

Market Effects Study and Evaluation of PG&E's 2000 Time of Sale Energy Renovation Program

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ABSTRACT

The Time of Sale Energy Renovation Program is designed to overcome key barriers that have impeded implementation of energy efficient mortgages (EEMs) when existing homes are sold. Conducted by 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 the cost of cost-effective efficiency upgrades in her mortgage. This paper presents the results of the third study of the market transformation effects of this Program and the energy savings associated with EEMs. The study relied on interviews with real estate agents, lenders, and homebuyers who had implemented EEMs, plus an analysis of loan and EEM statistics and estimated energy savings from homes upgraded through EEMs. This paper documents the market transformation effects of the Program, energy savings achieved by measure and for an average house, and a preliminary econometric analysis of factors influencing the number of EEMs implemented.

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 (TOSER) Program (Lee & Larkin 2000). This is the third assessment of this Program and its preceding third-party Program. The TOSER Program has been designed to increase the use of energy efficient mortgages (EEMs) for existing homes when they are being resold.

The EEM Process

An EEM, coupled with a rating from a home energy rating system (HERS), aims 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. The EEM has the potential to overcome the 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.

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.¹ Often

¹ Staples-Hutchinson and Associates, Inc. June 3, 1999. "Time of Sale Energy Renovation Program 1999 Communications Plan."

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 buyer barriers to installing efficiency improvements, implementation of the *EEM process itself faces its own barriers*. 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, which builds upon the 1998 third-party Energy-Aware Housing Agent Program (EAHAP). The TOSER Program focuses on increasing the use of EEMs for all PG&E-area existing homes purchased through the U.S. Department of Housing and Urban Development's (HUD's) Federal Housing Administration (FHA) loans and homes financed through the Department of Agriculture's Rural Housing Program. 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 to transform the market for EEMs and, thereby, reduce impediments to their use as a means to increase the energy efficiency of 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, Prael, & 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) and home loan consultants, and new efforts in 2000 were implemented to reach homebuyers.

The 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

EEMs have existed for nearly two decades as a means to increase residential efficiency—the goal of the TOSER Program has been to expand the usage of EEMs by reducing the market barriers that have limited their implementation. Increased implementation 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*, rather than the overall market for residential efficiency improvements.

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."

Figure 1 shows the theory, or model, that we developed to describe and assess the expected effects of the Program interventions in the market for EEMs. The primary Program interventions, real estate and lender training, are shown at the top of the figure. Their main objective is to increase these market actors' awareness and understanding of EEMs and EEMs' benefits.

Increased awareness and understanding were expected to lead to increased promotion of EEMs to buyers. This promotion was anticipated, in turn, to increase the knowledge and awareness of buyers who would then request and implement EEMs. The buyers, lenders, and agents who implemented EEMs were 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 were 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 goal of market transformation would be achieved.

This study concentrates on the effects of the TOSER Program training seminars attended by real estate agents and lenders. As shown in Figure 1, these trainings were intended to increase agent and lender EEM awareness and knowledge and implementation of EEMs. We had the benefit of two prior studies of the Program to permit us to assess the effect of the Program over time (Lee & Larkin 1999; Schiller & Assoc. 1998).

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

This study also included an analysis of the energy savings of home upgrades financed through EEMs and a preliminary analysis of the relationship between the penetration rate of EEMs and the extent of Program training.

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 last 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.

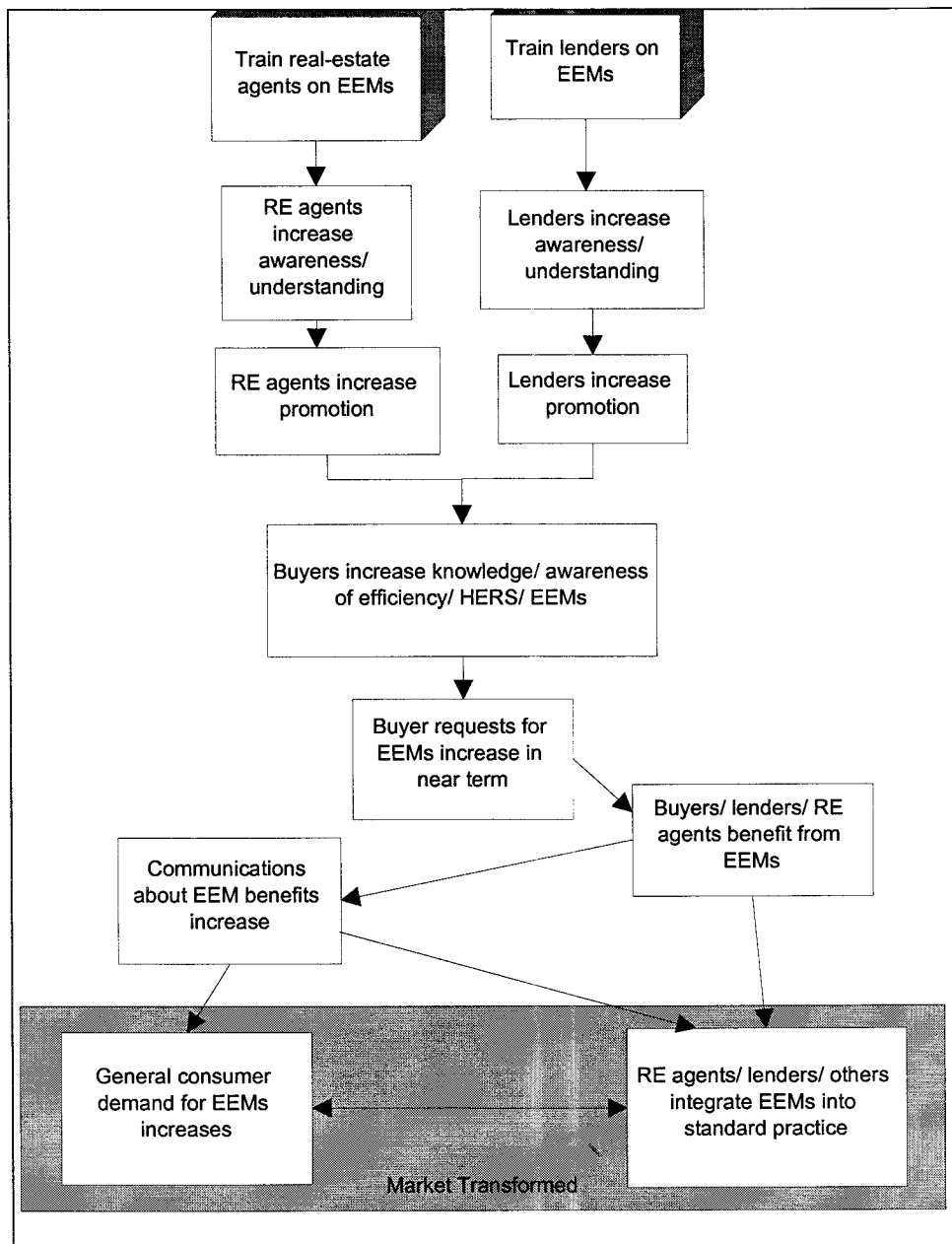


Figure 1. TOSER Program Theory

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

Data 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 illustrated in Figure 1. 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.²

The survey instruments that we used in the interviews described above 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.

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.

We used the HUD data to calculate the number of FHA loans and EEMs issued on a monthly basis in the PG&E territory. HUD reports these data by HUD region, but these regions are not contiguous with utility service areas. Consequently, we had to extract only those loans and EEMs that originated in PG&E zip codes. 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.

We also used these data to conduct statistical analyses of the factors that have affected the number of EEMs implemented over time. The primary objective was to estimate the effect of Program training on the number of EEMs, but it was also important to examine other variables that were likely to affect the number of EEMs implemented. In all cases, our models included the number of FHA loans as a primary explanatory variable; in addition, we examined and tested demographic effects, weather effects, temporal elements, and dynamic effects.

One model estimated the number of EEMs by county based on the number of FHA loans and numbers of agents and lenders trained over the full 39-month Program period. One set of more comprehensive equations was based on the cumulative total of EEMs, FHA loans, number of lenders trained and number of real estate agents trained at any point in time, and demographics data. We examined in some detail three functional forms:

- a linear model to estimate the number of EEMs as a linear function of demographics variables, training variables, and the number of FHA loans
- a logistic model to estimate the penetration rate (number of EEMs/number of FHA loans) as a linear function of demographic variables, training variables, and the number of FHA loans
- a nonlinear model to estimate the number of EEMs as the product of the number of FHA loans multiplied by the demographic and training variables.

Findings

The key findings from the study are summarized in this subsection.

² All the hypotheses are described in Lee & Larkin 2000.

EEM 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 and 384 therms of natural gas per year. Table 1 summarizes the mean energy savings by measure.

Table 1. Energy Savings from EEM Efficiency Upgrades

Upgrade Measure	Mean Energy Savings			
	Houses Installing Measure (Standard deviation in parentheses)		All Houses	
	kWh	Therms	kWh	Therms
Ceiling insulation	568 (208)	74 (28)	250	32.6
Wall insulation	675 (236)	105 (42)	163	25.3
Floor insulation	565 (NA)	101 (46)	7	1.3
Windows (double-pane)	979 (307)	131 (41)	294	39.3
Sunscreens	1091 (226)	N/A	229	N/A
Infiltration control	661 (192)	90 (20)	430	58.5
Duct loss reduction	713 (769)	193 (191)	257	69.4
Furnace efficiency	N/A	244 (53)	N/A	105
Electric furnace to heat pump conversion	5411 (NA)	N/A	38	N/A
Cooling (A/C) efficiency	1574 (687)	N/A	645	N/A
Setback thermostat	424 (68)	42 (17)	148	14.7
Whole house fans	967 (253)	N/A	396	N/A
Water heaters (including conversions of electric to gas)	4848 (133)	92 (81)	145	31.3
Lighting efficiency	878 (308)	N/A	342	N/A
Power Planner	624 (34)	N/A	44	N/A
Low-flow devices/pipe insulation	572 (NA)	29 (17)	3	3.3

Electric water heater conversions to natural gas and electric resistance furnace conversions to a heat pump each produced on the order of 5,000 kWh/year electricity savings. Because these conversions occurred in only a few houses, however, the savings averaged over all the houses were relatively low. Installing a new gas water heater produced mean savings of about 90 therms/year in houses where an older gas water heater was present.

More efficient air conditioners produced annual savings of about 1,500 kWh and the savings were large when averaged over all houses because so many implemented this measure. Upgraded furnaces had the largest single impact on total gas savings with a mean saving of 244 therms/year per house. Duct leakage reductions, which saved 193 therms/year, also contributed significantly to total gas savings. Reduced infiltration saved 90 therms/year in space heating energy use. The use of a setback thermostat produced less savings—approximately 40 therms/year. Reductions in duct leakage and air infiltration into the house produced significant cooling energy savings as well.

Installation of sunscreens, double-pane windows, or whole house fans each saved about 1,000 kWh/year through significant effects on the estimated cooling loads. Converting from single-pane to double-pane windows produced the third largest gas savings, 131 therms/year and the savings were relatively large averaged across all the houses in our sample also.

Electricity savings from lighting efficiency improvements also were significant—about 900 kWh/year.

Insulation upgrades saved between 74 (for ceiling insulation) and 105 (for wall insulation) therms/year for heating, on the average. The savings for ceiling and wall insulation averaged across all the houses were also relatively large, but the savings for floor insulation were not because this measure was implemented in so few houses. Improvements in envelope insulation levels also reduced cooling energy use. The mean savings for ceiling, wall, and floor insulation were about 600 kWh/year for each measure. 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.

Combining these energy savings, the equivalent annual total source energy savings for all 150 homes were estimated to be 71 million Btus per house.

Since the TOSER Program (and preceding EAHAP) began, 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.

The EEM Market

Although the number of EEMs decreased in the PG&E area in 2000, the EEM penetration rate continued to increase. The number of EEMs issued in the PG&E Program area declined this year after a steady rise the past two years. However, much of the decline appeared to be due to a dramatic decrease in the number of FHA loans transacted.

Normalizing by the number of FHA loans, the EEM penetration rate (percent of FHA loans that were EEMs) in the PG&E area increased from 2.7% for all of 1999 to 3.2% for all of 2000. Figure 2 shows the penetration rate for the PG&E Program area, non-Program area, and California as a whole. The EEM penetration rate in the Program area continued to exceed the rate outside the area, which was 2.2% during 2000. These data were consistent with the hypothesis that the Program was having a positive effect on the penetration of EEMs in this market.

Preliminary analysis indicated that several factors, including the Program training, had a statistically significant effect on the number of EEMs in a geographic region within the PG&E service territory. The number of EEMs increased with 1) the proportion of the population that was Hispanic, 2) lower mean family incomes, and 3) higher household mean growth rates. Preliminary analyses of the effects of Program training produced mixed results primarily because of analytic limitations. However, based on these preliminary analyses, we estimated that the number of EEMs in the PG&E territory increased by somewhere between 3.4% and 27% as a result of Program training.

Supply-Side Results

This subsection discusses findings for real estate agents and lenders. As they did last year, this year's attendees generally found the seminars to be very effective.

Attendees found the seminars very useful. 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.

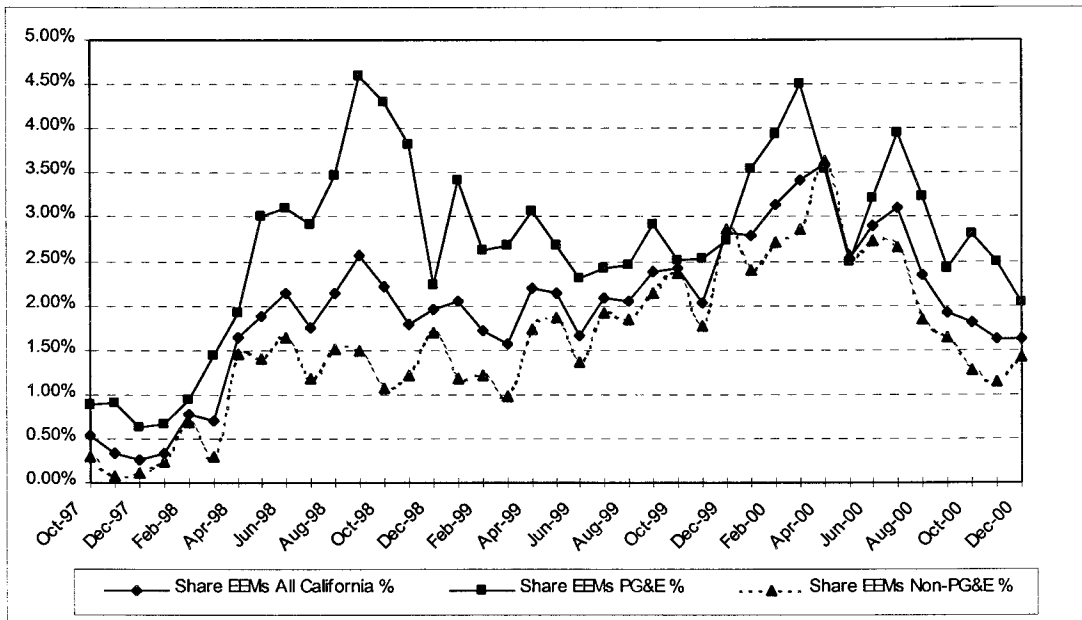


Figure 2. EEMs as Percentage of FHA Loans

Seminars were effective in increasing agents' and lenders' understanding of EEMs. Overall, the data indicated that the seminars appeared to substantially increase understanding of EEMs for both real estate agents and lenders. 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.

Seminars were effective in reducing perceived EEM barriers for real estate agents and lenders. The seminars reduced the perception of barriers to implementing EEMs for both groups. Table 1 provides results for the EEM barriers faced by real estate agents that were reduced the most by Program training. Table 2 provides similar results for lenders who attended Program training.

Table 1. Effects of TOSER Program Training on Real Estate Agent Perceptions of EEM Barriers

Barriers	Real Estate Agents	
	Rating After Seminar	Difference
Difficulty of understanding and explaining EEMs	1.9	-45%
Lack of buyer interest in or understanding of EEMs	3.1	-16%
Lack of benefits for buyers	1.7	-22%
Lack of information on EEMs	2.7	-26%
Lack of assistance available to implement EEMs	2.1	-31%
Time required to process EEMs	2.2	-26%
Front-end cost is too high	2.3	-25%

Note: Scale ranges from 0 = no barrier at all to 5 = major barrier. Differences are based on only participants who were aware of EEMs prior to the training.

Table 2. Effects of TOSER Program Training on Lender Perceptions of EEM Barriers

Barriers	Lenders	
	Rating After Seminar	Difference
Difficulty of understanding and explaining EEMs	1.7	-41%
Lack of information on EEMs	2.1	-33%
Lack of assistance available to implement EEMs	1.8	-31%
Incompatibility with lending practices	1.6	-18%
It's the agent's or buyer's responsibility to mention	1.8	-20%
Lack of EEM facilitators to recommend to buyers	1.3	-28%
Loan pre-qualification doesn't include EEMs	1.0	-34%
Time required to process EEMs	1.9	-24%

Note: Scale ranges from 0 = no barrier at all to 5 = major barrier. Differences are based on only participants who were aware of EEMs prior to the training.

Some significant barriers remained. Significant supply-side barriers that remained after the seminar included these:

- Lack of agents/lenders who acted as leaders in implementing EEMs or “EEM champions”
- Lack of buyer interest in or understanding of EEMs.

Effects of training generally appeared to persist over time. Reinterviews of 1999 Program participants showed that the effects of the TOSER training in reducing most perceived EEM barriers persisted this year. Real estate agents, however, rated “lack of assistance to implement EEMs” and “poor fit with how agents do business” as considerably more significant barriers this year than they did after last year’s training, possibly because of the experiences they had during the past year.

Supply-Side Market Effects

Program activities have increased real estate agents’ and lenders’ understanding and knowledge of EEMs. Nearly 1,200 real estate agents and over 400 lenders have attended TOSER Program (or EAHAP) training courses since 1998. Interviews with Program participants this year and last showed a substantial increase in their understanding and knowledge of EEMs. At least as important, trends for participants before training and nonparticipants suggested that the overall awareness and understanding levels have increased among the lender and agent populations. Although we could not determine how much of the trend was due to the Program, these results were consistent with possible spillover effects of the Program into the overall marketplace.

Increased understanding and knowledge of EEMs have led to increased promotion of EEMs. Participating agents and lenders this year indicated that they were much more likely to discuss and promote EEMs after the seminar than before. This likelihood was also considerably higher than that indicated by nonparticipants. Participating agents and lenders also reported that they were twice as likely as nonparticipants to have actually discussed EEMs with buyers.

Lenders were more likely than real estate agents to have discussed EEMs with other professionals after the seminar, but dissemination of information about EEMs was relatively low.

Increased EEM awareness and experience have helped 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 they closed with EEMs during 2000 was even higher than it was shortly after training (although this was not the case with lenders). It appeared that EEM knowledge and familiarity have increased EEM implementation, but it was not possible to quantify the broad effects on the market.

Home Buyer Results

Because the Program did not focus its efforts significantly on buyers, our findings for homebuyers were based primarily on the experiences they had with EEMs and their attitudes, knowledge, and behaviors related to energy efficiency and EEMs.³ 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 the buyers surveyed regarding the EEM process was 4.3.

Ninety-six percent (96%) of the buyers we interviewed said they would recommend an EEM to other buyers.

EEMs were useful in overcoming barriers to energy-efficiency upgrades for buyers. Buyers found EEMs very useful in reducing barriers to installing energy-efficiency upgrades overall. 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.

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. The most difficult step was reported to be “choosing measures to install.”

Some buyers had concerns about working with contractors. 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.

Overall Effects

This study, the third in a series of market effects studies, added to the strength of the evidence available on Program market effects. Additional evidence alone increased the certainty of our market effects findings. In addition, the findings have tended to be quite consistent across the studies, thus increasing the reliability of our findings.

The clearest and most extensive evidence of Program market effects involved the direct effects of the training on participants' awareness, understanding, and promotion of energy efficiency and EEMs. The Program has focused primarily on these objectives and it appeared to be quite successful at achieving them. Training of lenders and agents appeared to have notable effects on the demand side as well: buyers have increased their knowledge and awareness as a result of working with agents and lenders who were educated about energy efficiency and EEMs. The expected outcomes from buyers

³ The TOSER Program Consumer Awareness Campaign initiated this year was not in full force early enough to affect most homebuyers that we interviewed.

using EEMs also appeared to be realized through their benefiting from EEMs, communicating positively to others about EEMs, and increasing general buyer demand for EEMs.

The more tenuous and less clear market effects occurred in two general areas—institutionalized changes in the practices of lenders and agents in implementing EEMs and follow-through of buyers to obtain EEMs. Both types of market effects are essential for market transformation to occur. On the supply side, lenders and agents noted that the lack of EEM “champions” in their industry was a significant impediment to their embracing EEMs; this impediment could be related to the observed gaps in the supply-side market effects. On the buyer side, buyers, lenders, and real estate agents all mentioned that more third-party education of buyers about EEMs was needed, and the lack of this education could be related to the limited buyer follow-through to obtain EEMs, even after being informed by a lender or agent about EEMs.

As noted earlier, the effects of Program training on the number of EEMs implemented were not always consistent and varied depending on the type of model estimated and which time period we examined. However, as noted earlier, our results suggested that between 3.4% and 27% of the EEMs in the PG&E territory during the 39-month Program period resulted from the Program training.

Comparisons with 1999 Market Effects Study Findings

The results for real estate agents suggested that the seminars in 1999 generally reduced EEM barriers more than the 2000 seminars did. Although this was true, the main reason was that agents came into the seminars with a much higher level of understanding of EEMs in 2000. Although the amount attributable to the Program was uncertain, part of this increase was probably due to the cumulative effects of the Program and a resulting general increase in understanding and awareness.

In most cases, the *extent of the evidence* available on the hypotheses increased this year. For all but two hypotheses, we judged the *strength of the evidence* supporting the hypotheses to be the same this year as last. This should not be interpreted to mean that evidence of the postulated Program cause-effect relationships has not continued to remain significant; there appeared to be moderate or strong evidence supporting most of the hypothesized relationships.

The key difference between the results for 1999 and 2000 was that the extent of the evidence supporting most of the hypothesized relationships has continued to grow as more data have been accumulated. Consequently, the results this year suggested that the market effects observed last year were supported more strongly by the larger body of evidence acquired through this study.

Program Recommendations

Based on our analysis of the qualitative and quantitative data evaluated, we have made the following recommendations to improve the TOSER program:

- Continue to increase marketing to potential buyers.
- Use the results from this study to target EEM promotions to regions based on demographics that are consistent with higher EEM implementation rates.
- Continue recent efforts to recognize as champions and increase the visibility of industry leaders who have promoted EEMs actively.
- Provide follow-up information and seminars to training attendees.

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