CONF-950817--1



# ACTUAL VS. ANTICIPATED SAVINGS FROM DSM PROGRAMS: AN ASSESSMENT OF THE CALIFORNIA EXPERIENCE

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## Abstract

Since the late 1980's, utilities in California have used demand-side management (DSM) extensively to achieve a variety of corporate and public policy goals. This commitment to energy efficiency was encouraged by the establishment of financial incentives for the utilities to acquire demand-side resources. With restructuring of electric and gas markets underway in California, including recent cutbacks by the California utilities in their DSM program efforts, it is timely to review retrospectively the accomplishments of California's DSM investments.

This paper summarizes the results of 50 evaluation studies that assess California DSM programs operating between 1990 and 1992. On average, the programs delivered 112% of the energy savings that were planned, and the typical program realized approximately 86% of the energy savings it was expected to deliver. Thus, the California DSM programs outperformed DSM programs from the 1980s, in terms of more accurately forecasting energy impacts. Among the 50 impact studies, lower realization rates are associated with residential-sector programs, relatively high *ex-ante* estimates of savings, and significant levels of free ridership.

## Overview of the California Utilities and Their DSM Programs

Between 1990 and 1992, the four largest California investor-owned utilities spent $772 million on energy-efficiency/conservation programs (Division of Ratepayer Advocates, California Public Utilities Commission, 1993). The four utilities include:

- Pacific Gas and Electric Company (PG&E),
- San Diego Gas and Electric Company (SDG&E),
- Southern California Edison (SCE), and
- Southern California Gas Company (SoCalGas).

Almost half ($358 million) of this total was expended by PG&E, the largest of the four investor-owned utilities and the country's leading utility in terms of DSM expenditures in 1992 (Hirst, 1994). Less than 10 percent ($70 million) was spent by SDG&E, the smallest of the four utilities. However, the magnitude of the SDG&E investment is still large by national standards. According to Hirst (1994), only twelve electric utilities spent more than SDG&E on DSM in 1992.

The four investor-owned California utilities operate two types of DSM programs: (1) resource programs that typically earn the utilities shared-savings incentives, and (2) equity/services programs that generally are operated for performance-adder incentives. Resource programs include a variety of retrofit incentive and new construction programs. These programs are intended to be viable, cost-effective alternatives to supply-side options for which the utilities are eligible to earn shared-savings incentives. Equity/services programs include residential direct assistance programs for low-income households, which are viewed as equity programs. Most of the utilities are eligible to earn performance-adder incentives for operating these programs. DSM programs that provide energy management services such as energy audits of buildings and industrial processes also fall into the equity/services category. The savings of these programs are difficult to measure, even though they may be significant. Utility incentives are therefore based on

performance-adders and not shared-savings. Many of the equity and services programs are mandated by the California Public Utilities Commission, while the resource programs are not.

Reflecting these various programmatic differences, the CPUC employs the following classification scheme for DSM programs: (1) retrofit energy-efficiency incentives (residential and commercial/industrial/ agricultural - C/I/A), (2) residential direct assistance, (3) new construction (residential and C/I/A), and (4) energy management services (residential and C/I/A).

Retrofit energy-efficiency incentive programs accounted for the largest percentage of DSM expenditures of the four types of programs, totaling $313 million or 41 percent of the total. Residential direct assistance programs accounted for the next largest percentage, with $225 million (29 percent). Energy management services were a close third, with $157 million (20 percent). Finally, new construction programs represented the smallest type, with only $77 million, or 10% of the total expenditure.

## Summary Of *Ex-Post* Impact Estimates

This section summarizes energy and demand savings as reported in the 50 individual utility evaluations studied. First we discuss savings at the programmatic level (where available--not all of the studies reported program level savings). Then we summarize the savings reported for a select number of specific measures. The focus is on net electrical energy savings (mWh or kWh), net electrical demand savings (MW or kW), and net gas savings (therms).

Compiling the total savings estimates reported by the individual evaluation studies was complicated by the significant variation in the way savings were estimated and reported across the studies. Specifically, the reported savings: varied by time frame, were aggregated at many different levels, varied by unit of measurement, and resulted from a variety of estimation and evaluation methodologies.

For these reasons, it was difficult to summarize total savings across all of the evaluation studies.

### *Residential Programs*

For those nine studies reporting program level savings, a total of 124.6 GWh of savings were reported. Sixty-nine percent of these savings derived from retrofit incentive programs while 25% came from direct assistance programs. Southern California Edison's Residential Appliance Efficiency Program accounts for the largest program-wide electricity savings with a total of 53,341 megawatt hours of savings between 1990 and 1992.

Nine studies reported residential gas savings at the program level, totaling 8,853 kilotherms of gas savings. The largest portion, 65%, came from retrofit incentive programs. The balance was split approximately equally between direct assistance and energy management services. Southern California Gas' Residential Conservation Program reported the largest savings among these programs, totaling 2,559 kilotherms during 1990-92.

### *Commercial, Industrial, and Agricultural Programs*

A total of 1,182,994 mWh of non-residential electricity savings were reported, with 78% of these savings deriving from non-residential retrofit incentive programs. Non-residential energy management services accounted for 16% of the savings while new construction accounted for 6% of the reported savings. PG&E's Commercial, Industrial, and Agricultural Retrofit Rebate

Program reported over 663,000 megawatt hours of savings for the 1991-92 period. Its Commercial, Industrial, and Agricultural Customized Rebate Program saved over 208,000 megawatt hours between 1990 and 1991. In contrast, recall that Southern California Edison's Residential Appliance Efficiency Program is the residential program with the largest program-wide savings, totaling only 53,341 megawatt hours of savings between 1990 and 1992.

Six studies estimated the electrical demand (MW) savings of commercial, industrial, and agricultural programs. (NOTE: Very few residential programs reported MW demand savings.) A total of 225.7 MW of demand savings were reported for non-residential programs at the program level. The largest share, 64%, again derived from non-residential retrofit incentive programs. As with the estimates of energy savings, PG&E's Commercial, Industrial, and Agricultural Retrofit Rebate Program accounts for the largest estimated demand savings among the impact studies, totaling 110.5 MW for the 1991-92 period.

Only two studies reported non-residential program-level gas savings. A total of 2,712 kilotherms of gas savings were reported by these two studies. The largest of these programs, in terms of gas savings, was PG&E's Nonresidential Energy Management Services Program, which reported 2,572 kilotherms of savings between 1990 and 1992.

In summary, the aggregate program-level savings as reported by the impact studies are shown in Table 1 The table shows that electricity savings from C/I/A programs are an order of magnitude higher than electricity savings from the residential programs for those studies reporting program-level savings. However, a majority of the estimated gas savings resulted from residential programs. In aggregate, over 1.3 million mWh of electricity savings were reported, and 11,565 kilotherms of gas energy savings.

**Table 1. Summary of Reported Program-Level Savings***

| | Residential Programs | Commercial/ Industrial/ Agricultural Programs | Total |
|---|---|---|---|
| mWh | 118,200 | 1,182,994 | 1,301,194 |
| MW | --- | 225.6 | 225.6 |
| Kilotherms | 8,853 | 2,712 | 11,565 |

* Savings reflect only those reported at the program level in the studies reviewed. Many studies did not report program-level savings (e.g., only per measure savings were reported). These are not reflected in the above totals.

## *Selected Residential Measures*

Three residential measures are discussed here, where multiple impact studies provide estimates of measure savings. The selected measures are refrigerators, residential lighting, and low-flow showerhead measures. In all cases, *ex-post* net savings are reported.

Based on three impact studies, the annual savings per refrigerator vary widely, from 90 kWh to 392 kWh. This variation reflect some combination of differences in program design characteristics (e.g., refrigerator replacement versus early retirement programs) and evaluation methods. For example, two of the studies covered programs which provide incentives to purchase refrigerators with greater energy efficiency (resulting in estimated saving of 90 and 286 kWh per refrigerator), while the third program offered early retirement of refrigerators and refrigerator repair (saving 392 kWh per refrigerator).

Similar comparisons are available for residential lighting measures. Again, a wide variation of net kilowatt hour savings per lamp is reported (34 kilowatt hours to 128 kilowatt hours), reflecting some combination of differences in program design and implementation features (e.g., the number of lamps installed per home) and evaluation methods.

Low-flow showerheads also exhibited wide variation in *ex-post* net savings. Being a measure directed at both electricity and natural gas savings, the applicable per showerhead savings were 20 kWh to 495 kWh and 1 therm to 28 therms. Again, these ranges reflected substantial variation in program design, evaluation method, and approach to free-ridership estimation.

## Comparison Of *Ex-Post* And *Ex-Ante* Impact Estimates

In defining their programs, the individual utilities formulated preliminary estimates of program impacts, known as *ex-ante* impact estimates. In most cases, these estimates are based on engineering calculations. The formal evaluation studies, summarized here estimate impacts based on post-implementation measurement and/or estimates of key parameters. Their estimates are therefore called *ex-post* impact estimates.

This section assesses the relationship between *ex-ante* and *ex-post* estimates of energy savings. A primary purpose of the DSM impact evaluations described in this report is to determine whether or not any systematic biases exist in the *ex-ante* estimates of program savings. Do the anticipated savings tend to be larger or smaller than the savings subsequently achieved by the programs? Identification of systematic biases in the *ex-ante* estimates can lead to improvements in program design, more effective resource planning assumptions, and incentive payments that better reflect program benefits.

The realization rate is used as the main method of assessing bias. As a general rule, realization rates are calculated as the *ex-post* estimate of net savings divided by the *ex-ante* estimate of net savings. Net savings refer to the program impacts over-and-above naturally occurring conservation. They can be smaller than gross savings to the extent that some participants would have purchased and installed new energy conservation measures even without the program (i.e., free ridership). Net savings can also be larger than gross impacts to the extent that the program induces additional marketing by trade allies or additional customer investments in conservation measures outside of the program (i.e., market transformation). Many of the impact studies estimated the impacts of free ridership, but only a few of them attempted to estimate the market transformation impacts of California's DSM programs. As a result, in all of the impact studies reviewed, net savings never exceeded gross savings.

There are a few exceptions to this general definition. In come cases, the numerator of the realization rate is an *ex-post* estimate of gross savings because the impact study did not present net savings or because the net-to-gross ratio is assumed to be 100%. In these cases, the denominator of the realization rate is usually an *ex-ante* estimate of gross savings. In other exceptions the nature of the *ex-ante* estimate (i.e., net or gross) is unknown. Thus, the nature of all of the realization rates cannot be characterized with certainty.

Realization rates are influenced by numerous factors. First, external events such as economic conditions within a utility's service territory may cause a program to save more or less energy than planned. Economic growth, for instance, may increase the hours of operation of a commercial or industrial establishment, thereby increasing the energy saved by the installation of energy-efficient equipment. Alternatively, the demand for energy-efficient products could increase independent of the utility program. This could increase the percentage of free riders served by a program, thereby decreasing the energy savings attributable to the utility's DSM efforts.

Second, the methods used to predict the energy savings of a program (i.e., the *ex-ante* estimation procedure) may introduce biases in the calculation of realization rates. For instance, simple engineering calculations of *ex-ante* energy savings have often overestimated the energy savings generated by DSM programs (Keating and Nadel, 1991; Brown et al., 1991; Brown and White, 1992). An overestimation of the *ex ante* savings can cause the realization rate to fall below 1.0. Unfortunately, it was not possible to characterize the type of method used to produce *ex-ante* estimates of energy savings in order to explore this potential source of bias.

Finally, the methods used to estimate the energy savings of a program (e.g., the *ex-post* estimation procedure) may introduce biases in the calculation of realization rates. For instance, if the *ex-post* estimation procedure does not include an adjustment for free ridership, then the realization rate may be upwardly biased. Alternatively, if free drivers are counted as free riders, the bias is reversed. Similarly, *ex-post* estimation procedures that rely on engineering calculations can produce higher estimates than methods based on analysis of utility bills.

We begin by describing the realization rates of all the programs and program segments studied, and compare these across sectors and program types. We then focus on the realization rates associated with three specific DSM measures. As we move from an aggregate level of analysis to a focused assessment of specific measures, greater explanation of variations in realization rates is possible.

## *Realization Rates In Aggregate*

The distribution of realization rates associated with 158 programs and program segments is shown in Figure 1. The median realization rate for all 158 programs and program segments is 0.86 and the mean is 1.12. Four realization rates (ranging from 5.59 to 14.54) were found to be more than 3 standard deviations above the mean. (No values were more than 3 standard deviations below the mean.) Removal of these four outliers results in the same median of 0.86 but reduces the mean to 0.93. Overall, these results suggest that the forecasts of energy savings were reasonably accurate, and that most of the DSM programs were cost-effective since they generally were designed to produce benefit-cost ratios of at least 1.2. Further, these results suggest that the California DSM programs operating between 1990 and 1992 have outperformed typical programs from the 1980's, which often fell short of their expected savings by 30% to 70% (Hirst, et al., 1989; Sebold and Fox, 1985; Brown and White, 1992). However, it was not possible to discern how much the improved performance resulted from greater actual energy savings versus improved forecasting.

The realization rates presented in this report are unweighted. That is, each program or program segment realization rate (total of 158) has the same weight in the calculation of means. If the realization rates were weighted by energy savings, the mean would be expected to be greater. This is because the C/I/A programs have higher realization rates and tend to have higher savings than the residential programs, yet in the unweighted calculation all are counted equally. Thus, the overall mean of 1.12 (0.93 without the four highest outliers) could be viewed as a conservative calculation of the ratio of actual savings to anticipated savings.

The difference between the mean and median values reflects the skewed distribution of realization rates. Nearly one quarter (22%) of the programs delivered less than 50% of their *ex-ante* savings estimates, while 10% exceeded 150% of their *ex-ante* savings estimates. This wide variation makes it difficult for resource planners to identify the optimum level of investment in DSM programs. The implementation of initiatives to narrow the range of realization rates should be a major thrust of resource planners and program managers in the four California utilities.

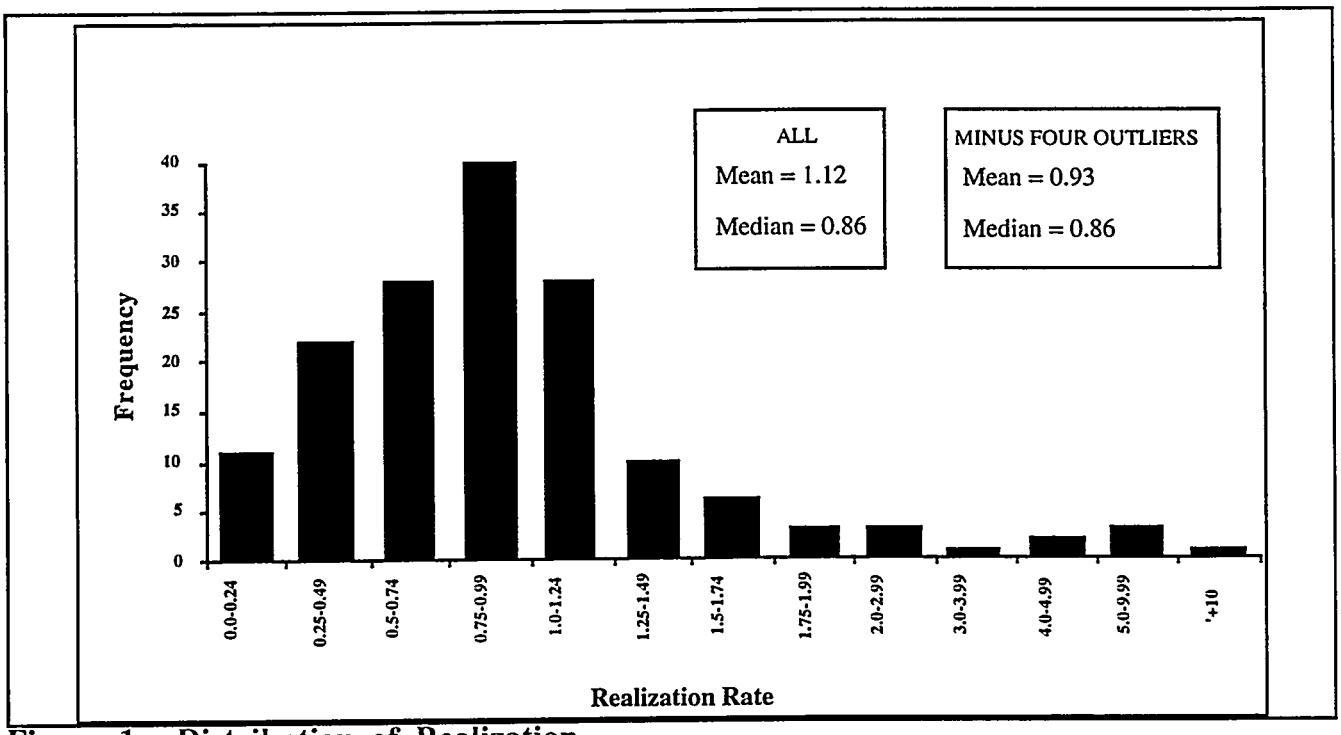


**Figure 1. Distribution of Realization Rates (N=158)**

## *Realization Rates By Sector and Program Type*

The realization rates for commercial, industrial, and agricultural DSM programs tend to be higher than those for residential DSM programs. The mean and median realization rates for C/I/A DSM programs are 1.26 and 0.91, respectively, suggesting that these programs consistently produced the magnitude of savings that they were designed to deliver. (If the four highest C/I/A realization rates are removed, the mean is 0.96 and the median is 0.89.) In contrast, the mean and median realization rates for residential DSM programs are only 0.88 and 0.69, respectively, suggesting that they consistently fell short of their projected energy savings. Some of these sectoral differences may be due to the fact that the impact studies of residential and C/I/A programs tended to rely on different *ex-post* estimation and evaluation methods. For instance, 26 of the nonresidential realization rates resulted from *ex-post* estimates based on simplified engineering models, which had a median realization rate of 1.0, while none of the residential realization rates used this method for *ex-post* estimation. Further, a higher percentage of the commercial/industrial/agricultural programs (compared with the residential programs) were operated by the utilities on the basis of shared-savings incentives, which may motivate the utilities to produce or exceed the expected levels of energy savings, thus increasing the *ex-post* savings and, thereby, the realization rate.

Of the seven types of DSM programs covered by the evaluations, the lowest realization rates are experienced by residential direct assistance programs (with a mean of 0.68 and a median of 0.53). Recall that these programs account for a large share (29%) of the total DSM expenditures of the four utilities during the three-year study period. The residential energy management services programs also tend to have low realization rates, with a median of 0.59 but a mean of 1.0, reflecting a few high-performing programs. C/I/A energy management services programs have mean and median realization rates of 0.92 and 0.95, respectively, indicating that they came close to

generating the energy savings they were projected to deliver. All three of these types of programs earn performance-adder incentives for the utilities, and not shared savings incentives.

With the exception of residential new construction programs, the shared-savings incentive programs generally had higher-than-average realization rates. Residential retrofit incentive programs have the highest median realization rate (1.06 compared to 0.86 for all realization rates), and their commercial, industrial, and agricultural counterparts had the highest mean realization rate (1.54 compared to 1.12 for all realization rates). Recall that retrofit incentive programs account for the second largest share of total DSM expenditures (23%) during the three-year study period. They also are the dominant DSM expenditure for which utilities earn shared savings incentives.

### *Realization Rates For Selected Measures*

Realization rates for three residential DSM measures are examined in this section: compact fluorescent lamps, low-flow showerheads, and refrigerator replacements. Collectively, these three measures have median realization rates that span the spectrum from 0.27 for low-flow showerheads to 1.23 for refrigerator replacements (Table 2). In addition to the wide variation in realization rates across programs offering different measures, there is also considerable variation in realization rates among programs offering similar measures. Features of the DSM programs that offer these measures and their impact evaluations are described below in an attempt to explain why realization rates are so variable.

**Table 2. Realization Rates for Selected Measures**

| | Mean | Median | Range | Number of Programs or Segments |
|---|---|---|---|---|
| **Compact fluorescent lamps** | 0.90 | 0.83 | 0.37 to 1.59 | 6 |
| **Low-flow showerheads** | 0.57 | 0.27 | 0.03 to 1.75 | 7 |
| **Refrigerator replacements** | 1.29 | 1.23 | 0.73 to 1.96 | 4 |

***Compact Fluorescent Lamps.*** The impact evaluations present six realization rates for compact fluorescents. These rates vary from 0.37 to 1.59, with a mean of 0.90 and a median of 0.83.

The magnitude of the *ex-ante* estimates of energy savings appears to explain some of the wide variation in realization rates. The six programs varied significantly in the assumed energy savings of a compact fluorescent bulb, ranging from 32 to 142 kWh/lamp, and the two programs with the largest realization rates have the lowest estimates of *ex-ante* savings. Uniformity across programs in the energy saved per bulb is not to be expected, since energy savings depend upon hours of use, replaced wattages, and levels of free ridership, among other variables. However, the variability among these six programs is also a function of differences in what factors are included in the *ex-ante* estimates. For instance, the planning assumptions for several of these programs did not include the possibility of free riders and did not discount the estimated energy savings to reflect the non-installation, removal, burnout, or destruction of some lamps. Where the planning assumptions were reported in the impact studies, they tended to overstate the magnitude of likely savings. For instance, PG&E assumed an average of 5.1 hours of use per lamp in its 1992 Residential Compact Fluorescent Lighting Program, while the impact study estimated 3.2 hours. Similarly, PG&E assumed that the lamps replaced by its Targeted Customer Appliance Program averaged 100 watts, but the impact study indicated an average of 65 watts, leading to a low average wattage replacement of 37.

Different evaluation methods appear to characterize higher versus lower realization rates. Calibrated engineering models were used for both of the SDG&E programs where *ex-post* estimates exceeded *ex-ante* projections. In contrast, statistically adjusted engineering approaches were used to evaluate the two programs with the lowest realization rates. Further, as noted above, realization rates will be lower if measure installation rates, rebound effects, and free ridership are included in the *ex-post* estimation, but not in the *ex-ante* estimation.

Program features also appear to explain realization rates. For instance, the lowest realization rate and the lowest *ex-post* energy savings was experienced by SCE's Relamping Program, which installed 4.6 lamps per participating low-income participant. This rate of installation may exceed the cost-effective opportunities available in the average participant's home, given the need for a lamp to be used several hours a day so that its replacement is cost-effective. This program had the lowest average hours of use per day (1.8 hours), which is consistent with the finding in Impact Study #156 that installation and persistence rates decline as the number of compact fluorescent lamps distributed to each participating household rises.

Finally, indicators of program performance can explain the wide-ranging realization rates. For instance, the three programs that estimated free ridership produced estimates that ranged from 22% to 46%, differences which will dramatically affect *ex-post* savings estimates as well as realization rates if these estimates deviate from planning assumptions. Similarly, rates of measure retention ranged from 61% to 90%, average daily usage ranged from 1.8 to 4.1 hours per day, and average wattage replacement ranged from 37 to 75 watts. In general, the lower these values are, the lower the realization rates.

Altogether, this analysis of realization rates for compact fluorescent lamps highlights the large complex of factors that can cause actual savings to deviate from anticipated savings.

***Low-Flow Showerheads.*** The impact evaluations present seven realization rates for low-flow showerheads. These rates vary from 0.03 to 1.75, and have a median value of 0.27.

As with the analysis of compact fluorescent lamps, the magnitude of *ex-ante* estimates of energy savings appears to explain some of the variation in realization rates. The *ex-ante* estimates of energy savings per low-flow showerhead vary widely, from 418 to 832 kWh/year and from 12 to 57 therms/year. The two programs with highest realization rates are both associated with relatively low *ex-ante* estimates of savings.

The use of different evaluation methods also helps to explain the magnitude of realization rates. In particular, the two highest realization rates resulted from evaluations that did not take into account the existence of free riders. In contrast, the two lowest realization rates (associated with PG&E's 1992 Energy Saver Showerhead Coupon Program) were the result of impact evaluations with extremely high estimated free ridership rates (92%) that were not anticipated when planning the program (when it was assumed that half of the participants would be free riders). *Ex-post* estimates of the retention of low-flow showerheads were fairly consistent across the impact studies, ranging from 83% to 97%. Although the planning estimates for this factor were not reported, it is unlikely that measure persistence was a major source of variation between realization rates.

The extremely low realization rates for PG&E's 1992 Energy Saver Showerhead Coupon Program also reflect the program's success during previous years. By 1992, the availability of high-flow showerheads to be replaced with program showerheads had shrunk dramatically, and with it, realized savings. Because the showerheads being replaced often had moderate, rather than high, gallon-per-minute flow rates, the program's *ex-post* estimate of energy savings was less than

one-third of its *ex-ante* estimates. The high free ridership level in 1992 may also reflect the market impacts of the program during previous years.

***Refrigerator Replacements.*** The impact evaluations present four realization rates for refrigerator replacements. These rates vary from 0.73 to 1.96, and have a median value of 1.23.

These four realization rates refer to two different types of refrigerator replacement programs. PG&E's Targeted Customer Appliance Program is primarily an "early retirement" program designed to help low-income customers reduce their electricity bills by replacing their older less energy-efficient appliances with more efficient ones at no cost to the participant. One of the realization rates is for 1991 and the second is for 1992. The other two programs provided incentives for households to purchase more energy-efficient refrigerators.

Realization rates differ by type of program. The highest *ex-ante* savings estimates and the lowest realization rates are associated with PG&E's early retirement program. The difference between the 1991 and 1992 realization rates (0.93 and 0.73, respectively) is a function of different *ex-ante* estimate of net savings. The *ex-ante* estimate for 1992 was increased based on the assumption that the 1992 program would replace more energy-inefficient refrigerators than in 1991. The lowest *ex-ante* savings estimates and the highest realization rates—both exceeding 1.5—were associated with the two programs that offered incentives to promote the purchase of more energy-efficient refrigerators. Thus, the *ex-ante* net savings of the first type were overestimated, and for the second type they were underestimated.

A variety of different evaluation methods were used to estimate the energy saved by the program per replaced refrigerator. As with the previous DSM measures, statistically adjusted engineering approaches produced lower realization rates than calibrated engineering models. Each of the evaluations accounted for free ridership in their *ex-post* estimation of net savings, but different methods were used. The PG&E program's evaluation user survey data to estimate a free ridership rate of about 30%, the SDG&E program's evaluation compared retail sales before vs. after the program to estimate net impacts, and the SCE program's evaluation used a nonparticipant group in its conditional demand analysis to adjust for free ridership. These different approaches may have had an impact on the resulting realization rates.

In sum, the impact studies reviewed here suggest that on average, California's DSM programs operating between 1990 and 1992 delivered 112% of the energy savings that were planned, and the typical program delivered approximately 86% of the energy savings it was designed to deliver. A majority of the programs (62%) delivered between 50% and 125% of their *ex-ante* savings. The implementation of initiatives to narrow this range should be a major thrust of resource planners and program managers in the four California utilities. The impact of different *ex-ante* estimation procedures warrants further examination in this regard. The *ex-ante* estimates of savings for similar DSM measures, across utilities and across programs in the same utilities, were found to be extremely wide ranging and a possible source of systematic bias in the realization rates.

No single program feature or *ex-post* evaluation method appears to dictate a program's realization rate. However, by comparing the realization rates of similar DSM measures, it is possible to identify likely influences. In the residential sector, high realization rates are associated with (1) *ex-post* impact estimates that rely on calibrated engineering models, (2) relatively low *ex-ante* estimates of savings, and (3) evaluations that fail to discount savings for free riders, rebound effects, and imperfect measure retention. Among the C/I/A programs, high realization rates are associated with commercial-sector programs and *ex-post* evaluation methods that involve use of either simplified engineering models or conditional demand analysis.

## Conclusions

More information and knowledge would have been gained from this review of California's recent impact evaluations if similar types of programs had been evaluated using similar methodologies and if consistent reporting formats had been employed. The California state-wide measurement protocols will promote more consistent reporting of savings in future evaluation studies and thus facilitate the statewide aggregation of savings and comparative analysis. In general, such greater consistency will result in the following benefits:

- improvement in the transferability of savings estimates across utilities (so that the number and frequency of evaluations might be reduced),
- greater ability to identify effective program features (so that programs can be redesigned to maximize performance), and
- aggregations of energy savings estimates, participation levels, realization rates, and other key statistics across utilities (to help state level DSM planning and forecasting).

Finally, any future effort to summarize and synthesize lessons learned from California impact studies should involve the analysis of a wider range of data. In particular, it should include: (1) calculation of a total energy savings estimate appropriate for weighting each realization rate, (2) analysis of procedures used to generate *ex-ante* estimates of energy savings, and (3) compilation of utility statistics such as the numbers of customers by sector which would facilitate comparisons of the relative market penetration of each utility's DSM programs.

In summary, the studies reviewed for this report provide a preliminary basis for (a) obtaining insights into the performance of California's DSM programs, (b) developing information which can be used to enhance program performance, and (c) guiding future evaluation work. The California monitoring and evaluation protocols should allow future evaluation efforts to build off this base and produce results which allow more complete summaries and comparisons across utilities.

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## Acknowledgments

The research described in this paper was sponsored by the California DSM Measurement Advisory Committee (CADMAC) and the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy. Oak Ridge National Laboratory is managed by Martin Marietta Energy Systems, Inc., for the Department of Energy under Contract No. DE-AC05-84OR21400.