ASSESSING THE EFFECTS OF A PROGRAM TO PROMOTE ENERGY-EFFICIENCY UPGRADES IN EXISTING HOMES

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ABSTRACT

Energy efficient mortgages (EEMs) are intended to mitigate some of the financial barriers to upgrading the energy efficiency of existing (and sometimes new) houses. The Time of Sale Energy Renovation Program (TOSER) is designed to overcome key obstacles that have limited the use of EEMs when existing homes are sold. Conducted by Staples-Hutchinson for Pacific Gas and Electric, the Program primarily provides seminars to real estate agents and lenders to educate them about the characteristics and benefits of EEMs. EEMs typically allow the buyer to include cost-effective efficiency upgrades in her mortgage. This paper presents an overview of the TOSER Program and the results of the third and fourth evaluation of this Program. This study relied on market actor interviews and statistical analyses of key program data to identify program impacts and opportunities to improve program effectiveness.

INTRODUCTION

This paper summarizes the results of an assessment and market effects study by XENERGY, Inc., of Pacific Gas and Electric's (PG&E's) Time of Sale Energy Renovation Program (TOSER) (Lee & Larkin 2000). Three annual evaluations of the TOSER Program (and its preceding program) have been conducted. This paper supplements the information from the third annual study with the results of quantitative analyses that have been conducted since the 2000 evaluation was completed.

The EEM Process

An energy efficient mortgage (EEM), coupled with a rating from a home energy rating system (HERS), is intended to address many of the reasons buyers do not invest in residential efficiency improvements at the time they purchase a home. The rating can answer questions about the energy use and utility bills of the existing home, as well as what different types of efficiency improvements cost, which ones are cost-effective, and how much they will reduce utility bills. An EEM has the potential to overcome financial impediments to making the energy-efficiency improvements by allowing the buyer to qualify for financing for the efficiency improvements and by making the buyer aware that, even with higher monthly loan payments, her combined financing and utility costs will decline. The HERS rating is used to identify those efficiency upgrades that reduce the monthly utility bills more than they increase the monthly mortgage payments. Thus, only those measures that are cost-effective from the buyer's perspective are qualified for inclusion in the EEM.

Both real estate agents and lenders can be key players in the EEM process. The real estate agent can play a major role by acting as a "gatekeeper" and first point-of-contact for the homebuyer. Often the agent is the conduit through which potential buyers learn what EEMs are and what benefits they provide. The lender's role is critical because he must be knowledgeable about EEMs and willing to implement them with minimum complications.

Although an EEM process can alleviate several barriers that buyers face to installing efficiency improvements, implementation of the EEM process itself faces its own obstacles. They include the following generic impediments:

- Lenders are not fully aware of or knowledgeable about EEMs, and lenders often view an EEM as a complication of the lending process.
- Real estate agents are not very aware of EEMs and fear that EEMs can interfere with the orderly home sale/purchase transaction.
- Buyers are generally unaware of and lack knowledge about EEMs and often find the process complicated.
- The home energy rating process can be perceived to be relatively costly.

The TOSER Program

The TOSER Program is a PG&E program initiated in 1999 and implemented by Staples-Hutchinson, which builds upon the 1998 third-party Energy-Aware Housing Agent Program (EAHAP). The TOSER Program focuses on increasing the use

of EEMs at time-of-sale for existing homes in the PG&E service area. The Program has focused on homes purchased through the U.S. Department of Housing and Urban Development's (HUD's) Federal Housing Administration (FHA) loan program. The Program targeted HUD EEMs because HUD has a relatively mature EEM program. There have been some efforts to expand the use of EEMs in the much larger conventional mortgage market, but the scale of these efforts has been considerably less than those of HUD so far. TOSER is being conducted in PG&E's service territory, which is approximately contiguous with the Fresno, Sacramento, and San Francisco HUD regions.

TOSER was designed as a market transformation program to make lasting reductions in impediments to using EEMs for existing homes. Market transformation has been defined as "a reduction in market barriers resulting from a market intervention, as evidenced by a set of market effects, that lasts after the intervention has been withdrawn, reduced, or changed" and market effects are changes "in the structure of a market or the behavior of participants in a market that is reflective of an increase in the adoption of energy-efficient products, services, or practices and is causally related to market interventions" (Eto, Prahl, & Schlegel 1996).

TOSER's primary intervention is training aimed directly at influencing the key housing supply-side market actors—lenders and real estate agents. Its secondary activities are directed at facilitators (contractors who provide EEM/HERS services), home loan consultants, and new efforts started in 2000 to reach homebuyers.

STUDY APPROACH

This section discusses the different components of the approach used to conduct this study. It presents information on the scope of the study, data collection, and analyses conducted.

Study Focus and Scope

Although EEMs have existed for nearly two decades as a means to increase residential efficiency, their use has been fairly limited. The goal of the TOSER Program has been to expand and make the usage of EEMs common practice by reducing the market barriers limiting their implementation. Increased use of EEMs should result directly in a more energy-efficient housing stock.

Given the market transformation nature of this Program, our analytic focus was on identifying and assessing the market effects that have occurred as a result of the Program and the extent to which those market effects appeared to be fundamental market changes that were likely to persist. Consequently, this study addressed principally the changes that the TOSER Program has caused in the market for EEMs.

An integral part of the study design phase was development of a program theory, an essential step under the theory-based evaluation (TBE) approach used in our study. According to Bickman and Peterson (1990), "Program theory is essential for deciding what to measure in a program…With a good sense of program theory, the evaluator can move to observing program process and operation, rather than focusing on simple (and frequently uninterpretable) outcomes."

The theory, or model, for this Program postulates that the primary Program interventions, real estate agent and lender training, will increase these market actors' awareness and understanding of EEMs and EEMs' benefits to buyers, and the benefits to agents and lenders of promoting EEMs.

Increased awareness and understanding, in turn, are expected to lead to increased promotion of EEMs to buyers. This promotion is anticipated to increase the knowledge and awareness of buyers who would then request and implement EEMs. The buyers, lenders, and agents who implement EEMs are expected to realize benefits from the process and communicate these benefits to other professionals and associates. Ultimately, the positive experiences of buyers, lenders, and real estate agents and the communications to other market actors are anticipated to lead to increased consumer demand for EEMs and an integration of the EEM process into the standard practices of housing market supply-side actors. If these changes occur and become permanent, then the market transformation goal of this Program would be achieved.

In 2001, a new element—the Energy Snapshot™—was added to the Program to increase interest in efficiency upgrades (see Energy Snapshot website listed in references). The Energy Snapshot™ is a simplified assessment of the potential for energy savings through energy-efficiency upgrades to existing homes. Staples-Hutchinson developed this low-cost tool to provide homebuyers a guide to energy-efficiency upgrade opportunities. In cases where the Energy Snapshot™ showed a large potential for energy-efficiency improvements, it was anticipated that buyers would have complete HERS ratings performed and obtain EEMs to make the upgrades (Lee and Larkin 2001).

The main focus of the Program is on increasing EEM knowledge and implementation, but the Program's effectiveness is linked to underlying changes in market actors' awareness, knowledge, and perceptions of energy efficiency. Consequently, we investigated these market changes as part of this study, but to a lesser extent than our assessment of market effects related directly to EEMs.

In addition to assessing the effects of the Program on the EEM market, our study also used an innovative econometric analysis to estimate the quantitative effects of the Program on the number of EEMs implemented. It also included an analysis of the energy savings of home upgrades financed through EEMs and an assessment of the effects of the Energy Snapshot™.

Data Collection

This study is based on both survey and statistical data. The surveys were conducted by telephone with the three key market actors in the housing transaction: real estate agents, lenders, and homebuyers distributed throughout the Program area. We conducted interviews with three different groups of agents and lenders. First, we interviewed 68 agents and 30 lenders who participated in training in 2000, and 45 buyers who obtained EEMs in 2000. Second, we reinterviewed 14 agents and 10 lenders who attended training in 1999 and were interviewed for the prior year's study. Third, to develop baseline market information, we interviewed 45 agents and 30 lenders who have never participated in Program training. Sample sizes were limited by the budget available for data collection, and we caution the reader that these modest sample sizes limited the precision and generalizability of the findings from the surveys.

The primary data used to assess the Energy Snapshot™ were from interviews of homebuyers who had obtained Energy Snapshots™. Staples-Hutchinson provided lists of properties for which Energy Snapshots™ had been prepared. Well over 3,000 have been generated since July 1999. We conducted telephone interviews based on a list of 389 addresses and phone numbers of buyers who had obtained Energy Snapshots™ since September 2000. A total of 120 interviews were conducted.

The statistical data that we analyzed included total numbers of EEM and FHA loan closures, number of agents and lenders trained by the Program, and key demographic data for the HUD regions served by the TOSER Program. We also obtained energy savings estimates from HERS ratings of 150 houses in which efficiency upgrades were performed through EEMs.

Data Analysis

This subsection describes the analytic approaches we used.

Market Effects Analysis.

Using the TBE approach, our analysis of Program market effects was structured to test a series of hypotheses about how the Program interventions affected the market for EEMs. The hypotheses were basically the relationships that constituted the Program theory described earlier. For example, a key hypothesis was that the real estate agent trainings led to increased agent awareness and understanding of both energy efficiency and EEMs.[1]

The survey instruments that we used to assess the training effects were designed to collect the information needed to test our Program hypotheses. The surveys provided both quantitative and qualitative data. Generally, we calculated the mean values for the quantitative variables and categorized the qualitative data.

We used survey results for training nonparticipants to establish baseline information about lender and real estate agent EEM awareness and understanding. The interviews of training participants allowed us to test whether self-reported EEM awareness and understanding had increased as a result of the training; comparisons between the results for training participants and nonparticipants allowed us to validate the self-reported training effects from participants. We also investigated whether differences were statistically significant for key results and explored cross-tabulations of significant variables.

Energy Savings Analysis.

We estimated energy savings associated with EEMs by analyzing the HERS ratings for 150 homes. The analyses included calculating the mean energy savings for each measure and the average savings per house.

[1] All the hypotheses are described in Lee & Larkin 2000.

Attribution of EEMs to the Program.

A significant challenge in assessing information or educational programs is estimating the quantitative effects attributable to the program. In this study, we devised a technique that was well adapted to the available data and provided an innovative way to estimate effects to the Program's training efforts.

We used the HUD FHA loan and EEM data to calculate the number of FHA loans and EEMs issued on a monthly basis in the PG&E territory. These data allowed us to document trends in FHA loans, EEMs, and the EEM penetration rate (number of EEMs/number of FHA loans) from October 1997 through December 2000.

Clearly, we could not assume that all the EEMs issued in the PG&E area could be attributed to the Program. To determine Program impacts, it was critically important to estimate the additional EEMs resulting from the Program. Consequently, we developed a technique for estimating how many EEMs were due to the Program.

The primary objective was to estimate the effect of Program training on the number of EEMs, but it was also important to examine and control for other variables that were likely to affect the number of EEMs implemented. To develop a model, we used a production function framework in which EEMs were viewed as the output of a process and the inputs included the number of real estate agents and lenders trained over time. We used a production function model formulated in terms of a general power function of lender training and real estate agent training, coupled with an array of demographic factors (Kavanaugh & Lee 2001). The power functions themselves can be quite simple—they can be scalar functions of fixed coefficients, linear functions, or higher order functions. The final form we selected allowed us to investigate several informative relationships among the inputs to the model.

We combined the training data (number of agents and lenders trained during a given period) with several demographic and weather variables in our model to explain the pattern of EEMs observed. Our model also included the number of FHA loans issued over time (as discussed later). All date were compiled at the four-digit zip code level. Using a nested-hypothesis testing framework, the preferred form of the production model that resulted included the following variables in addition to the Program training data:

- Household formation over the period 1990 to 2000
- Ethnic composition of population
- Cooling degree-days for air conditioning

Energy Snapshot™ Analysis.

For the Energy Snapshot™ analysis, the ultimate objective of the interviews was to determine what effect the Energy Snapshot™ had on homebuyers' decisions about implementing energy-efficiency upgrades. As a first measure of the effect of the Energy Snapshot™, we asked respondents whether they remembered it. We discovered during pre-testing that an improbably large percentage of respondents did not remember the Energy Snapshot™ when they were asked about their recall without any further information provided. Consequently, we revised the question after the pre-test to provide more details so that respondents who did use the Energy Snapshot™, but did not associate the term "Energy Snapshot" with the document, would be able to provide valid information. This increased the recall rate significantly and, we believe, this modification provided much more reliable data. We used the count of people who were contacted and did or did not recall the Energy Snapshot™ as an initial metric of its effect.

For those people who recalled the Energy Snapshot™, we then asked a series of questions to address the following topics:

- when they obtained the Energy Snapshot™
- the kinds of information they remembered that it provided
- the usefulness of the information
- whether and what energy-efficiency improvements were made after obtaining the Energy Snapshot™
- the importance of the Energy Snapshot™ in making decisions to improve energy efficiency
- how energy-efficiency improvements were financed and
- whether the homebuyer had a HERS rating and used an EEM.

To measure attribution of energy-efficiency upgrades to the Energy Snapshot™, we included both those respondents who could not recall it and those who could. We measured attribution using two factors. First, for those respondents who could not recall the Energy Snapshot™, we assigned a value of zero attribution. Second, for those who recalled it, we

assigned an attribution value based on how important they said it was in their decision to make efficiency improvements. Based on responses, we assigned attribution as follows:

- Not at all important = 0
- Slightly important = 0.33
- Somewhat important = 0.67
- Very important = 1.0.

We used the data on what efficiency upgrades were made and the estimate of attribution to estimate the energy savings due to the Energy Snapshot™. Estimated energy savings for each measure were based on the data from the 2000 TOSER Program evaluation study. We extrapolated this result to the population of homebuyers who have obtained Energy Snapshots™.

In addition, for those respondents who had made upgrades, we calculated the percent who followed up the Energy Snapshot™ with a HERS rating and an EEM.

FINDINGS

This section presents the key findings from the main components of this study.

Program Effectiveness and Market Effects

This subsection discusses findings regarding training effectiveness and Program market effects.

Training Effectiveness.

Consistent with our previous evaluations, training attendees generally found the Program seminars to be very effective. Approximately 91% of the agents and 94% of the lenders said that the seminars had "provided everything they needed" to discuss EEMs with potential buyers.

Overall, the attendees indicated that the seminars substantially increased their understanding of EEMs. Agents reported that their understanding level, on a scale from 0 to 5, increased from 1.6 before the seminar to 3.2 after the seminar and lenders reported an increase from 2.4 to 3.8.

Participating agents and lenders reported that the seminars reduced the barriers that they perceived to implementing EEMs. Both groups reported that the training had the largest effect on reducing barriers associated with understanding and explaining EEMs and having access to information or assistance on EEMs.

Lenders and agents, however, continued to have significant concerns about two potential barriers:

- Lack of agents/lenders who act as leaders in implementing EEMs or "EEM champions"
- Lack of buyer interest in or understanding of EEMs.

Reinterviews of 1999 Program trainees showed that, in general, the training had a lasting effect on reducing the barriers.

Supply-Side Market Effects.

The initial market effect anticipated from the Program training was increased agent and lender awareness and understanding of EEMs. Well over 1,200 real estate agents and 400 lenders have attended TOSER Program (or EAHAP) training courses since 1998. Interviews with Program participants in 2001 and 2000 showed, in fact, that the training led to a substantial increase in trainees' understanding and knowledge of EEMs. On the average, participants (and nonparticipants) rated their understanding before the training around 2.0 on a 6-point scale (0=no understanding and 5=complete understanding) and about 3.5 after the training.

Consistent with our model of the Program, this increased understanding and knowledge of EEMs have led to increased EEM promotion. Participating agents and lenders indicated that they were much more likely to discuss and promote EEMs after the seminar than before. This likelihood was also considerably higher than the level indicated by nonparticipants—participating agents and lenders reported that they were twice as likely as nonparticipants to have discussed EEMs with buyers.

Another key step in our market transformation model—dissemination of information about EEMs from trainees to other professionals—however, did not appear to be happening to much of an extent.

Interviews with agents and lenders provided some evidence that the Program training, through increased EEM awareness and experience, have had an overall market effect by helping to integrate EEMs into supply-side business practices. Interviews with training attendees for the past three years have shown consistently that agents and lenders increased their implementation of EEMs after the training. Reinterviews in 2000 with agents who participated in 1999 training indicated that the effects may be long-lasting; in fact, the share of homes these agents closed with EEMs during 2000 was even higher than

it was shortly after training. Thus, it appeared that EEM knowledge and familiarity have increased EEM implementation, but it was not possible from this analysis to quantify the broad effects on the market.

Homebuyer Results

Because the Program did not focus its efforts significantly on buyers, our findings for homebuyers were based primarily on documenting their observations about and experiences with EEMs. To a limited extent, the TOSER Program influenced the buyers that we interviewed indirectly through the participating agents and lenders and other Program activities. However, without analysis of data from buyers in a non-Program area, it was not possible to infer Program effects on buyers.

Buyers were satisfied with EEMs overall. On a scale from 0 to 5, the average satisfaction rating of buyers regarding the EEM process was 4.3. Ninety-six percent (96%) of the buyers interviewed said they would recommend an EEM to other buyers. Buyers reported very low levels of difficulty with the EEM process. No step in the EEM process received an average difficulty rating from buyers greater than 1.6 on a 0 to 5 point scale.

Buyers generally found EEMs to be very useful overall in reducing barriers to installing energy-efficiency upgrades. The buyers surveyed found EEMs to be particularly useful in reducing the difficulty of understanding energy-efficiency and financing improvements and reducing the time required to select and make improvements.

While buyers were satisfied with the process overall, several expressed dissatisfaction with various aspects of working with project contractors. The concerns usually had to do with the contractor not performing as expected by the homebuyer.

Energy Savings

Based on HERS rating data for 150 houses in the PG&E area, we estimated that the upgrades conducted through each EEM saved the homebuyer an average of 3,261 kWh of electricity and 384 therms of natural gas per year. As noted earlier, only measures that produce a net decrease in the total of utility bills and mortgage payments can be included in an EEM.

Across the entire sample of houses, the largest average electricity savings resulted from replacing air conditioners with new, more efficient ones. Average savings per installation were estimated to be about 1,500 kWh/year. We note that virtually all the air conditioners installed were standard efficiency units (but they replaced much less efficient old units) and the installation could be described as an early replacement. Weatherization and reductions in duct leakage were estimated to produce significant cooling energy savings.

Installation of sunscreens, double-pane windows, or whole house fans were estimated to save about 1,000 kWh/year each through significant reductions in the estimated cooling loads.

Early replacement of existing gas furnaces produced the largest natural gas savings, averaging 244 therms/year per installation. Duct leakage reductions, which saved 193 therms/year, also contributed significantly to total gas savings. Converting from single-pane to double-pane windows produced the third largest gas savings, 131 therms/year. Weatherization that reduced infiltration saved an average of 90 therms/year in space heating energy use

Improvements in envelope insulation levels reduced cooling energy use significantly. The mean savings for ceiling, wall, and floor insulation were about 600 kWh/year for each measure installed. Averaged over all houses, the ceiling insulation electricity savings were high, but the savings for floor insulation were low because this measure was implemented only rarely.

Insulation upgrades also reduced gas consumption significantly—between 74 (for ceiling insulation) and 105 (for wall insulation) therms/year. Across all the houses in our sample, the average savings for ceiling and wall insulation were also relatively large, but the savings for floor insulation were not because this measure was implemented in very few houses.

Between when the TOSER Program (and preceding EAHAP) began and the end of 2000, 4,804 EEMs have been implemented in the PG&E area. For these houses, the total estimated energy savings were the following:

- 15.7 million kWh (15.7 GWh) per year
- 1.84 million therms per year
- 341 billion Btu of source energy per year
- electricity demand savings totaling 3.73 average megawatts.

We did not conduct an independent cost-effectiveness analysis, but based on the EEM economic criterion these savings should be cost-effective to the hombuyer.

Program Effects on the Quantity of EEMs

To assess the energy savings due to this Program, it was important to determine how many of the EEMs in the PG&E area could be attributed to the Program. As noted earlier, we developed a model to examine the factors that influenced the number of EEMs produced.

Table 1 shows that the number of EEMs declined in the PG&E area between 1999 and 2000. Although this would seem to be evidence that the Program had not increased the use of EEMs, other data in the table provide a better understanding.

Table 1. FHA Loan and EEM Statistics

	Within PG&E Territory		Outside of PG&E Territory	
	1999	2000	1999	2000
EEM Loans	1,706	1,229	2,072	1,659
FHA Loans	62,953	38,723	121,332	74,390
Percentage	2.7%	3.2%	1.7%	2.2%

The number of EEMs fell outside the PG&E area between 1999 and 2000 as well. Most importantly, the number of FHA loans, which are the source of the EEMs we studied, fell almost 40% between 1999 and 2000. To control for the effect of FHA loans, we calculated the penetration of EEMs as the percent of FHA loans that are EEMs. The table shows that, in fact, this penetration was higher in the PG&E area and increased between 1999 and 2000. To capture the major effect of the number of FHA loans, our model incorporated this variable as one of the explanatory variables.

The main findings from our quantitative analysis of the effects of the Program training were the following:

- The number of FHA loans is a major determinant of how many FHA EEMs are issued.
- Both the number of real estate agents and number of lenders trained enter jointly as factors in explaining the number of EEMs generated.
- The training impacts are statistically significant and quite pronounced and range from about 2 to 4 additional EEMs produced per trainee over the first three years of the Program.
- Nearly 1 out of every 5 EEMs originated during the TOSER Program can be attributed to the lender and real estate agent training activities (18.3%).

We also found that two demographic and one weather factor were important determinants of the number of EEMs produced. Specifically, the number of EEMs generated was higher in areas that had experienced higher housing growth rates, had larger Hispanic population shares, and had fewer cooling degree-days.[2] Including these factors in our model was very important to minimize bias in the estimates of the Program effects.

Energy Snapshot™ Results

Our analysis of the Energy Snapshot™ interview data produced several interesting results. One of the original objectives of the Energy Snapshot™ was to motivate homeowners to obtain a HERS rating and an EEM to perform major efficiency upgrades. We found, however, that only 1.7% of the Energy Snapshot™ recipients we interviewed actually obtained an EEM.

Recollection of the Energy Snapshot™ was surprisingly limited. Only slightly over one-third (34%) of the 120 recipients we interviewed recalled the Energy Snapshot™. Overall, most respondents were either unable to recall any information provided by the Energy Snapshot™ or the information they recalled was not very consistent with what Energy Snapshots™ actually present. Only 15% of the respondents who recalled the Energy Snapshot™ described the information in a way that was very consistent with it.

Overall, however, the respondents who recalled the Energy Snapshot™ rated it to be quite useful. On a scale from 1 (not at all useful) to 4 (very useful), the average rating was 2.9. This high rating translated into actions. Over half the respondents who

[2] The effect of cooling degree-days seems counterintuitive. There are many possible explanations for this observed relationship including the smoothing effect of the large climate zones used to specify cooling degree-days, correlations between weather data and other variables, and the relationship between building codes and climate. A purely behavioral explanation was offered by the Program manager who noted that HERS facilitators had been less active in the hottest regions. Although we are uncertain of the actual cause for this counterintuitive result, it is statistically significant and important to include in the model to minimize bias.

recalled the Energy Snapshot™ made efficiency upgrades after they received it. Another 22% considered making efficiency upgrades as a result of it, but chose not to. Those respondents who made energy-efficiency upgrades after receiving the Energy Snapshot™ typically said that it was somewhat important in their decision.

The respondents who made efficiency upgrades after obtaining an Energy Snapshot™ implemented a wide range of measures. Generally, low-cost measures were implemented most frequently. The most commonly implemented upgrade was weatherization measures; one-third of respondents who recalled the Energy Snapshot™ installed weatherstripping, sealed penetrations, etc. Another third installed compact fluorescents and other efficient lighting. Nearly one-fourth said that they installed duct insulation or sealed their heating/cooling ducts. Almost 20% said they had installed a setback thermostat. The higher cost measures such as adding wall insulation, replacing windows, and converting to higher-efficiency equipment were less common.

To derive a realistic estimate of the energy savings from the Energy Snapshots™ and compare them with the savings from EEMs, we wanted to avoid counting savings that were not due to the Energy Snapshot™. To do so, we adjusted the savings for each measure installed in each house by the attribution factor discussed earlier. The resulting average savings over all the houses receiving Energy Snapshots™ are summarized in Table 2 and compared with the average savings from EEMs.

Table 2. Average Energy Savings per House

	Electricity Savings, kWh/yr	Natural Gas Savings, therms/yr
EEM	3,260	384
Energy Snapshot™	292	23

The estimated average savings due to the Energy Snapshot™ were less than 10% of the savings from implementing an EEM. Although the savings were small by comparison to EEMs, it is important to keep in mind that Energy Snapshots™ can be provided at very low cost and in high volume.

A major original intention of the Energy Snapshot™ was to motivate homebuyers to have a HERS rating performed and then obtain an EEM to upgrade their house. We asked those people who indicated that they had made efficiency upgrades since obtaining the Energy Snapshot™ whether they also had a HERS rating. Only 23% said that they did so. As noted earlier, only 1.7% of all respondents went on to obtain an EEM to finance their upgrades.

Responses to questions about the relationship between the Energy Snapshot™ and home financing provided very good insights into how the Energy Snapshot™ was being used. The expectation was that most buyers would receive the Energy Snapshot™ before they had financed the purchase of an existing house. When we asked respondents who recalled the Energy Snapshot™ when they obtained it, however, over three-fourths said they received the Energy Snapshot™ *after* they had arranged financing. This suggested that either a buyer got the Energy Snapshot™ while living in a house he had already financed or he received it late in the purchase process. Neither case was consistent with the usual way that EEMs are implemented and this helped explain why the number of resulting EEMs was so small. The cases where owners obtained an Energy Snapshot™ after they had been living in a house for a while could present opportunities for promoting significant efficiency upgrades through mortgage refinancing.

Finally, we asked all respondents who said that they did implement energy-efficiency upgrades after obtaining an Energy Snapshot™ how they financed those upgrades. Eighty-one percent (81%) said they paid cash and 14% (3 individuals) said that they used a mortgage. As mentioned earlier, two of the three people who used a mortgage did the financing through a conventional loan EEM. The large proportion paying cash was consistent with the emphasis on lower cost measures installed after owners received an Energy Snapshot™.

CONCLUSIONS AND RECOMMENDATIONS

Evaluations of this Program have been conducted for over three years now and many of the findings have been quite consistent. The Program has evolved through creative additions such as the Energy Snapshot™ and some re-targeting. The most significant conclusions that we have drawn from these evaluations are the following:

- The training component of the Program has been well received and lenders and real estate agents have found it to be quite effective at educating them about EEMs and preparing them to promote EEMs to customers.

- The training increases EEM awareness, knowledge, and promotion and the effects appear to last for at least a year. However, the relatively high turnover of lenders and agents limits the long-term effects of the training.
- Lenders and agents who participate in Program training do not communicate much of what they learn about EEMs to others in their business.
- From the perspective of lenders and agents, the two major EEM barriers that remain are a lack of EEM "champions" and limited buyer awareness and knowledge of EEMs.
- The effects of the Program training on the generation of EEMs can be estimated based on Program and other data. Each trainee was responsible for between about 2 and 4 additional EEMs over the first three years of the Program as a result of the training, accounting for nearly 20% of the EEMs issued in the PG&E area over this period.
- On the average, EEMs in the PG&E area saved each participating homeowner nearly 3,300 kWh and about 380 therms per year. Based on the EEM economic criterion, these energy savings reduce monthly utility bills more than they increase the monthly mortgage payment.
- The Energy Snapshot™ showed promise as an educational tool to make homeowners aware of energy-efficiency opportunities. Despite the fact that homeowner awareness of the Energy Snapshot™ was quite low and it rarely resulted in an EEM, the Energy Snapshot™ appeared to lead to significant, lower-cost efficiency upgrades financed with cash. Although the upgrades had modest energy saving impacts overall, the costs of delivering the Energy Snapshot™ were low.

Based on these major conclusions and findings, we make the following programmatic recommendations:

- *Continue to increase marketing to potential buyers*: Both supply-side actors and buyers mentioned the need for more promotion of EEMs to buyers.
- *Target EEM promotion*: Our EEM quantitative analysis identified several demographic factors that were related to higher rates of EEM use. To maximize effectiveness, the Program should emphasize promotion in areas with higher than average Hispanic population proportions, lower than average income levels, and higher than average housing growth rates.
- *Continue recent efforts to increase the visibility of industry leaders who have successfully promoted EEMs actively*: A major need in the industry is for champions who show that promoting EEMs can be a successful business strategy. There was some evidence that the lack of champions had declined as a barrier, but it still remained as one of the most significant reasons for lenders and agents to not embrace and promote EEMs.
- *Implement follow-up with the training attendees*: Many agents and lenders felt that EEMs could get lost among all the other activities in their business, but most were very committed to pursuing EEMs. Many suggested the need for reminders, refresher courses, and materials that would help them give EEMs their continued attention. Agents and lenders mentioned specific types of information that they would find useful to remind them of the benefits of EEMs and to communicate these benefits to buyers.
- *Develop and make available additional EEM cost and benefit information*: All three groups interviewed mentioned this need in both 1999 and 2000. Estimated energy savings for houses upgraded through EEMs should be supplemented with upgrade cost estimates and used to develop cost-effectiveness information for buyers, real estate agents, and lenders.
- *Investigate ways to address buyer concerns about facilitators and contractors*: A vocal minority of buyers expressed reservations about the service provided by facilitators and contractors, the upgrade costs, and possible conflicts of interest. The facilitators and contractors can be extremely useful in making the process work, but buyer concerns need to be alleviated.
- *Tailor training to the different market actors:* There was evidence that real estate agents were less knowledgeable about EEMs and less active in promoting them than lenders after the training. It may be desirable to train each group separately or devise ways to provide additional

information to agents through longer sessions or more follow ups.

- *Expand the training to increase the emphasis on EEMs with conventional loans*: Recent programs by non-federal organizations have increased the opportunities for EEMs with non-FHA loans. The number of conventional home loans is significantly larger than the number of FHA loans and this market offers opportunities to expand the quantity of EEMs substantially.
- *Explore ways to make the Energy Snapshot™ or similar low-cost tools to provide homebuyers energy-efficiency information more effective:* The Energy Snapshot™ appeared to lead to increased installation of efficiency upgrades, but only a relatively small proportion of recipients recalled the Energy Snapshot™. Ways to increase the impact of this or similar tools could have significant payoffs in terms of increased energy-efficiency upgrades for a low program cost.

Our analytic recommendations include the following:

- *Further quantitative analyses of factors affecting the number of EEMs implemented should be conducted.*
- *EEMs implemented through conventional loans should be analyzed.*
- *The analysis should be refined to clearly differentiate between EEMs for existing and new homes.*
- *Buyers who did not obtain EEMs should be included in future studies of the Program's market effects to establish better baseline information about buyers who do not obtain EEMs.*
- *Analysis of the long-term effects of the Program should be expanded.*

REFERENCES

Bickman, L. and K. Peterson. 1990. "Using Program Theory to Describe and Measure Program Quality." New Direction for Program Evaluation Fall: 63.

http://www.energysnapshot.net/

Eto, J., R. Prahl, and J. Schlegel. 1996. *A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs.* LBNL-39058. Berkeley, Calif.: Lawrence Berkeley National Laboratory.

Kavanaugh, D. and A. Lee. 2001. *Estimating the Number of EEMs Attributable to the Time of Sale Energy Renovation Program:* prepared for Pacific Gas and Electric Company by XENERGY, Inc.

Lee, A. and J. Larkin. 2000. *2000 Market Effects Study of the TOSER EEM Program—Updated Final Report*. Oakland, Calif.: prepared for Pacific Gas and Electric Company by XENERGY, Inc.

Lee, A. and J. Larkin. 2001. *Effects of the Time of Sale Energy Renovation Program Energy Snapshot*. Oakland, Calif.: prepared for Pacific Gas and Electric Company by XENERGY, Inc.