) ÷ Domestic hot water efficiency ÷ 3413*

5. *% Spray head retention rate = # of Spray heads retained ÷ # of Spray heads verified * 100*

To calculate energy savings, we applied the following equation:

6. *Total Annual energy savings = [Pre annual energy use (therms/year/head) – Post annual energy use (therms/year/head)] * # of Heads claimed by program * % Spray head retention rate * % Spray heads claimed that were verified installed*

Similarly, to calculate water savings, we applied the following equation:

7. *Annual water savings (gallons/year) = [Pre annual mixed water use – Post annual mixed water use] * # of Heads claimed by program * % Spray head retention rate * % Spray heads claimed that were verified installed*

The lone deviation to the savings calculation methodology occurred with the 10 supplemental metering installations. Because the original spray valves were no longer available, it was impossible to meter baseline usage. As a result, instead of using metered pre-installation hours of usage as we did for the initial 19 metering installations, we instead applied the average observed increase in post hours of use over pre hours for non-grocery installations to estimate pre hours for the additional installations.

2.4 Process Evaluation and Net-to-Gross Ratio Analysis

For the process evaluation and net-to-gross ratio analysis, the evaluation team designed an in-depth interview protocol to meet the objectives of this study. This protocol can be found in the appendix. Interviews were conducted in June 2005 with four program managers, three program installers, two pre-rinse spray valve manufacturers, and three distributors. We aggregated and analyzed data from the in-depth interviews to evaluate the effectiveness of the program process and to determine the program net-to-gross ratio.

In calculating net program impacts, evaluators need to estimate a net-to-gross ratio for measures implemented through the program. Market transformation programs attempt to stimulate markets through intervention in order to accelerate the natural development of markets for energy efficiency technologies that do not currently enjoy significant market share. Understanding current market share or naturally occurring sales for targeted measures is essential in separating out impacts that would have happened without program intervention from those that were stimulated through program intervention—that is, impacts truly acquired because of the program.

The net-to-gross ratio is simply the portion of measures installed through an intervention program that would not have been implemented if the program had not existed—in other words, program-induced measures. For example: A net-to-gross ratio of 1 indicates that none of the implemented measures would have happened if the program had not intervened, so the program receives credit for all implemented measures. A net-to-gross ratio of 0.5 indicates that one half of implemented measures would have been installed even if the program had not existed, and the other half of implemented measures happened because of program intervention. Thus the program receives credit for half of the implemented measures.

The evaluation team selected a qualitative research methodology as the most appropriate and economical technique for establishing a net-to-gross ratio and simultaneously securing process-related information from program stakeholders. The findings described later in this report are based on the results of data gathered through in-depth interviews with program installers, program managers, pre-rinse spray head manufacturers, and distributors. The net-to-gross ratio is based, in large part, on the naturally occurring installation rate of efficient pre-rinse spray heads—installations that would have occurred in the absence of the program. Given the lack of pre-rinse spray head market data, these experts in the industry are best suited to lend insights into naturally occurring installations of efficient pre-rinse spray heads.

The evaluation team also collected onsite data on users' satisfaction with spray head performance and cleaning speed at sites we visited. Site contacts were asked to rate these parameters on a scale of 5, with the 1 one being very dissatisfied and 5 being very satisfied.

2.4.1 Follow-Up Process Evaluation

The follow-up process evaluation focused on determining the causes for the breakdown in quality control procedures that resulted in discrepancies between reported and actual spray head installations. This task featured in-depth interviews with four individuals involved with the program. These four individuals had diverse experiences at both the field and management levels. The interviews were conducted between July 12, 2006 and July 26, 2006. An in-depth interview protocol (provided in the appendix) was designed to provide a very loose format for managing the conversation. Respondents and the interviewer were provided great latitude in exploring the topics at hand.

2.5 Program Savings and Cost-Effectiveness

Extrapolating the site-level savings results to each gas utility service area and the program as a whole required eight discrete steps that incorporated all remaining data sources. Each step is described in detail below.

1. **Obtain the final program tracking database**, and review for and reconcile any data anomalies. Tally the total claimed valve installations for the two participating energy utilities, Pacific Gas & Electric and SoCalGas, as well as all participating water utilities.

2. **Apply case weights to engineering data to get program averages.** For each sampled verification spray head, calculate a sampling weight to account for that particular head's probability of selection. Calculate weighted average values for mixed temperatures, pre-and post-installation flow rates, operating hours, first year spray head retention rate, % hot water used, % spray heads in grocery establishments and spray heads with gas or electric heating. Combine these values to estimate average energy savings per valve.

3. **Adjust for regional differences in water supply temperatures.** Determine average annual water supply temperatures for five California regions based on available water utility data (Contra Costa, East Bay, Sacramento, South Bay, and Southern California south of Santa Barbara). The average water supply temperature for the first three regions listed is below the standard 68°F that was assumed for all of Southern California.

4. **Apply spray head retention rate:** Apply the program-level retention rate developed from field data to the tracking database counts to determine the number of installed spray heads that are yielding savings.

5. **Adjust for observed domestic hot water fuels**: From data obtained from verification visits, determine the domestic hot water heating fuel split between electric and gas for the program and apply these to the counts of retained valves from Step 4. Calculate corresponding aggregate electric and gas savings. To calculate peak electric demand reduction, divide the electric savings in kWh/year by the average annual hours that the inspected facilities are in use. This yields a conservative estimate of demand reduction.

6. **Apply net-to-gross ratio:** Apply this ratio to the gross savings from Step 5 to calculate final estimates of net program savings for each utility (energy and water) and for the program overall.

7. **<u>Estimate savings over measure life</u>**: As requested by the CPUC, estimate program savings over the life of the measure by year to capture the shape, persistence and availability of energy and demand savings. Based on information obtained in the retention rate analysis, apply professional judgment to assess the reasonableness of the program measure life estimate of five years, and adjust accordingly.

8. **<u>Determine program cost-effectiveness</u>**. Input verified installed counts and evaluated gross unit savings for each utility, the evaluated program net-to-gross ratio, and the actual program expenditures provided by the program implementation team into the PIP workbooks. Determine revised TRC benefit-cost ratios, which indicate the cost-effectiveness of the program.

3. Results

This section presents key findings of the evaluation, including program baselines, sample dispositions, summaries of engineering data, and savings results per head, per utility, and for the program overall.

3.1 Reported Accomplishments

The program implementation plans laid out goals of 24,700 spray heads to be installed and 8.275 million therms/year of gas savings (based on an assumption of 335 therms/year of gas savings per spray head from the Phase 1 evaluation). The installation goal by utility broke down to 7,463 heads (30%) for PG&E and 17,237 heads (70%) for SoCalGas. The program implementer provided their final database that documented all spray head installations that occurred during the program. We used this database to conduct all installation and retention verification. Table 3-1 summarizes our final accounting of program installations based on the program implementer's database.

Table 3-1: Summary of program claimed installations

Gas utility	# of sites	% of all sites	# of spray heads	% of all spray heads	Ex ante gas savings (therms/year)
Pacific Gas and Electric	4,413	36.7%	6,048	36.3%	2,026,080
SoCalGas	7,624	63.3%	10,634	63.7%	3,562,390
Program Total	**12,037**	**100.0%**	**16,682**	**100.0%**	**5,588,470**

As the table shows, the program claimed installation of 16,682 spray heads at a total of 12,037 sites. The number of installed heads is significantly lower than the goal of 24,700 heads. Most of the heads (64%) were installed at businesses in SoCalGas service territory, although somewhat less than the original projection of 70%. The remaining 36% of the heads were installed within the PG&E service territory. The revised program gas savings claim is about 5,588,000 therms/year, 68% of the program gas savings goal of 8,274,500 therms/year. The former is lower because fewer heads were installed than originally envisioned.

3.2 Sample Disposition

Table 3-2 shows the overall sample disposition for the evaluation effort. By randomly selecting installations for verification and supplemental verification, we were able to visit 4.0% of the claimed installations. We collected spray head performance data at 1.2% of the installations, and metered slightly more than 4% of the installations we visited (0.2% of the population).

Table 3-2: Sampling breakdown

Group	# of heads	% of population
Population (claimed)	16,682	100.0%
Sample	659	4.0%
Verification	195	1.2%
Metering	29	0.2%
Supplemental verification	464	2.8%

3.3 Actual Installations

As Table 3-3 shows, 100% of the spray heads claimed in the PG&E service territory and 97.3% of the spray heads claimed in SoCalGas territory were actually installed, based on our fieldwork. This yields an average ratio of installed to claimed heads of 98.3% for the whole program. Discrepancies resulted from situations where we found that installers had never visited the site, or had simply left an efficient spray head, uninstalled, with the customer.

Table 3-3: Spray head actual installation rate

	# of heads			
Gas utility	**Program goal**	**Program claim**	**Verified as installed***	**Verified as % of claimed**
Pacific Gas and Electric	7,463	6,048	6,048	100.0%
SoCalGas	17,237	10,634	10,347	97.3%
Program Total	**24,700**	**16,682**	**16,395**	**98.3%**

3.4 Savings Parameters

Summaries of data collected from evaluation verification and metering work are presented below. These include pre and post spray head flow rates, mixed water temperatures, daily hours of spray head use, and hot water heating fuel types. Throughout the discussion, we compare the results from this evaluation to those obtained from the similar evaluation of Phase 1, and try to explain reasons for discrepancies.

3.4.1 Flow rates

For the 195 spray heads selected in the verification and metering sample, we measured flowrates on site whenever possible. The pre flow rates were measured by temporarily reinstalling the old spray heads at the sink where the efficient spray head was installed. In the majority of cases, the program implementer was able to provide the old spray head for this purpose. Table 3-4 shows average flowrates for groceries and non-groceries. Both the pre and post flowrates are quite similar for both groups.

Table 3-4: Measured Pre- and Post-Installation Flow Rates

		Flowrates* (gallons per minute)	
	# of sampled heads	Pre-installation	Post-installation (low-flow)
Non-grocery	154	2.25	1.12
Grocery	41	2.15	1.12
Program Total	**195**	**2.23**	**1.12**

* Weighted averages, based on field measurements from verified sites.

Comparing these values to those from the Phase 1 program evaluation, we find that the post flow rates are nearly identical to the average Phase 1 post flow rate (1.11 gallons per minute, or gpm). The Phase 2 pre flow rate, however, is significantly lower from the average Phase 1 post flow rate (3.35 gpm). This difference is critical, as it alone will halve the Phase 1 energy savings. One explanation for the difference is that the Phase 1 pre flow rates were developed using laboratory flow measurements, adjusted for actual water pressures measured in the field. It is also possible that the drop in flow rate occurs because a different population of spray heads was treated in the second phase of the project, with a different mix of manufacturers. It has been shown in other studies that field flowrates for Fisher standard spray valves, for instance, are dramatically lower than those for T&S standard spray valves.

3.4.2 Water temperatures

Table 3-5 shows average measured water temperatures for the verification and metering sample. Both hot water and mixed water temperatures tend to be lower at groceries than at other sites. In comparing these results to the Phase 1 results, we find that the non-grocery mixed water temperature of 107.0°F closely matches the average mixed water temperature at evaluated sites of 108.6°F from the Phase 1 evaluation. The Phase 1 evaluation, however, incorporated supplemental measurements taken by the program implementer that were considerably higher (121.4°F). In hindsight, these latter measurements appear suspect, meaning that the Phase 1 savings are overstated by about 25%.

Table 3-5: Measured Water Temperatures

		Water temperatures* (F)		
Establishment type	# of sampled heads	Cold	Mixed	Hot
Non-grocery	154	72.8	107.0	127.5
Grocery	41	70.7	97.6	118.5
Program Total	**195**	**72.3**	**105.0**	**125.6**

* Weighted averages, based on field measurements from verified sites.

3.4.3 Daily Hours of Use

We measured hours of use at 29 randomly selected spray head installations by installing in-line flow meters upstream of the spray heads. For 19 of these installations, we metered usage for well over a month each with both the efficient and original heads. For an additional 10 installations selected at the end of the evaluation, we metered use with the efficient head only. Seven of the 29 total were groceries, and the remaining 22 were non-groceries. We observed a dramatic difference between use at the two types of facilities, as both Table 3-6 and Figure 3-1 show. We also saw a net increase in the hours of use from the pre to the post period. Both of these results are consistent with other published studies[7]. Again comparing these results to Phase 1 evaluation results, we note that the non-grocery post hours of use (0.73 hours/day) are considerably lower than the comparable value of 1.27 hours/day measured in Phase 1. It is possible that this reflects the high degree of variability we would expect in the relatively small samples in both cases. Unfortunately, the net result of both the increase in hours of use in the post, as well as the lower overall hours, is to reduce Phase 2 savings compared to Phase 1.

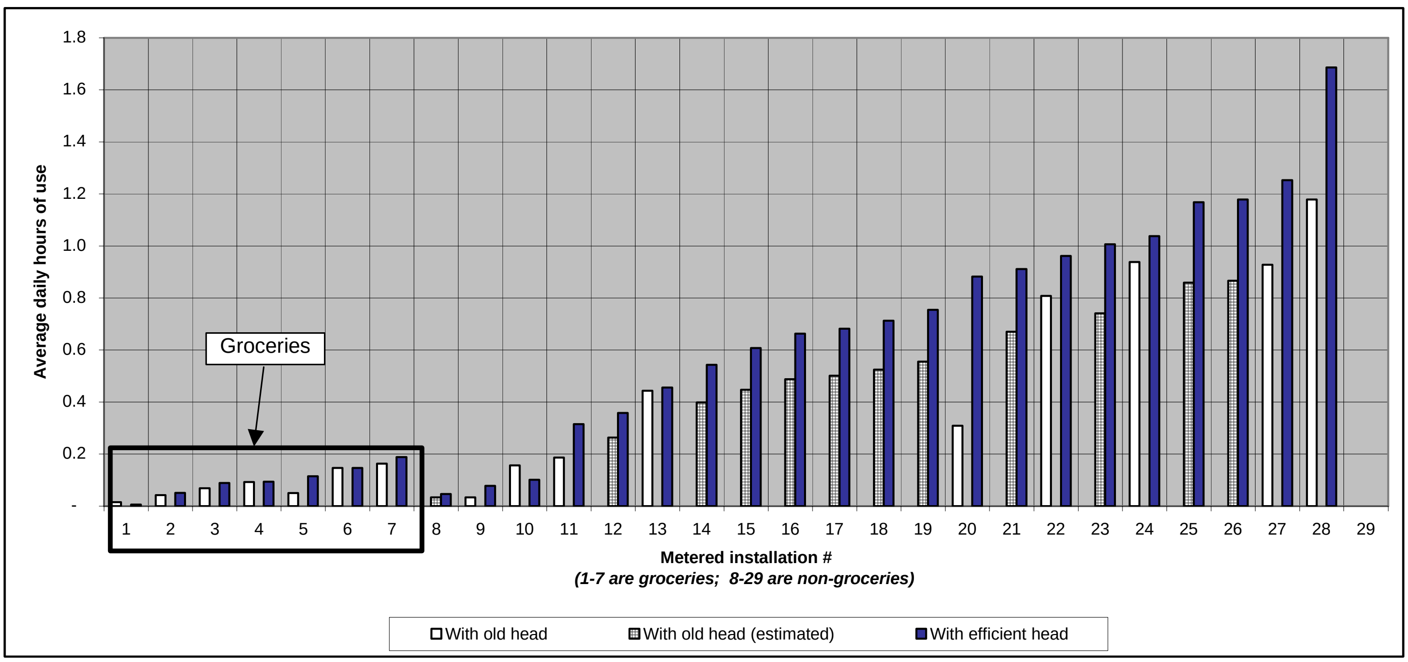
A breakdown of measurement and calculation details for the metered sites can be found in Table 5-1 in the appendix.

Table 3-6: Measured Pre- and Post-Installation Daily Hours of Use

	Sample size			Average daily hours of use		
	# of sampled heads	# with pre-installation data*	# with post-installation data*	Pre-installation	Post-installation (low-flow)	% increase, pre to post
Non-grocery	22	9	21	0.54	0.73	36%
Grocery	7	7	7	0.08	0.10	19%
Program Total	**29**	**16**	**28**	**0.44**	**0.60**	**35%**

* One non-grocery pre data point was eliminated as an outlier. Another non-grocery installation yielded no information because customer removed flow meter.

Figure 3-1: Distribution of Daily Hours of Use at Measured Installations



[7] Tso, B. and Koeller, J. "Pre-Rinse Spray Valve Programs: How Are They Really Doing?" Proceedings of 2006 American Water Works Association Water Sources Conference.

3.4.4 Hot water fuel type

Table 3-7: Distribution of Hot Water Heating Sources

		Water heating source (% of sample)		
Establishment type & Gas Utility	**# of sampled heads with verified heating sources**	Electric	Natural gas	Other**
Non-grocery	**514**	**7.5%**	**89.9%**	**2.5%**
Pacific Gas and Electric	197	3.6%	94.8%	1.7%
SoCalGas	317	10.0%	86.9%	3.1%
Grocery	**99**	**1.5%**	**86.9%**	**11.6%**
Pacific Gas and Electric	39	2.1%	89.2%	8.7%
SoCalGas	60	1.2%	85.4%	13.4%
Program Total*	**613**	**6.4%**	**89.2%**	**4.5%**

* Percentages weighted by verified ratio of grocery to non-grocery establishments.
** Generally, waste heat recovery systems.

Table 3-7 shows the distribution of domestic hot water heating source by utility service territory and establishment type. At some sites, we found that domestic hot water was heated by using waste heat, most often from refrigeration compressors. These sites are identified under the "Other" water heating source. These sites reduced overall program savings, since the energy saved by the efficient spray heads at these sites is secondary energy and so has no appreciable impact on customer utility meters. The percentage of installations with "Other" water heat sources fuel in our sample was surprisingly large.

Additionally, we found a high level of electrically heated domestic hot water. This was surprising, since the program presumably screened these sites out during recruitment. The amount of electric heat was higher in SoGalGas service territory than in PG&E service territory.

3.4.5 Water supply temperatures

Information collected from a variety of water providers throughout the state suggested that a sizeable difference in the average annual water supply temperatures exists between Northern and Southern California. Many northern sources are snowmelt-fed reservoirs, leading to cooler supply temperatures. Table 3-8 lists the supply temperatures that we used to calculate the weighted average cold water supply temperature for the entire population of installed spray heads. We defined each of the water regions based on the availability of annual water supply temperature data from California water utilities (the same approach as was used in the evaluation of Phase 1 of the program). The weighted average of 66.0°F is similar to the corresponding temperature of 66.8°F used in the Phase 1 evaluation. Details of the assignments of temperatures and water regions to participating water utilities can be found in Table 5-3 in the appendix.

Table 3-8: Average Annual Water Supply Temperatures

Water supply region* / Energy utility	# of claimed heads	Average annual temperature (deg F)
Contra Costa	432	64.3
East Bay	2,139	61.0
Sacramento	1,416	56.4
South Bay	2,865	68.0
Southern California	9,802	68.0
Pacific Gas and Electric service territory	6,852	63.2
SoCalGas service territory	9,802	68.0
Program total**	**16,654**	**66.0**

*Defined during evaluation based on water supply temperature data available for Phase 1.
** Water utilities for 28 installations are not known. These were not considered in these calculations.

3.5 Savings per Spray Head

Table 3-9: Evaluated Gross Savings per Spray Head

	UNIT WATER SAVINGS		UNIT ENERGY SAVINGS*		
Building Type	Gallons per day	CCF/year	Gas (therms/year)	Electric (kWh/year)	Average peak kW reduction**
Non-grocery	23.6	11.5	42.0	957	0.218
Grocery	4.0	2.0	5.5	126	0.029
Program Total*	19.1	9.3	26.2	596	0.136

* Based on gas and electric water heating efficiencies of 70% and 90%, respectively. Gas and electric savings are mutually exclusive, so that a valve with gas savings will have no electric savings, and vice versa.
** Based on typical 12 hours/day, 7 days/week operation.

Table 3-9 shows the evaluated gross annual water, gas and electric energy savings per spray head for non-grocery and grocery facilities. Energy savings are expressed both in therms for heads with gas water heating, and in kWh for heads with electric water heating. It is important to note, however, that the gas and electric savings are mutually exclusive, so that a head with gas savings from reduced gas-fired water heating will see no electric savings, and vice versa.

For reasons described in previous sections, the energy savings per head is substantially lower than that seen in the Phase 1 program evaluation. To recap, key factors include:

- Lower pre and post flow rates.
- Overall decrease in daily hours of use.
- Increase in post hours of use compared to pre.
- Decrease in average mixed water temperature.

- Increase in the percentage of grocery establishments where efficient spray heads were installed.
- Significant number of sites using heat recovery from site processes to heat water instead of gas or electricity.

3.6 Other Results

3.6.1 Customer Satisfaction

We developed three customer satisfaction ratings from information collected during the verification process. During the process, site contacts were asked two questions about the efficient spray head. The first was simply a rating of the performance of the spray head on a scale from 1 to 5. The second asked them to compare the rate at which the new head cleans the dishes (or product) to that of the old spray head: faster slower, or the same. The third rating came from comments from the contact about the pressure of the new efficient spray head compared to the old spray head.

Our analysis consisted of counting the responses in each category and then calculating the weighted percentage. The calculations were the same for all three analyses, while the methods for gathering the data was slightly different. The specific data gather methods are described in the sections below. Those that did not respond or responded with “don’t know” were not included in the analysis.

To rate the performance of the spray head the respondents were asked, “On a 1-5 scale how satisfied are you and your coworkers with the performance of the new spray head?” For further clarification the scale was described as 1 for hate the new spray head, 5 for love the new spray head. They were also given an opportunity to explain their answer, which, in part, lead to the pressure ratings in the section below.

It is clear from Table 3-10 below that the majority of respondents was pleased with the performance and gave a rating of 4 or 5. A small minority, about 12%, were unhappy with the performance and gave ratings of 1 or 2.

Table 3-10: Summary of Satisfaction Ratings

Rating	Number of responses	Average % of Total
1 (least satisfied)	11	7%
2	8	5%
3	44	26%
4	45	27%
5 (most satisfied)	58	35%

The speed ratings are derived from the question “Does the new spray head clean dishes faster, slower, or the same as before.” The 153 responses were fairly evenly spread among the three choices. Some 38% indicated “faster,” while 30% thought it cleaned slower having the lowest percentage at 30. The results are shown in Table 3-11 below.

Table 3-11: Summary of Speed Ratings

Rating	Number of responses	Average % of Total
Slower	44	30%
Faster	58	38%
Same	51	32%

Opinions about water pressure ratings were derived from unprompted respondent comments. While there was no specific question about pressure, enough respondents mentioned pressure to warrant looking for a pattern. The number of responses is therefore lower than the ratings in the sections above. Note that "pressure" in this context refers not to the engineering quantity, but the perceived force of the water spray on the object being washed.

As shown in Table 3-12, among those commenting on it, 60% reported the efficient spray valve provided lower pressure and 40% higher pressure. Of course it is worth noting that of 184 respondents, only 35 offered comments about the pressure change. It is also worth mentioning that in some cases higher pressure was noted as a complaint.

Table 3-12: Summary of Pressure Ratings

Rating	Number of responses	Weighted Percentage
Lower	22	60%
Higher	13	40%

3.6.2 Customer Type

Table 3-13: Grocery and Non-Grocery Establishments

	# of sampled heads	Grocery %	Non-Grocery %
Pacific Gas and Electric	257	21.1%	78.9%
SoCalGas	392	20.6%	79.4%
Program Total*	**649**	**20.8%**	**79.2%**

* Excludes 10 supplemental metering sites, which were required to be non-grocery.

Table 3-13 shows the evaluated percentage of the population that consists of groceries. For reasons discussed previously, energy savings in grocery establishments are relatively small. The percentage of groceries appears to be much higher in Phase 2 of the program than it was in Phase 1.

3.6.3 Retention Rates

From field data, we estimated a first-year attrition rate of 10.8%, i.e., if we were able to go back to each installation after a year, we would find about a tenth of the efficient heads no longer there (because the business closed, the head was replaced with a standard variety, the spray head station was remove, and so on). We assumed that this attrition happens at a regular rate, so that the average retention rate for the first year would be one minus half of the first-year attrition rate, or 94.6%.[8]

We found that the spray head was tampered with at one of the 185 sites we initially verified. Since this is less than 1%, we considered the impact of tampering on savings to be negligible.

[8] The Federal Energy Policy Act of 2005 contains minimum-efficiency standards for pre-rinse spray valves, which must have a maximum flow of 1.6 gallons per minute. As a result, it will become more and more difficult for food service establishments to find standard high-flow replacement valves, so this retention rate can be expected to increase as time goes on.

3.6.4 Net-to-Gross Ratio

Specific market share for efficient pre-rinse spray valves in California is not known. In the absence of market data for pre-rinse spray valves, we relied on the opinions of market actors and stakeholders (i.e., manufacturers, program implementers, industry associations, etc.) in estimating market penetration for resource efficient valves. Several estimates of market share for resource efficient spray valves are listed below.

- A program manager estimates that 6% of installed pre-rinse spray valves observed by installers in the field are low-flow models.

- Other program managers and installers estimate that 0% to 20% of installed pre-rinse spray valves are resource efficient.

- A manufacturer of pre-rinse spray valves estimates—based on their pre-program total sales in California and the number of low-flow models sold—that market penetration for pre-program, low-flow valves is 6.7%.

- Another manufacturer—that does not provide low-flow spray valves to the program—indicated that of all the pre-rinse spray valves they sell, 6.7% are low-flow models *("We might sell one low-flow for every 15 standard-flow valves…")*

- Phase 1 of the CUWCC Pre-Rinse Spray Valve Installation Program found that approximately 4% of installed pre-rinse spray valves were low-flow models[9].

For the purpose of calculating a net-to-gross ratio and based on these findings it is reasonable to adopt a 6.7% pre-program market share for low-flow pre-rinse spray valves. While the pre-program market penetration for low-flow valves is 6.7%, freeridership is only 3.8%, because the program is a direct install initiative.

Fisher Manufacturing, the manufacturer holding about 60% of the California market share and the exclusive provider of program installed spray valves, estimated that one-half of their total sales in California after the program began are low-flow models. Roughly 90% of these are low-flow spray valves that were installed by the program. Therefore we calculated freeridership as follows (using annual sales of 100 spray valves for calculation purposes and assuming numbers from Fisher Manufacturing sales as the market):

Table 3-14: Freeridership/Net-to-Gross Ratio Calculation

Total annual sales	100.0
Baseline market share for resource efficient spray valves (6.7%)	6.7
Annual low-flow sales during program (50% of total)	50.0
Portion of low-flow models installed through program (90% of all LF)	45.0
Program induced = total sold (50) – baseline (6.7)	43.3
Freeridership = program installed (45) – program induced (43.3)	1.7

Freeridership is simply the percent of program installed low-flow pre-rinse spray valves that would have been installed regardless of program intervention, or 3.8%.

[9] California Urban Water Conservation Council, *Potential Best Management Practices,* 2004.

<u>Free riders (1.7)</u>
Program Installed (45)

Freeridership is not equal to pre-program naturally occurring sales (market share) of low-flow pre-rinse spray valves, because of the direct installation nature of the program. Facilities with low-flow models currently installed are not eligible for participation. Freeridership would have been larger had the program relied on a rebate intervention strategy—and the net-to-gross ratio would have been lower—because current users of low-flow models would likely have had the opportunity to participate by submitting rebates on replacement valves.

The net-to-gross ratio is that portion of program installed spray valves that were truly induced by the program (not including those valves that would have been installed regardless of program intervention) or 0.962.

<u>Program Induced (43.3)</u>
Program Installed (45)

Both manufacturers interviewed agree that the program has had a positive affect on either the market or their internal efforts to sell low-flow products, which would not have taken place if the program had not been implemented.

<u>Interview Quotes</u>

> *Manufacturer: There would have been little increase in market penetration without the program. Word of mouth and satisfaction with low-flow through the program will increase market penetration.*
>
> *Manufacturer: It did not have a direct effect on our sales. However, it has caused us to change (develop a 1.2 GPM product) and market low-flow. It is hard to tell what impact it has had, because we just made the change in September of 2004.*

3.6.5 Effective Useful Life

According to evaluation survey respondents (manufacturers and distributors), the useful life of a pre-rinse spray valve ranges from one to 10 years, and there is no difference in life between resource efficient spray valves and standard spray valves. It has been estimated that the typical life expectance is five years. It has also been estimated that 90,000 to 110,000 hot water pre-rinse spray valves are installed in California. For the purposes of this study we have assumed that 100,000 pre-rinse spray valves are installed in California. Given the number of spray valves installed and a typical useful life expectance of five years, approximately 20,000 spray valves would be replaced each year. However, Fisher Manufacturing—a pre-rinse spray valve manufacturer that estimates they hold about 60% market share in the Western United States —estimates that they sell approximately 30,000 pre-rinse spray valves in California each year. This level of sales has remained consistent at least since 2002. If Fisher truly enjoys a 60% market share and sells 30,000 valves in California each year, total sales would be closer to 50,000 (30,000/60%) pre-rinse spray valves each year in California, indicating that every two years the inventory of pre-rinse spray valves installed in California is replaced. Note, however, that a high degree of uncertainty surrounds this estimate of effective useful life, and that further investigation would be required to confirm or refute it.

Although we suspect that the effective useful life of the average spray head is less than five years, and the process evaluation information points in this direction as well, we felt we did not have a strong enough case to warrant replacing the five-year estimate with a different figure.

3.7 Program and Utility Energy Savings

Tables 3-15 and 3-16 show the final evaluated program and unit saving, respectively, incorporating the results discussed above. Overall, the program yielded first-year net savings of about 459,000 therms and electric savings of 846,000 kWh. This translates into average net savings per claimed head of about 28 therms/year, 51 kWh/year, and 18 gallons per day (9 CCF/year).

Table 3-17 compares the evaluated results with the program goals and claims. We found that the program installed 66% of its goal, but only achieved 6% of its gas savings goal.

Table 3-15: Final Evaluated Program Savings

		Total annual savings			
		Water (CCF)	Gas (therms)	Electricity (kWh)	Demand (average peak kW)
Pacific Gas and Electric	Gross	54,359	198,472	168,142	38.4
	Net	**52,293**	**190,930**	**161,753**	**36.9**
SoCalGas	Gross	93,513	278,802	711,771	162.5
	Net	**89,960**	**268,208**	**684,724**	**156.3**
Program Total	Gross	147,872	477,274	879,913	200.9
	Net	**142,253**	**459,138**	**846,476**	**193.3**

Table 3-16: Final Evaluated Savings per Claimed Head

	Annual net savings per claimed head				
	Water (CCF)	Water (gallons/day)	Gas (therms)	Electricity (kWh)	Demand (average peak kW)
Non grocery	10.3	21.1	33.6	63.6	14.5
Grocery	1.8	3.6	4.3	1.7	0.4
Program Total	**8.5**	**17.5**	**27.5**	**50.7**	**11.6**

Table 3-17: Program Goals Compared with Evaluated Results

Gas Utility	Program goals	Program claim	Evaluated finding	Evaluated as % of goal	Evaluated as % of claim
# of spray heads					
Pacific Gas and Electric	7,463	6,048	6,048	81.0%	100.0%
SoCalGas	17,237	10,634	10,347	60.0%	97.3%
Program Total	**24,700**	**16,682**	**16,395**	**66.4%**	**98.3%**
Net gas savings (therms/year)					
Pacific Gas and Electric	2,500,105	2,026,080	190,930	7.6%	9.4%
SoCalGas	5,774,395	3,562,390	268,208	4.6%	7.5%
Program Total	**8,274,500**	**5,588,470**	**459,138**	**5.5%**	**8.2%**

Table 3-18: Evaluated PG&E Savings over 20 Years

PG&E Program Energy Impact Reporting for 2004-2005 Programs

Program ID*: 1198-04
Program Name: PHASE 2 OF CUWCC PRE-RINSE SPRAY VALVE INSTALLATION PROGRAM

Year	Calendar Year	Ex-ante Gross Program-Projected Program MWh Savings (1)	Ex-Post Net Evaluation Confirmed Program MWh Savings (2)	Ex-Ante Gross Program-Projected Peak Program MW Savings (1**)	Ex-Post Evaluation Projected Peak MW Savings (2**)	Ex-Ante Gross Program-Projected Program Therm Savings (1)	Ex-Post Net Evaluation Confirmed Program Therm Savings (2)
1	2004	0		0		2,500,105	
2	2005	0	162	0	0.037	2,500,105	190,930
3	2006	0	159	0	0.036	2,500,105	187,111
4	2007	0	155	0	0.035	2,500,105	183,369
5	2008	0	152	0	0.035	2,500,105	179,701
6	2009		149		0.034		176,107
7	2010						
8	2011						
9	2012						
10	2013						
11	2014						
12	2015						
13	2016						
14	2017						
15	2018						
16	2019						
17	2020						
18	2021						
19	2022						
20	2023						
TOTAL	**2004-2023**	0	777			12,500,525	917,218

Definition of Peak MW as used in this evaluation: Average demand reduction between 12p-7p M-F.
Assumed nominal attrition rate from second year on of 2.0%
1. Gross Program-Projected savings are those savings projected by the program before NTG adjustments.
2. Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

Table 3-19: Evaluated SoCalGas Savings over 20 Years

SCG Program Energy Impact Reporting for 2004-2005 Programs

Electric savings accrue to SoCal Edison and other electric utilities.

Electric savings accrue to SoCal Edison and other electric utilities.

Program ID*: 1200-04
Program Name: PHASE 2 OF CUWCC PRE-RINSE SPRAY VALVE INSTALLATION PROGRAM

Year	Calendar Year	Ex-ante Gross Program-Projected Program MWh Savings (1)	Ex-Post Net Evaluation Confirmed Program MWh Savings (2)	Ex-Ante Gross Program-Projected Peak Program MW Savings (1**)	Ex-Post Evaluation Projected Peak MW Savings (2**)	Ex-Ante Gross Program-Projected Program Therm Savings (1)	Ex-Post Net Evaluation Confirmed Program Therm Savings (2)
1	2004	0		0		5,774,395	
2	2005	0	685	0	0.156	5,774,395	268,208
3	2006	0	671	0	0.153	5,774,395	262,844
4	2007	0	658	0	0.150	5,774,395	257,587
5	2008	0	644	0	0.147	5,774,395	252,435
6	2009		632		0.144		247,386
7	2010						
8	2011						
9	2012						
10	2013						
11	2014						
12	2015						
13	2016						
14	2017						
15	2018						
16	2019						
17	2020						
18	2021						
19	2022						
20	2023						
TOTAL	**2004-2023**	0	3,289			28,871,975	1,288,460

Definition of Peak MW as used in this evaluation: Average demand reduction between 12p-7p M-F.
Assumed nominal attrition rate from second year on of 2.0%
1. Gross Program-Projected savings are those savings projected by the program before NTG adjustments.
2. Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

Table 3-20: Evaluated Program Savings over 20 Years

Sum Of Energy Impacts for This 2004-2005 Program

2004-2005 form

Program IDs*: 1198-04 & 1200-04

Program Name: PHASE 2 OF CUWCC PRE-RINSE SPRAY VALVE INSTALLATION PROGRAM

Year	Calendar Year	Ex-ante Gross Program-Projected Program MWh Savings (1)	Ex-Post Net Evaluation Confirmed Program MWh Savings (2)	Ex-Ante Gross Program-Projected Peak Program MW Savings (1**)	Ex-Post Evaluation Projected Peak MW Savings (2**)	Ex-Ante Gross Program-Projected Program Therm Savings (1)	Ex-Post Net Evaluation Confirmed Program Therm Savings (2)
1	2004	0	0	0	0.000	8,274,500	-
2	2005	0	846	0	0.193	8,274,500	459,138
3	2006	0	830	0	0.189	8,274,500	449,955
4	2007	0	813	0	0.186	8,274,500	440,956
5	2008	0	797	0	0.182	8,274,500	432,137
6	2009		781		0.178		423,494
7	2010						
8	2011						
9	2012						
10	2013						
11	2014						
12	2015						
13	2016						
14	2017						
15	2018						
16	2019						
17	2020						
18	2021						
19	2022						
20	2023						
TOTAL	**2004-2023**	0	4,066	0	0	41,372,500	2,205,678

Definition of Peak MW as used in this evaluation: Average demand reduction between 12p-7p M-F.

Assumed nominal attrition rate from second year on of 2.0%

1. Gross Program-Projected savings are those savings projected by the program before NTG adjustments.
2. Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

3.8 Program Cost-effectiveness

We updated the PIP workbook to include evaluation findings summarized in Tables 3-15 and 3-16, as well as final program costs. The cost-effectiveness modeling showed that TRC benefit-cost ratios are much lower than the proposed 7.50. Although the program costs were lower because of fewer spray heads were installed than planned, the significantly lower unit savings resulted in benefit-cost ratios of 0.80 for PG&E and 0.73 for SoCalGas.

Table 3-21: Benefit-Cost Ratios

Total Resource Cost (TRC) test parameter	**PG&E**		**SoCalGas**		**Combined**	
	Program proposal	Evaluated	Program proposal	Evaluated	Program proposal	Evaluated
Costs (1)	$897,635	**726,322**	$2,073,088	**$1,388,428**	$2,970,723	**$2,114,751**
TRC Costs (1,2)	$666,281	**$537,625**	$1,538,740	**$1,052,791**	$2,205,021	**$1,590,417**
TRC Benefits	$4,997,275	**$427,627**	$11,542,011	**$730,791**	$16,539,286	**$1,158,418**
TRC Net Benefits	$4,330,994	**($109,998)**	$10,003,271	**($322,000)**	$14,334,265	**($431,999)**
TRC Ratio	7.50	**0.80**	7.50	**0.69**	7.50	**0.73**

Notes
1. Evaluated costs include final EM&V expenditures.
2. Costs, less water agency contributions.

3.9 Process Findings

The findings from the process evaluation are presented below, broken out into the following subsections:

- Market barriers
- Implementation challenges
- Perceptions of efficient spray valves
- Program strengths
- Program weaknesses
- Program improvements
- Follow-up investigation (quality control issues)

3.9.1 Implementation Challenges

Table 3-22: Hurdles to securing program participation

Response	Number of Respondents
Language barriers	6
Corporate approval requirements	2
Skeptical/Suspicious prospective participants	2
Large geographical area covered by individual installers	1
Busy prospective participants	1

- By far the greatest challenge program implementers faced is language barrier. Installers were often faced with presenting the program to restaurant managers/employees that either did not speak English or spoke only broken English. Asian and Hispanic dialects are the most common languages barriers to overcome.

- Corporate approval is occasionally presented as an obstacle for program implementers in getting immediate consent to install resource efficient spray valves.

- Some prospective participants are suspicious of the program, because the service and equipment are provided free of charge. They feel like there has to be a catch.

<u>Interview Quotes</u>

Program Manager: Some restaurants want corporate approval. That takes additional time and installers have to go back to establishment to install valves later.

Installer: …The process has a learning curve. We deal with thousands of places…the biggest problem is the language barrier. There is a big Asian population in California and there are often Latinos in the kitchen.

Installer: In San Diego, you can run into a language problem. There are a number of Hispanic people as well as other nationalities…Sometimes the person you are talking with may even pretend that they don't understand to avoid a sales pitch.

- Letters of referral from water authorities, utilities, or the state will provide program installers with credibility to overcome prospective participants' skeptical or suspicious positions regarding the "free" resource efficient spray valve.
- It may be difficult to recruit and hire multilingual program installers and match those installers to specific communities, although this would help overcome the language barrier. Providing multilingual marketing materials and program printed materials will assist in overcoming this hurdle.

Table 3-23: Overcoming hurdles to securing program participation

Response	Number of Respondents
Provide referral letter(s)	2
Provide multilingual marketing material	2
Hire multilingual installers	1
Match installers to community	1
Pre-qualify corporate locations	1
Remove maximum installation limits	1
Time site visits appropriately	1

Interview Quotes

Program Manager: Phase 2 has developed bilingual marketing materials and some of the installers are bilingual…The water agencies have provided letters indicating that the program is legitimate and encourage participation. Installers carry these letters with them to show restaurant owners.

Installer: Provide brochures that are bilingual…I carry them with me…They help if someone does not understand English very well.

The general process has not changed much from Phase 1 to Phase 2.

- Program implementers are having a more difficult time finding qualified program participants, because of Phase 1 successes.
- Many of the prospects requiring little recruiting effort were approaching during Phase 1, leaving tier two prospects—those less likely to participate—for Phase 2 recruiting.
- The program implementer has experienced significant turnover in installers and some turnover in supervisory staff, further affecting Phase 2 participant recruiting.

Interview Quotes

Program Manager: The general process is the same…Based upon some client concerns with a "free" product, we did add a line in the statement that a client would never be charged for the valve installed.

Program Manager: "Cream skimming" in Phase 1 makes installations more difficult…Market penetration from Phase 1 leaves less territory to cover…we have had a big turnover in installers and also some turnover in supervisory staff…so we fell behind on installations.

3.9.2 Perceptions of Efficient Spray Valves

- Poor performance perception is noted most often as the reason restaurant owners install standard pre-rinse spray valves instead of resource efficient valves. Poor experiences with other water saving fixtures have influenced these perceptions.

- Limited access to resource efficient spray valves through suppliers and maintenance contracts on leased equipment are barriers for restaurant owners/managers to install resource efficient pre-rinse spray valves.

Table 3-24: Installation of standard valve over low-flow valve

Response	**Number of Respondents**
Performance perceptions	6
Availability	3
Maintenance contracts	2
Skeptical of free product	1

Interview Quotes

Program Manager: Poor performance perceptions. They are suspicious of "free" items. Restaurants get free valves from dishwasher owners. About 50 percent of sites visited are receptive to installation of low-flow valves. Reasons that they are not installed in other facilities are: 6% of the time low-flow valves already exist; 32% of the time there is no spray valve assembly in the establishment; 13% of the time management is not available; and 3% of the time the site is not open.

Program Manager: It is easier to find standard valves…There are some poor performance perceptions and some restaurants rent equipment and the leaser just changes out the valves for them as needed…I don't think that they are more expensive than standard valves.

Program Manager: They don't know about the new valves…The spray pattern is different and they are unwilling to try something new. The demonstration installers do is really important, it shows them that valves work better…They are concerned about performance. They have tried energy efficient toilets and showerheads and know that they don't work as well…They lease their equipment and valves are replaced by the leaser.

> *Installer: I don't know the retail price, but think they are comparable in price. Some restaurant owners are at the mercy of the plumber or the restaurant supply store. They may only stock the standard valves…Restaurant owners feel that the standard valves clean a little better.*
>
> *Installer: There are poor performance perceptions. They have tried low flow showerheads or low flow toilets and didn't like them.*

- Few restaurant owners/managers are aware that resource efficient pre-rinse spray valves are available. Program installers estimate that only 5 to 25 percent of the restaurant operators they approach are aware of these valves prior to receiving the program information.

- Of those restaurant operators that were aware of resource efficient pre-rinse spray valves, but had standard valves installed, poor performance is the reason cited for using standard pre-rinse spray valves instead of low-flow models.

Interview Quotes

> *Installer: About 5 percent of the establishments I visited had gotten a flyer about the program. Some already had low flow, while others had tried low flow valves before and had poor performance experiences. I try not to use the term "low flow" as it conjures up poor performance thoughts.*
>
> *Manufacturer: The low-flow cost more and perceptions are that low-flow won't work as well. People have had negative experience with low-flow showerheads and toilets. They think that if it is promoted as a conservation item, it won't be as good.*
>
> *Manufacturer: We didn't actively start marketing low-flow valves until Sept 2004. We developed low-flow valves in the 80's but they never really took off. The perception in the market was that low-flow was weak flow. We might sell one low-flow for every 15 standard-flow valves. We've had a tremendous market with the standard-flow, so we didn't really need to market low-flow. It wasn't that important to be environmentally friendly in the past. Now water conservation has become a big issue.*
>
> *Distributor: The perception is that the low-flow doesn't clean as well. The spray isn't as strong as it is in a standard valve and it doesn't get the dishes clean.*

- Restaurant operators accept the program with mixed reactions with some being open to the technology and others being skeptical of the free product.

Interview Quotes

Installer: Any program that is free causes some scrutiny…Most business owners are accepting.

Installer: It can go either way. If the restaurant operator is either environmentally oriented or budget conscious, they will be easy to convince. Other operators are harder to convince.

- Poor performance perceptions and skepticism/suspicion about the program are the primary reasons prospective program participants decline to have the resource efficient pre-rinse spray valves installed.

Table 3-25: Reasons for declining to participate in the program

Response	Number of Respondents
Poor performance perceptions	2
Skeptical of free product	2
Suspicious of the program	2
Installer specific	1

Interview Quotes

Program Manager: Less than 1% decline to participate. Reasons for non-participation are they don't believe it is free or they are suspicious of motives.

Installer: Restaurant operators have a mindset about water savers like toilets and showerheads. There is a mentality that water conservation devices do not work as well.

3.9.3 Program Strengths

Ease of participation is mentioned most often as the greatest strength of the program. Participants need only agree to installation of the resource efficient spray valve—there is no paperwork for participants to complete, no rebates to collect, etc. See Table 3-26 for a list of other program strengths.

Table 3-26: Program strengths

Response	Number of Respondents
Ease of participation	5
Free equipment	4
Significant savings	3
Quality product	2
Multi-resource benefit	2
Targets hard to find markets	1
Direct install	1

Interview Quotes

Program Manager: It targets a market that normally doesn't have access or take advantage of efficiency programs. Its ease of use…there are no forms to fill out and the environmental aspect of the program…saves energy, water, and sewer.

Program Manager: I have been in program implementation for 18 years and it is the best program that I have ever worked on. Savings are so significant that you can afford to do the program right. Restaurant owners are not typically involved in analyzing what is best. This is done for them…We canvass the territory, which is a very thorough approach...The product is described, installed, and tested the same day.

Manufacturer: Honeywell goes door to door and installs low-flow spray valves…It is a direct install rather than a rebate format. It is free and a good product.

> *Installer: It is an amazing program…totally free to the restaurant. I appreciate the flexible hours for installers. It is awesome. You walk into a restaurant, install the valve, and leave.*
>
> *Installer: It is easy, free, and straightforward for the restaurant operator*

3.9.4 Program Weaknesses

The program weakness most often mentioned (by program managers and installers) is the gas water heater limitation. Respondents indicate that there would be much more participation if establishments with electric water heaters were eligible for participation. See Table 3-27 for a list of other program weaknesses mentioned by respondents.

Table 3-27: Program weaknesses

Response	**Number of Respondents**
Limited to gas water heaters	4
Favors one manufacturer	1
Limited market effects	1
Skeptical respondents	1
Limited number per site	1
Limited water district participation	1
Lost distributor sales	1

Interview Quotes

> *Program Manager: Will there be market transformation? I am concerned that they may not continue to use low-flow when valve needs to be replaced.*
>
> *Program Manager: It is FREE: Because it is free, people think that there is a catch to it.*
>
> *Manufacturer: The program hands out valves free, which is fantastic. However, the business owners are not contacted ahead of time. They have no choice in what kind of valve to install. They have to put in Fisher equipment. Equipment dealers have lost sales due to the program free installation. Some have also lost replacement business. Since all valves that are put in free are Fisher, dealers who previously sold another brand of valve have now lost an opportunity to replace the valves in the future.*
>
> *Installer: Because funding comes from natural gas money, we can't do restaurants with electric hot water heaters. It is an incentive based program and installer gets paid for installing valves. We visit a restaurant and spend time with a customer only to find out that they have electric hot water heating.*

3.9.5 Program Improvements

When program managers and installers were specifically asked how program participation could be improved, few consistent responses were offered. Instead a number of individual suggestions were made including provide additional incentives, include establishments with electric water heaters, pre-qualify participants, etc. (see Table 7).

Table 3-28: Suggestions for improving participation

Response	**Number of Respondents**
Additional incentives	1
Include electric water heaters	1
Pre-qualify participants	1
Emphasize environmental benefits	1
Referrals	1

Interview Quotes

Program Manager: Get lists of potential participants from water agencies. Get lists of commercial, institutional, or industrial participants from PG&E. Do some mailings or telemarketing. It is becoming more cumbersome to find clients because more valves are installed and there is a lack of remaining sites…maybe use SIC codes to identify potential sites.

Installer: Expand the program to include electric hot water heater establishments. Provide materials from a credible source that could be handed out to the customer

When respondents were asked how the program could be improved including sites with electric water heaters and promoting the program through marketing were mentioned by more than one respondent as ways to improve the program. See Table 3-29 for a list of other suggestions for improving the program.

Table 3-29: Suggestions for program improvements

Response	Number of Respondents
Include sites with electric water heaters	3
Promote through marketing	2
Better training for installers	1
Bid for products installed	1
Get dishwasher manufacturer participation	1
Legislate low-flow valves	1
Get maintenance contractor participation	1

Interview Quotes

Program Manager: The design is good. There was probably some "cream skimming" in the first phase, which is making it harder to complete the installations required in the second phase. In 90% of the restaurants, owners do not own the dishwasher. Sometimes the dishwasher owners replace spray valves for them, so the "free" low-flow valve isn't such an attractive benefit.

Program Manager: Open it up and allow restaurants with electric hot water heaters to participate. Some restaurants that put in low-flow valves in Phase 1 are now back to standard valves. Lots of restaurants have maintenance contracts. The maintenance company comes in regularly to check operation of equipment and may replace the valves if they are dirty or something. The replacement valves will probably be standard valves. The restaurant operator may or may not know that the valves have been changed from low-flow back to standard.

Manufacturer: Purchasing for the program should go out on bids annually so that T & S would have an opportunity to bid on it. There should be more advertising within the food service industry. Only about 10% of California food service businesses are aware of the program.

Installer: Quality of the installers is important. The better the installer, the more success you have in the program. It is important to have installers who are well trained. A little more marketing on the part of the Water Authority would be helpful. I don't get very many referrals from them.

Installer: Let restaurants with electric hot water heaters participate too. The relationship between the customer and the installer is crucial. The Public Service Commission sent out a notice about the program…that helps installers convince the restaurant operators to participate

3.9.6 Follow-Up Investigation (Quality Control Issues)

This portion of the process evaluation focused on determining the causes for the breakdown in quality control procedures that resulted in discrepancies between reported and actual spray head installations. These findings provided below discuss implementer policies, address where these policies and procedural failed, and provide conclusions and recommendations for preventing future breakdowns.

3.9.6.1 Implementer Policies

A. Compensation

Installers were compensated for their performance with a base hourly wage and tiered incentive for each low flow pre-rinse spray valve installed. This basic structure has been in place from the beginning of the program through the current phase of the program (Phase 3). However, as markets became more saturated, program administrators revised the base and incentive amounts. These adjustments served two primary purposes. First, it became more difficult for installers to solicit participation, so base pay increased to compensate for considerable effort in participation prospecting. Second, incentive payments increased to reward installers for securing participation. These incentives were paid out on a tiered system to reward installers as they install additional low flow valves throughout the week. For example, installers may receive zero incentive for the first three valves installed, $20 per valve for the next four valves installed, and $30 per valve for the next four valves installed. In order to reach the $30 incentive the installer first needs to install seven valves within the week.

The bulk of field supervisor compensation was base pay, but they did received nominal incentive for additional valve installations.

B. Installer Training

Installers received one day of classroom training prior to entering the field. This training session concentrated more on policies, procedures, and paperwork than installation and prospecting for participants, but they did receive instruction on identifying different valve models. After completing the one-day classroom training new installers were matched with veteran installers and sent to the field. In the field they observed the veteran installer and learned most of the hands on requirements. The period of time that new installers spent with a veteran was dependent upon their ability to grasp the concepts and skills necessary to perform their job adequately. Once they and the field supervisor were comfortable with their performance, they began operating on their own.

Phase 3 training follows a very similar training format, but it appears that the classroom instruction covers more of the installation process than Phase 2.

C. Quality Control

The following procedures were in place and clearly communicated to installers through the training they received.

1. On a weekly basis, Installers turned over two documents—work orders for valves installed and their canvass log. These documents were faxed into the main office where the data entry task was completed.

    a. Work Orders—Installers completed a work order for all low flow valves installed.

    b. Canvass log—The canvass log basically served as their time card and activity log. They recorded their activity throughout the day including sites approached, participation, and other activity.

2. There were clearly defined procedures for handling the old valves removed.

    a. Old standard flow valves removed from participant locations were to be placed into a plastic bag and appropriately labeled.

    b. Procedure stated that these were then to be reconciled to installers' original work orders on a weekly basis. If the installer was in close proximity to the main office, they would meet in-person with the field supervisor. If their location was not within reasonable distance, they would mail their old valves and the original paperwork to the office for reconciliation.

    c. During valve reconciliation, original work orders were matched to labeled valves one-for-one. Once reconciled, valves were boxed by the installer and field supervisor and then secured in a storage facility by the field supervisor.

    d. Old valves were retained in storage for an extended period of time. One reason for this extended storage was so participants dissatisfied with the low flow model could get their original valve back.

3. It appears that installers were paid based on work orders submitted for data entry, before they were reconciled with the old valves. The program implementers also claimed program credit at the time of data entry.

4. Initially there were two primary methods by which program implementers ensured quality control.

    a. Telephone or site verification for all instances in which a standard flow valve was not presented at reconciliation.

    b. Random telephone and field verification on all installations. Initially 4 percent of all valves were reconciled either by phone or on site. In November of 2006, after serious discrepancies were discovered, this was increased to 5 percent and conducted on site.

D. Exclusion of Groceries

According to the project managers, the Phase 2 program was not supposed to be installing spray valves in groceries, since it was known to them that groceries yielded negligible savings and that the highest savings were to be found in true "dishwashing pre-rinse" applications. Nonetheless, the program database shows that program installers replaced spray heads at groceries all the way up to the end of the program. Evaluation fieldwork confirmed this was the case. So clearly a disconnect existed in the program process: either the program managers did not convey this restriction clearly to the program implementer, or the program implementer ignored it, or the program installers ignored it, or some combination of factors.

From a process standpoint, the other breakdowns in control that are described below make it easy to speculate that additional indiscretions might have occurred. Grocery installations might have presented especially appealing targets because each site typically contains numerous valves. This would be especially true as market penetration increased, and prospective participants became scarcer. The lack of procedural control that allowed some installers to defraud the program early on would certainly have permitted installations in ineligible establishments, such as groceries. All in all, the only thing that can be said without further exploration of how well the installers understood they were not supposed to install in groceries is that the procedural breakdowns in the program made it susceptible to "gamesmanship."

3.9.6.2 Policy and Procedure Failures

Respondents speculate on exactly how the dishonest installers completed the fraudulent activity and point out several procedurals failures that allowed the fraud to take place. In some cases these comments are speculation on the part of respondents. They do agree that if procedures that had been put is place were followed, the fraudulent activity would have either never happened or been discovered quickly.

A. Lack of Internal Control Enforcement

A complete lack of internal control made it possible for dishonest installers to take advantage of the system. It was simply a matter of not following procedures. Project managers and field supervisors did not truly reconciling old valves. The procedures were not being followed at different level of operation, which voided the checks and balances that were put in place. The checks and balance procedures were in place, but because of the multi-level procedural failure discrepancies were not discovered.

B. Lack of Valve Reconciliation

Valve reconciliation would have signaled potential issues, but the lack of consistent reconciliation allowed individuals to fraud the system. Periodically old valves were to be reconciled to work orders, but the weekly schedule requirement was not maintained by all field supervisors. Reconciliation of old valves to work orders was not routinely completed or not thorough. When reconciliation reports were not submitted to management as required, management did not follow through appropriately.

C. Inventory Control

There is speculation that individuals involved in the fraud could have simply accessed old valves in an attempt to show additional installations. Access to these supplies of old valves was not as secure as it should have been. Respondents **speculate** that:

1. Old valves may have never even been logged, which could have been a product of limited reconciliation or a simple failure on the field supervisor's part to follow procedure. They could have been recycled as new installations.

2. Old valves were somehow removed from storage after reconciliation and then sent back through the system representing new installations.

3. Dishonest installers secured a source of standard valves they represented as removed from participant properties. (This scenario is unlikely since these valves would have eventually made it to storage and been presented upon request to the evaluation team.)

D. Limited Verification Procedures

It appears the program implementer spent limited effort verifying valve installations until after the significant discrepancies were discovered. There is some indication (based on comments from one respondent who was an installer during Phase 2) that installers were lead to believe that a significant portion of their installations was verified by phone. Had this been the actual practice, the falsified installations would likely have been discovered sooner. As indicated above only 4% of installations were verified.

E. Inconsistent Application of Procedures

The interview with the Phase 2 installer revealed additional inconsistent application of procedures. This installer worked under the impression that he did not receive incentive payments until after old valves were reconciled to work orders.

F. Limited Feedback Mechanism

One respondent said that after discrepancies had been discovered, data entry personnel mentioned they had noticed suspect activity. Their suspicions were never brought to the attention of management.

G. Potential Contributing Factors

1. Program management was overwhelmed with limited availability. Had there been more management available to spend time face-to-face, problems may have been averted. The lack of visibility may have contributed to individuals feeling like they could get away with fraudulent behavior.

2. At least part of the administrative team was staffed by temp employees, which may have limited their loyalty.

3.9.6.3 Conclusions and Recommendations

The compensation format stimulates an environment in which installer income becomes dependent on incentive payments. The considerable incentives paid and tiered system create pressure on installers to show additional installations. If they are short installs, they are motivated to find ways in which they can show additional installs to secure next tier incentives. The incentive structure was set up in a way that prompted individuals to look for ways to skirt the system.

Saturated markets make it increasingly difficult for installers to maintain compensation levels. Installers become accustom to high levels of compensation during early stages of the program—program prospects are abundant and securing participation is easy. Compensation drops as it becomes increasingly difficult to secure installations.

Expectations and compensation policies needed to be adjusted as markets change in order to award effort as well as results. There is a fine balance between motivating installers to secure additional participation while providing fair compensation for effort. Once that becomes imbalanced, the potential for negative behaviors increase.

Incentive compensation should be paid and program credit should be applied only after old valves are reconciled with work orders. Strict adherence to the reconciliation process would have, at least, identified discrepancies more quickly. Given the lack of reconciliation, dishonest installers discovered an opportunity to fraud the program by claiming installations, knowing that their field supervisor would not be asking for the old valves to reconcile.

Retain old valves for a limited period of time and then recycle. If participants are not satisfied with the low flow model and their old valve had been reclaimed, provide a suitable substitute.

Stored valves must be sealed and secured in a manner that limits access to few individuals with checks and balances on those individuals.

Improve verification policies. Confirm installations through true random sampling at a level that is statistically sound. Telephone interviews could be presented—as they are in Phase 3—as customer satisfaction calls rather than verification. It would be advisable to contract verification to an independent third party if limited budgets are adequate. Continue on-site verification for all unconfirmed telephone attempts as well as 5% randomly selected sites.

Build in multiple layers of reconciliation and hold each level responsible for fulfilling requirements. Build in mechanisms throughout the process for any employee to point out discrepancies or instances in which suspect activity occurs. Ensure that all employees understand the quality control procedures and that they are being monitored.

Ensure there is adequate program management including increased visibility with field staff.

Standardize Program QC—Rather than allowing program implementers to define QC procedures, program stakeholder need to formulate standard templates that can be used for different programs, especially direct install programs. Program stakeholders should define the checks and balances and take a more active role in the system.

4. Conclusions

The impact portion of our evaluation showed that Phase 2 of the CUWCC Pre-Rinse Spray Head Distribution Program is providing energy savings to the State of California, although far less than originally expected. These savings are on the order of 459,000 therms of natural gas and 846,000 kilowatt-hours of electricity annually. As a result, the revised TRC benefit-cost ratios for both the PG&E and SoCalGas portions are 0.80 and 0.69, respectively. Since a value higher than one (1) denotes cost-effectiveness, this leads us to conclude that Phase 2 of program was not cost-effective. This is a particularly surprising conclusion, since the evaluation of Phase 1 of this program showed that phase to be highly cost-effective. A wide variety of disparate factors, however, conspired to reduce the Phase 2 unit savings per spray head from the Phase 1 results. These included:

A. Over 20% of the installations occurring at groceries, which generally have minimal spray head use.

B. Program implementer quality control issues, which led to slightly fewer heads being installed than were claimed.

C. More rigorous evaluation methodology in Phase 2 that made significant downward adjustments to savings for non-gas water heating and the increased spray head use with efficient heads. The improved methodology also showed that the pre flowrates obtained from lab tests and the mixed water temperatures provided by the program implementer in the Phase 1 evaluation may have been inaccurate, resulting in savings being overstated.

The process portion of our evaluation revealed these key findings:

D. By far the greatest challenge program implementers faced is language barriers. Installers were often faced with presenting the program to restaurant managers/employees that either did not speak English or only broken English. Asian and Hispanic dialects are the most common language barriers to overcome.

E. It may be difficult to recruit and hire multilingual program installers and match those installers to specific communities, although this would help overcome the language barrier. Providing multilingual marketing materials and program printed materials will assist in overcoming this hurdle.

F. Some prospective participants are suspicious of the program, because the service and equipment are provided free of charge. They feel like there has to be a catch.

G. Letters of referral from water authorities, utilities, or the state will provide program installers with credibility to overcome prospective participants' skeptical or suspicious positions regarding the "free" resource efficient spray valve.

H. Poor performance perceptions are noted most often as the reason restaurant owners install standard pre-rinse spray valves instead of resource efficient valves. Poor experiences with other water saving fixtures have influenced these perceptions.

I. Limited access to resource efficient spray valves through suppliers and maintenance contracts on leased equipment remove the option for restaurant owners/managers to install resource efficient pre-rinse spray valves.

J. Few restaurant owners/managers are aware that resource efficient pre-rinse spray valves are available. Program installers estimate that only 5 to 25 percent of the restaurant operators they approach are aware of these valves prior to receiving the program information.

K. Ease of participation is mentioned most often as the greatest strength of the program. Participants need only agree to the installation of the resource efficient spray valve—there is no paperwork for participants to complete, no rebates to collect, etc.

Recommendations

Several possibilities exist for future programs to address the low cost-effectiveness from an energy perspective.

1. Aggressively limit installations to those likely to yield highest energy savings (that is, sites that have high hours of spray head use and employ warm water for pre-rinsing). According to program managers, such steps have already been taken in the Phase 3 program.

2. Find practical ways to reduce the cost per installed valve ($129/ valve in the Phase 2 program, of which $97/valve was included in the TRC benefit-cost calculation) through operational efficiencies.

3. Reexamine the allocation of program costs between the water utilities and energy utilities (through the California public goods charges). If energy entities are paying a disproportionately high portion of the overall program cost, this could drive down the energy benefit-cost ratio.

In addition, we recommend a number of changes to future programs to prevent breakdowns in the quality control procedures governing installers.

11. Revise the installer compensation format. Systems where installers are paid on commission, with rates tiered according to their installation rates, can prompt installers to cut corners so that they can maximize their income.

12. Strictly adhere to improved valve reconciliation procedures, and improve storage of old valves. These steps will dramatically reduce the possibility of installers claiming falsified installations.

13. Enhance in-house verification policies and adopt standardized program quality control procedures. These will improve all parties' understanding of safeguards and expectations, and facilitate identifying problems more quickly.

14. Increase management oversight. Programs must dedicate adequate resources to quality control and field supervision to ensure that procedures are effective.

Program managers have claimed that many of the flaws of the Phase 2 program have been addressed in the Phase 3 program that succeeded it. Future evaluations of the latter program need to confirm that this was indeed the case. To that end, we recommend that future evaluations accomplish the following:

4. Verify the program better targeted facilities with high potential for energy savings, consistent with Recommendation #1.

5. Confirm that program efforts to improve quality control, including those in Recommendations #4-7, indeed eliminated the problems observed in Phase 2.

6. Determine how the 2006 California state law[10] mandating efficient spray valves has altered the marketplace by increasing the percentage of efficient valves that would be installed even without programs.

[10] As of 2006, California state law mandates efficient valves, so, in theory, resource inefficient valves cannot be installed on pre-rinse stations. However, it appears that both the state regulation by the California Energy Commission and the Federal legislation regarding pre-rinse spray valves are flawed because both permit the continued sale of resource inefficient valves for applications other than pre-rinsing. Therefore, a food service operator still can replace an efficient valve with an inefficient one if they so choose. The actual level of compliance with this new standard is currently being studied by the State of California.

5. Appendix

5.1 Measured data and key results

Table 5-1: Data Summary for 29 Metered Sites

	GENERAL				WATER TEMPERATURES (deg F)			POST HEAD		PRE HEAD	
Sample Round*	Work Order ID	Gas Utility	Grocery**	Hot water heating type***	Mixed	Cold	Hot	Flow, gpm	Hours/day usage	Flow, gpm	Hours/day usage
2	W005937416	PGE	0	1	113.7	72.3	133.7	1.40	0.75	2.46	-
2	W005897034	PGE	0	1	136.0	72.6	142.0	2.20	-	2.90	-
2	W005943658	PGE	0	1	120.3	70.0	133.8	1.10	1.25	2.88	0.93
2	W005888620	PGE	1	1	69.5	64.5	116.8	1.26	0.01	2.85	0.02
2	W005871293	PGE	0	1	120.5	69.0	138.5	1.10	0.96	2.25	0.81
2	W005871460	PGE	1	2	125.7	67.3	132.0	1.11	0.19	1.35	0.16
2	W005863083	PGE	1	2	130.3	69.0	130.6	1.05	0.09	1.70	0.07
2	W005852613	PGE	0	1	103.9	69.7	128.1	1.25	1.04	2.40	0.94
1	W005711673	SCG	1	2	123.5	60.3	125.0	1.47	0.15	2.41	0.15
1	W005863435	SCG	0	1	116.8	70.5	117.5	1.31	0.91	2.01	-
1	W005864356	SCG	1	2	125.7	60.9	127.7	1.20	0.05	1.48	0.04
1	W005715297	SCG	0	1	121.3	70.3	128.3	0.95	1.69	1.90	1.18
1	W005872633	SCG	0	1	129.3	67.0	146.3	1.20	0.88	2.08	0.31
1	W005876342	SCG	0	1	117.8	75.5	130.0	1.20	0.32	2.48	0.19
1	W005877808	SCG	0	1	127.0	73.3	135.8	1.23	0.46	1.58	0.44
1	W005870274	SCG	1	2	107.0	69.1	119.0	1.10	0.12	2.70	0.05
3	W005972583	SCG	0	1	106.7	62.9	118.7	1.22	0.08	2.23	0.03
3	W005993508	SCG	0	1	105.0	64.5	120.3	0.88	0.10	1.10	0.16
3	W005996576	SCG	1	2	118.7	65.8	121.8	0.90	0.09	1.67	0.09
SM	W005947281	SCG	0	3	118.0	67.0	136.5	1.30	0.05	-	-
SM	W005988114	SCG	0	0	110.0	73.0	128.5	1.10	1.18	-	-
SM	W005977206	SCG	0	1	96.0	70.5	111.0	1.50	0.61	-	-
SM	W005979426	SCG	0	1	146.5	71.5	146.5	1.30	0.71	-	-
SM	W005967856	SCG	0	1	144.0	69.5	144.0	1.40	0.66	-	-
SM	W005974248	SCG	0	0	99.5	76.0	121.0	1.10	0.36	-	-
SM	W005977768	SCG	0	1	111.0	74.0	154.0	2.20	1.01	-	-
SM	W005718986	SCG	0	1	145.0	68.0	145.0	1.50	1.17	-	-
SM	W005987057	SCG	0	1	89.5	63.5	154.5	1.40	0.54	-	-
SM	W005946832	SCG	0	1	94.5	66.5	103.5	1.40	0.68	-	-

* SM = supplemental round, authorized after draft EM&V report was submitted.
** 0 = non-grocery, 1 = grocery.
*** Electric = 0; Gas=1; Other = 2; Unable to determine = 3.

Table 5-2: Detailed Program Savings Calculations

	Annual unit savings				Spray head counts					
Utility / Establishment type	Water (CCF)	Gas (therms) (1)	Electricity (kWh) (1)	Demand (avg. peak kW) (1)	Claimed	Verified as installed (2)	Retained (3)	Gas Water heat	Electric water heat	Other water heat
Pacific Gas & Electric - Non Grocery	11.5	44.9	1,023.0	0.234	4,770	4,770	4,512	4,276	161	75
Pacific Gas & Electric - Grocery	2.0	6.0	137.6	0.031	1,278	1,278	1,209	1,078	25	106
SoCalGas - Non Grocery	11.5	40.0	910.6	0.208	8,445	8,217	7,773	6,754	779	240
SoCalGas - Grocery	2.0	5.2	118.4	0.027	2,189	2,129	2,014	1,720	24	271
Non Grocery	**11.5**	**41.8**	**951.8**	**0.217**	**13,215**	**12,987**	**12,285**	**11,030**	**940**	**315**
Grocery	**2.0**	**5.5**	**125.6**	**0.029**	**3,467**	**3,408**	**3,223**	**2,798**	**49**	**376**
Pacific Gas & Electric	**9.5**	**36.7**	**835.8**	**0.191**	**6,048**	**6,048**	**5,721**	**5,355**	**186**	**180**
SoCalGas	**9.6**	**32.8**	**747.5**	**0.171**	**10,634**	**10,347**	**9,787**	**8,474**	**802**	**511**
PROGRAM TOTAL	**9.3**	**26.2**	**596.3**	**0.136**	**16,682**	**16,395**	**15,509**	**13,828**	**989**	**691**

NOTES

1 Gas and electric savings are mutually exclusive as reported here.
2 Based on % of installations not verified in SoCalGas territory of 2.7% (For PG&E, % = 0)
3 Based on first year average sprayhead retention rate of 94.6%

	Spray head percentages					Total annual gross savings				Total annual net savings (5)			
Utility / Establishment type	Verified as installed (% of claimed)	Retained (% of verified)	Gas water heat (% of retained)	Electric water heat (% of retained)	Other water heat (% of retained)	Water (CCF)	Gas (therms)	Electricity (kWh)	Demand (average peak kW)(4)	Water (CCF)	Gas (therms)	Electricity (kWh)	Demand (average peak kW)(4)
Pacific Gas & Electric - Non Grocery	100.0%	94.6%	94.8%	3.6%	1.7%	51,975	191,961	164,676	37.6	50,000	184,666	158,418	36.2
Pacific Gas & Electric - Grocery	100.0%	94.6%	89.2%	2.1%	8.7%	2,384	6,511	3,466	0.8	2,293	6,263	3,335	0.8
SoCalGas - Non Grocery	97.3%	94.6%	86.9%	10.0%	3.1%	89,543	269,870	708,951	161.9	86,140	259,615	682,011	155.7
SoCalGas - Grocery	97.3%	94.6%	85.4%	1.2%	13.4%	3,971	8,932	2,821	0.6	3,820	8,593	2,713	0.6
Non Grocery	**98.3%**	**94.6%**	**89.8%**	**7.6%**	**2.6%**	**141,518**	**461,831**	**873,626**	**199.5**	**136,140**	**444,281**	**840,429**	**191.9**
Grocery	**98.3%**	**94.6%**	**86.8%**	**1.5%**	**11.7%**	**6,355**	**15,443**	**6,287**	**1.4**	**6,113**	**14,856**	**6,048**	**1.4**
Pacific Gas & Electric	**100.0%**	**94.6%**	**93.6%**	**3.3%**	**3.2%**	**54,359**	**198,472**	**168,142**	**38.4**	**52,293**	**190,930**	**161,753**	**36.9**
SoCalGas	**97.3%**	**94.6%**	**86.6%**	**8.2%**	**5.2%**	**93,513**	**278,802**	**711,771**	**162.5**	**89,960**	**268,208**	**684,724**	**156.3**
PROGRAM TOTAL	**98.3%**	**94.6%**	**89.2%**	**6.4%**	**4.5%**	**147,872**	**477,274**	**879,913**	**200.9**	**142,253**	**459,138**	**846,476**	**193.3**

NOTES

4 Assumes electric savings occur on average for 12 hours/day, 7 days/week.

5 Based on net-to-gross ratio of 96.2%

	Annual gross savings per claimed head					Annual net savings per claimed head				
Utility / Establishment type	Water (CCF)	Water (gallons/ day)	Gas (therms)	Electricity (kWh)	Demand (average peak watts)	Water (CCF)	Water (gallons/ day)	Gas (therms)	Electricity (kWh)	Demand (average peak watts)
Pacific Gas & Electric - Non Grocery	10.9	22.3	40.2	34.5	7.9	10.5	21.5	38.7	33.2	7.6
Pacific Gas & Electric - Grocery	1.9	3.8	5.1	2.7	0.6	1.8	3.7	4.9	2.6	0.6
SoCalGas - Non Grocery	10.6	21.7	32.0	83.9	19.2	10.2	20.9	30.7	80.8	18.4
SoCalGas - Grocery	1.8	3.7	4.1	1.3	0.3	1.7	3.6	3.9	1.2	0.3
Non Grocery	**10.7**	**21.9**	**34.9**	**66.1**	**15.1**	**10.3**	**21.1**	**33.6**	**63.6**	**14.5**
Grocery	**1.8**	**3.8**	**4.5**	**1.8**	**0.4**	**1.8**	**3.6**	**4.3**	**1.7**	**0.4**
Pacific Gas & Electric	**9.0**	**18.4**	**32.8**	**27.8**	**6.3**	**8.6**	**17.7**	**31.6**	**26.7**	**6.1**
SoCalGas	**8.8**	**18.0**	**26.2**	**66.9**	**15.3**	**8.5**	**17.3**	**25.2**	**64.4**	**14.7**
PROGRAM TOTAL	**8.9**	**18.2**	**28.6**	**52.7**	**12.0**	**8.5**	**17.5**	**27.5**	**50.7**	**11.6**

Table 5-3: Claimed Installations and Evaluated Results by Water Utility

Water Utility	# of spray heads claimed	Water Service Region	Average annual supply water temperature (F)	Evaluated net water savings		
				CCF/year	gallons/day	acre-feet/year
Alameda County WD	96	East Bay	61.0	819	1,678	1.9
Arden Cordova Water Svc	59	Sacramento	56.4	503	1,031	1.2
Belmont	29	South Bay	68.0	247	507	0.6
Burlingame WD	50	South Bay	68.0	426	874	1.0
Cal American Water Co.	66	Contra Costa	64.3	563	1,153	1.3
Calleguas MWD	555	Southern California	68.0	4,733	9,699	10.9
Castaic Lake	192	Southern California	68.0	1,637	3,355	3.8
Central Basin MWD	804	Sacramento	56.4	6,856	14,050	15.7
City of Anaheim	173	Southern California	68.0	1,475	3,023	3.4
City of Beverly Hills	69	Southern California	68.0	588	1,206	1.4
City of Burbank	124	Southern California	68.0	1,057	2,167	2.4
City of Cotati	31	South Bay	68.0	264	542	0.6
City of Fullerton	114	Southern California	68.0	972	1,992	2.2
City of Glendale	148	Southern California	68.0	1,262	2,586	2.9
City of Pasadena	204	Southern California	68.0	1,740	3,565	4.0
City of Petaluma	16	South Bay	68.0	136	280	0.3
City of Rohnert Park	26	South Bay	68.0	222	454	0.5
City of San Fernando	23	Southern California	68.0	196	402	0.5
City of San Luis Obispo	101	Southern California	68.0	861	1,765	2.0
City of Santa Ana	284	Southern California	68.0	2,422	4,963	5.6
City of Santa Monica	226	Southern California	68.0	1,927	3,949	4.4
City of Santa Rosa	204	South Bay	68.0	1,740	3,565	4.0
City of Suisun	27	Contra Costa	64.3	230	472	0.5
City of Torrance	149	Southern California	68.0	1,271	2,604	2.9
City of Windsor	30	South Bay	68.0	256	524	0.6
Contra Costa Water District	339	Contra Costa	64.3	2,891	5,924	6.6
Daly City	96	South Bay	68.0	819	1,678	1.9
Eastern MWD	551	Southern California	68.0	4,699	9,629	10.8
Fair Oaks WD	13	Sacramento	56.4	111	227	0.3
Folsom	61	Sacramento	56.4	520	1,066	1.2
Foothill MWD	21	Southern California	68.0	179	367	0.4
Half Moon Bay	50	South Bay	68.0	426	874	1.0
Hayward	10	East Bay	61.0	85	175	0.2
Inland Empire Utilities	791	Southern California	68.0	6,745	13,823	15.5
LADWP	2,274	Southern California	68.0	19,391	39,739	44.5
Las Virgenes MWD	100	Southern California	68.0	853	1,748	2.0
Marin MWD	263	South Bay	68.0	2,243	4,596	5.1
Menlo Park	51	South Bay	68.0	435	891	1.0
Millbrae	11	South Bay	68.0	94	192	0.2
MWD of Orange County	1,928	Southern California	68.0	16,441	33,692	37.7
Napa	103	South Bay	68.0	878	1,800	2.0
No participating water agency	28	--	--	239	489	0.5
North Marin WD	35	South Bay	68.0	298	612	0.7
Pacifica	50	South Bay	68.0	426	874	1.0
Placer County Water Agency	69	Sacramento	56.4	588	1,206	1.4
Redwood City	86	South Bay	68.0	733	1,503	1.7
Rio Linda Elverta Community WD	9	Sacramento	56.4	77	157	0.2
Sacramento City Water	284	Sacramento	56.4	2,422	4,963	5.6
Sacramento Cnty DWR	43	Sacramento	56.4	367	751	0.8
Sacramento Suburban WD	2	Sacramento	56.4	17	35	0.0
San Benito Water District	46	Sacramento	56.4	392	804	0.9
San Juan Water District	26	Sacramento	56.4	222	454	0.5
San Mateo/San Carlos	182	South Bay	68.0	1,552	3,180	3.6
Santa Barbara Water Authority	488	Southern California	68.0	4,161	8,528	9.6
Santa Clara Valley WD	1,354	South Bay	68.0	11,546	23,661	26.5
SFPUC-San Francisco WD	2,033	East Bay	61.0	17,336	35,527	39.8
Sonoma County Water Agency	39	South Bay	68.0	333	682	0.8
South San Francisco	101	South Bay	68.0	861	1,765	2.0
Three Valleys MWD	536	Southern California	68.0	4,571	9,367	10.5
USGVMWD	242	Southern California	68.0	2,064	4,229	4.7
Vallejo City Water	58	South Bay	68.0	495	1,014	1.1
West Muni WD of Riverside County	509	Southern California	68.0	4,340	8,895	10.0
Grand Total	**16,682**		**66.0**	**142,253**	**291,522**	**326.6**

5.2 Data Collection Form – Full Verification

SITE INFO (from database / phone interviews)

Business Name

Tracking # | Phone #

Address | Directions

Contact | Notes

Sampled head location | Install date | # heads installed

PERFORMANCE & PROGRAM

Before you participated in the Spray Valve Distribution Program, were you aware that these efficient spray heads are available? **Y N**

Why did you not install efficient spray heads before your involvement with the distribution program? (Probe: Cost? Lack of distributor? Performance?)

On a 1-5 scale, how satisfied are you and your coworkers with the performance of the new spray head(s)? **1 (hate) 2 3 4 5 (love)**
Care to elaborate on your answer?

Does the new spray head(s) clean dishes faster, slower, or the same as the old head? **Faster Slower Same as before**

Any other comments about the spray head, the installation process, or the program in general?

VERIFICATION

Hours	Weekdays	Saturday	Sunday
Business			
Dishwashing			

Seasonal business variation affecting dishwashing, if any (probe for details as appropriate, e.g., months with more business and % increase over typical)

Efficient head still installed (should have blue bumper, H1/4U Veejet nozzle) **Yes** **No (describe why removed below:)**

Any evidence of tampering (e.g.., drilled out nozzle)? If so, describe:

Hot water heater type **Gas** **Electric** **Other** Notes:

Water temps (measured) **Mixed** __________ **Cold** __________ **Hot** __________

Flow data	Post head, Test 1	Post head, Test 2	Pre head, Test 1	Pre head, Test 2
Gallons				
Seconds				

Date Verified

Verifier Initials

METERING (info for metered sites only)

Meter serial # ________________________

	VISIT 1 Start post	VISIT 2 End post	VISIT 2 Start pre	VISIT 3 End pre
Meter reading				
Read date				
Read time				
Spray head mixed water temperature				
Cold water temperature				
Hot water temperature				

Adjustments: Any unusual occurrences with the business, the kitchen, or dishwashing that would have affected water measurements since the meter was installed? If so, probe for as much detail as possible, so that engineering adjustments can be made to the meter data.

5.3 Data Collection Form – Supplemental Verification

SITE INFO (from database)

Tracking #	**Database Contact:**
Business Name:	**Phone #:**
Address:	**Number of heads at site:**
	Installation Date:

VERIFIED INFO (from site visit)

Current contact name / number:		**Head number(s) for multiple head site:**
		Location (optional):
Length of Employment (if not database contact):		
Fuel Type: **O**bserved **R**eported	**Photos:**	**Verification Date:**

Is an efficient spray head there? (Identify by blue bumper, nozzle number or fan spray.)
YES

Was it installed by the Program?

YES (Done)	**NO**	**DON'T KNOW**
	When was it installed?	**Who would?** (NEW CONTACT)
	Who installed it?	
	Contact for more information	

Is an efficient spray head there? (Identify by blue bumper, nozzle number or fan spray.)
NO (Ask to speak to database contact, show site contact an example head, jog memory)

Was a spray head like this installed by the Program?

YES	**NO**	**DON'T KNOW**
		Who would? (NEW CONTACT)
Why was it removed?		
Who removed it?	**Contact for more information**	

Questions from the field? Call (425) 894-1485

5.4 In-Depth Interview Protocol

California Urban Water Conservation Council
Pre-Rinse Spray Valve Installation Program
Process and NTGR Depth Interview Protocol

April 13, 2005

Introduction

Hello, my name is _____________. I am calling from Glacier Consulting Group on behalf of the California Urban Water Conservation Council. We have been commissioned to conduct a study regarding the Pre-Rinse Spray Valve Installation Program.

The interview will take 15 to 20 minutes to complete (If not a convenient time to conduct the interview, schedule a call back.) Thank you for your participation.

Respondent ID/Code				
Respondent Type	Installer	Program Manager	Manufacturer	Distributor
Interview Date				
Contact Name				
Contact Phone				
Start Time				
Finish Time				

A. Installers

General

[INTERVIEWER NOTE: ENSURE THAT RESPONDENT COMMENTS ARE LIMITED TO PHASE 2 OF THE PROGRAM.]

QI1. How long have you been associated with the current California Urban Water Conservation Council's Pre-Rinse Spray Valve Installation Program?

QI2. What would you identify as the program strengths?

QI3. What would you identify as the program weaknesses?

QI4. In general, how could the program be improved?

NTGR

QI5a. Approximately how many sites, both participant and non-participant, did you visit in 2004 and 2005? (Probe: Approximately how many of these were done in 2004?)

QI5b. How many pre-rinse spray valves did this represent? (Probe: Approximately how many of these are attributable to 2004 visits?)

QI5c. Of all the pre-rinse spray valves you observed, approximately how many were low-flow models? (Probe: Approximately how many of these are attributable to 2004 visits?)

Process

QI8. What are the steps you follow in getting a low-flow pre-rinse spray valve installed? (Probe: What is the first step? How do you identify a prospect? How do you approach a prospect? What happens next? Please describe your process from identifying the prospect through installation of the low-flow pre-rinse spray valve.)

QI9a. Are there any particular hurdles that you encounter in this process? (Probe: Does the process bottleneck? Are there any steps that are particularly difficult to complete?)

QI10. How can these hurdles be avoided or overcome? (Probe: What could be done differently to improve the process?)

QI11. What steps in the process work particularly well?

QI12. How has the program process changed since you began installing valves? (Probe: Is it more efficient now or more cumbersome?)

QI12a. In general, how did the restaurant operators at the sites you visited accept the program? (Probe: Where they open to receiving the low-flow pre-rinse spray valve? What did they like/dislike about the program?)

QI13. Why does a potential restaurant operator decide not to participate in the program? (Probe: What reasons did they provide you for not participating?)

QI14. How could the program be changed in order to get more of these non-participants to install the low-flow spray valve?

QI15. Why do establishments with pre-rinse spray valves install standard valves over low-flow models? (Probe: Are they more expensive than standard models? Are there poor performance perceptions? Are efficient models difficult to find?)

QI16. Were the restaurant operators that you visited already aware of low-flow pre-rinse spray valves?

QI17. Of those that were aware and did not have low-flow pre-rinse spray valves installed, what did they tell you about why they were not using low-flow pre-rinse spray valves? (Probe: Are they more expensive than standard models? Are there poor performance perceptions? Are they difficult to find?)

B. Program Managers

[INTERVIEWER NOTE: UNLESS SPECIFIED, QUESTIONS IN THE SECTION REFER TO BOTH PHASE 1 AND 2 IN AGGREGATE.]

General

QP1. How long have you been associated with the California Urban Water Conservation Council's Pre-Rinse Spray Valve Installation Program?

QP2. What would you identify as the program strengths?

QP3. What would you identify as the program weaknesses?

QP4. In general, how could the program be improved?

NTGR

QP5. Before the program was initiated, what percent of installed pre-rinse spray valves were low-flow models? (Probe: What is your estimate based on?)

Process

QP8a. What are the steps utilized in getting a low-flow pre-rinse spray valve installed? (Probe: What is the first step? How do you identify a prospect? How do you approach a prospect? What happens next? Please describe the process from identifying the prospect through installation of the low-flow pre-rinse spray valve.)

QP8b. How has this process changed from Phase 1 to Phase 2?

QP9a. What are the hurdles that installers encounter in the process? (Probe: Does the process bottleneck? Are there any steps that are particularly difficult to complete?)

QP9b. How do these hurdles compare to those faced by the installers during Phase 1? (Probe: Are the same hurdles in place? If not, are there additional/fewer hurdles? Please explain? How was the program able to remove hurdles? How did these additional hurdles come to be?)

QP10. How can these hurdles be avoided or overcome? (Probe: What could be done differently to improve the process?)

QP11. What steps in the process work particularly well?

QP12. In what other ways has the program process changed over the past two years? (Probe: Is it more efficient now or more cumbersome?)

QP13. Why does a potential program participant decline to participate in the program?

QP14. How could the program be changed in order to get more non-participants to install the low-flow spray valve?

QP15. Why do establishments with pre-rinse spray valves install standard valves over low-flow models? (Probe: Are they more expensive than standard models? Are there poor performance perceptions? Are the efficient models difficult to find?)

C. Manufacturers

General

[IF NOT FAMILIAR WITH THE PROGRAM, SKIP TO QM6]

QM. Are you familiar with the California Urban Water Conservation Council's Pre-Rinse Spray Valve Installation Program? (Probe: Please describe your affiliation with the program.)

QM1. How long have you been aware of the California Urban Water Conservation Council's Pre-Rinse Spray Valve Installation Program?

QM2. What would identify as the current program's strengths?

QM3. What would you identify as the current program's weaknesses?

QM4. In general, how could the current program be improved?

QM5. Have the programs had an effect on sales of low-flow pre-rinse spray valves? (Probe: How has the program affected sales of pre-rinse spray valves? Have sales increased/stayed the same?)

NTGR

QM6. How many different models of pre-rinse spray valves do you provide? (Probe: List models.)

QM7. How many are low-flow models? (Probe: A low-flow/resource efficient pre-rinse spray valve is defined as one with a flow rate of 1.6 gpm of less. Which models are low-flow?)

QM8a. In 2002, how many pre-rinse spray valves did you sell in California?

QM8b. Of these, how many were low-flow pre-rinse spray valves? (Approximately what percent of the pre-rinse spray valves you sold in this area in 2002 were low-flow models? Was any significant portion of these installations made under an efficiency program? If so, what portion?)

QM9a. In 2003, how many pre-rinse spray valves did you sell in California?

QM9b. Of these, how many were low-flow pre-rinse spray valves? (Approximately what percent of the pre-rinse spray valves you sold in this area in 2003 were low-flow models? Was any significant portion of these installations made under an efficiency program? If so, what portion?)

QM10a. In 2004, how many pre-rinse spray valves did you sell in California?

QM10b. Of these, how many were low-flow pre-rinse spray valves? (Approximately what percent of the pre-rinse spray valves you sold in this area in 2004 were low-flow models? Was any significant portion of these installations made under an efficiency program? If so, what portion?)

QM11. Why didn't more low-flow pre-rinse spray valves sell in 2002, 2003, and 2004? (Probe: How would you describe the demand for low-flow models? Did you actively market and stock low-flow models? What barriers do you face in selling more low-flow pre-rinse spray valves?)

QM12. What is the expected useful or physical life of a pre-rinse spray valve installed in a typical food service application?

QM13. Is there a difference in product life between low-flow and standard pre-rinse spray valves? (Probe: What is the difference?)

QM14a. Have the sales of low-flow pre-rinse spray valves been increasing, decreasing, or remained level over the past five years? (Probe: Based on a percent of all pre-rinse spray valves sold?)

QM14b. How would market penetration for low-flow pre-rinse spray valves have changed if there were no intervention programs? (Probe: Would sales have continued to increase/decrease? What are the driving factors behind low-flow pre-rinse spray valve market penetration?)

D. Distributors

General

[IF NOT FAMILIAR WITH THE PROGRAM, SKIP TO QD6]

QD. Are you familiar with the California Urban Water Conservation Council's Pre-Rinse Spray Valve Installation Program? (Probe: Please describe your affiliation with the program.)

QD1. How long have you been aware of the California Urban Water Conservation Council's Pre-Rinse Spray Valve Installation Program?

QD2. What would identify as the program strengths?

QD3. What would you identify as the program weaknesses?

QD4. In general, how could the program be improved?

QD5. Has the program had an effect on sales of low-flow pre-rinse spray valves? (Probe: How has the program affected sales of pre-rinse spray valves? Have sales increased/stayed the same?)

NTGR

QD6. How many different models of pre-rinse spray valves do you provide? (Probe: List models.)

QD6a. Which manufacturers?

QD7. How many are low-flow models? (Probe: A low-flow/resource efficient pre-rinse spray valve is defined as one with a flow rate of 1.6 gpm of less. Which models are low-flow?)

QD8a. In 2002, how many pre-rinse spray valves did you sell in California?

QD8b. Of theses, how many were low-flow pre-rinse spray valves? (Approximately what percent of the pre-rinse spray valves you sold in this area in 2002 were low-flow models? Was any significant portion of these installations made under an efficiency program? If so, what portion?)

QD9a. In 2003, how many pre-rinse spray valves did you sell in California?

QD9b. Of these, how many were low-flow pre-rinse spray valves? (Approximately what percent of the pre-rinse spray valves you sold in this area in 2003 were low-flow models? Was any significant portion of these installations made under an efficiency program? If so, what portion?)

QD10a. In 2004, how many pre-rinse spray valves did you sell in California?

QD10b. Of these, how many were low-flow pre-rinse spray valves? (Approximately what percent of the pre-rinse spray valves you sold in this area in 2004 were low-flow models? Was any significant portion of these installations made under an efficiency program? If so, what portion?)

QD11. Why didn't more low-flow pre-rinse spray valves sell in 2002, 2003, and 2004? (Probe: How would you describe the demand for low-flow models? Did you actively market and stock low-flow models? What barriers do you face in selling more low-flow pre-rinse spray valves?)

QD12. What is the expected product life of a pre-rinse spray valve installed in a typical food service application?

QD13. Is there a difference in physical or useful life between low-flow and standard pre-rinse spray valves? (Probe: What is the difference?)

QD14a. Have the sales of low-flow pre-rinse spray valves been increasing, decreasing, or remained level over the past five years? (Probe: Based on a percent of all pre-rinse spray valves sold?)

QD14b. How would market penetration for low-flow pre-rinse spray valves have changed if there were no intervention programs? (Probe: Would sales have continued to increase/decrease? What are the driving factors behind low-flow pre-rinse spray valve market penetration?)

5.5 Process Follow-up Interview Protocol

California Urban Water Conservation Council
Pre-Rinse Spray Valve Installation Program
Follow-up Process Evaluation

June 28, 2006

The overall objective of this evaluation task is to gain a thorough understanding of circumstances leading to a breakdown in procedures regarding the implementation of Phase II of the CUWCC Pre-Rinse Spray Valve Installation program and to develop recommendations for preventing similar instances for future initiatives.

The following are proposed questions for a qualitative interviewing protocol to thoroughly explore the process by which program implementers solicit program participation, install resource efficient pre-rinse spray valves, track/report program impacts, and maintain quality control. This protocol will be used to guide the interviewer in a discussion rather than a structured interview. It is fully anticipated that additional questions/topics will be raised during the interview and will be explored by the interviewer.

Installation

1. What are the steps you follow in getting a low-flow pre-rinse spray valve installed? (Probes: What is the first step? How do you identify a prospect? How do you approach a prospect? What happens next? Please describe your process from identifying the prospect through installation of the low-flow pre-rinse spray valve.)
2. Explain the post installation process. (Probe: How do you report that a valve has been installed? What do you do with the old valve?)

Installers

3. What training do installers receive before they begin soliciting program participants?
4. Please explain the compensation structure for installers.

Quality Control

5. Please explain your quality control process. (Probes: How do you ensure that valves are installed correctly?)
6. What are your procedures when discrepancies are discovered?
7. In the past discrepancies were discovered through systems outside of your procedures. What went wrong? (Probe: Cite discrepancies noted. Was there a quality control procedure in place for discovering discrepancies? Where did the procedure break down?)
8. What could have been done differently to prevent the discrepancies?
9. Have new procedures been put in place to prevent such an event from occurring again?
10. What is the difference between prior procedures and current procedures?
11. How could current procedures be improved?