CALIFORNIA STATEWIDE RESIDENTIAL CONTRACTOR PROGRAM ENERGY AND MARKET IMPACT ASSESSMENT STUDY

Study ID #SW058

Final Report

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EXECUTIVE SUMMARY

The Statewide Residential Contractor Program (RCP) as implemented in PY2000 contained two distinct elements: a Single-Family Element (SF-RCP) that applied to single-family homes, condominiums, and small attached apartments (e.g., duplex, four-plex) and a Multi-Family Element (MF-RCP) that applied to apartment and condominium complexes. Mobile homes were addressed in either program element as appropriate.

The purpose of this energy and market assessment study was to assess the energy and market impacts of measures installed through both elements of the RCP. There were four major objectives for this assessment study:

- To measure energy impacts from SF-RCP measures using data for measures installed under SF-RCP during PY2000;
- To measure energy impacts for MF-RCP measures using data for measures installed during PY2000;
- To examine and evaluate two approaches (i.e., deemed savings and measured savings) that could be applied for savings from measures installed under MF-RCP and to evaluate incentive levels for such measures; and
- To examine the diffusion of program-promoted measures and interest in these measures among contractors.

ES.1 OVERVIEW OF METHODOLOGY

The gross savings impacts of measures installed under the RCP were estimated using complementary analytical methodologies (e.g., econometric analysis and engineering analysis) and alternative types of data on energy use (e.g., billing data and engineering estimates).

- The econometric analysis of savings involved using longitudinal and cross-sectional comparisons of energy consumption before and after installation of energy efficiency measures to determine how electricity and natural gas use changed *ex post* (i.e., after a measure was installed at a house). Engineering estimates of savings were developed through engineering calculations or through simulations with energy analysis models.
- Various types of data were used for the savings analysis. Program tracking data and customer billing data were provided by the utilities. In addition, a short mail survey was fielded to a sample of households to collect information that could be used in the analysis.

Estimates of kWh and therm savings for single-family RCP measures were developed through both econometric and engineering analysis for the following measures:

- High performance windows;
- HVAC diagnostics (kWh savings only);
- Duct testing and sealing;
- Attic and wall insulation package;
- Programmable thermostats; and
- Energy Star central air conditioners (kWh savings only).

Several sets of comparisons were developed for the savings estimates for single-family RCP measures:

- Econometric estimates of savings developed during this study versus *ex ante* engineering estimates of savings developed in an earlier study by Robert Mowris and Associates;
- Econometric estimates of savings developed during this study versus engineering estimates of savings; and
- Engineering estimates of savings developed during this study versus *ex ante* engineering estimates of savings developed in an earlier study by Robert Mowris and Associates.

There were several aspects to the analysis of savings from MF-RCP measures. One aspect was to estimate the savings for the two types of MF-RCP measures installed by contractors during PY2000 (i.e., lighting measures and water heater measures). A second aspect was to examine deemed and measured savings approaches for MF-RCP measures. The third aspect was to examine incentive levels for MF-RCP measures.

Savings estimation for MF-RCP was based on engineering calculations using data from contractor provided information, tracking data, and *ex post* monitoring data. Secondary research was used to analyze the deemed and measured savings approaches and the incentive levels issue in MF-RCP.

Market changes and impacts were assessed with an approach that is based on the theory of diffusion of innovation. The theory describes a series of stages that characterize market participants according to the degree to which they have accepted/adopted an innovation or practice. Data for examining the diffusion of program-promoted measures were obtained through a telephone survey of both participating and non-participating contractors. The survey interviews were used to gather information with which to determine why contractors chose to participate or not to participate in the program, as well as to determine from the participating contractors their opinions on the operation of the program and other evaluation issues.

ES.2 SUMMARY OF SAVINGS RESULTS

Estimates of savings for single-family RCP measures were developed through both econometric and engineering analysis. Econometric analysis accounts for behavioral as well as technical factors affecting measure savings, while engineering analysis assumes particular behavioral patterns. Accordingly, the econometric estimates of savings for single-famly RCP measures are summarized here.

- The econometric estimates of kWh savings from single-family RCP measures are shown in Table ES-1 for PG&E's service territory and in Table ES-2 for the service territories of SCE and SDG&E.
- The econometric estimates of therm savings from single-family RCP measures are shown in Table ES-3 for PG&E's service territory and in Table ES-4 for the service territories of SCE and SDG&E.

Table ES-1. Estimated kWh Savings from Selected RCP SF Measures by CEC Climate Zones and Weather Stations within Service Area of PG&E (kWh Saved per House per Year)

CEC Climate Zone	*Weather Station*	*High Performance Windows*	*HVAC Diagnostics*	*Duct Sealing*	*Attic/Wall Insulation*	*Programmable Thermostats*	*Energy Star Central A/C*
1	Eureka	204	137	2	-31	-204	162
2	Ukiah	585	92	21	103	-162	487
2	San Rafael	287	90	12	45	-148	218
2	Santa Rosa	352	85	15	65	-143	271
3	Oakland	205	52	10	48	-90	108
3	Colma	193	105	3	-18	-157	98
3	Potrero	178	57	7	25	-92	67
3	Belmont	227	44	13	69	-81	129
3	Santa Cruz	195	97	7	12	-152	137
3	Salinas	182	90	6	6	-139	110
4	Milpitas	231	43	13	72	-80	135
4	Paso Robles	589	100	21	103	-175	510
4	Cupertino	293	31	18	102	-68	187
11	Chico	728	28	31	188	-81	553
11	Marysville	617	50	26	149	-107	477
11	Red Bluff	826	29	33	199	-86	633
11	Auburn	556	99	21	104	-173	485
12	Concord	417	48	19	107	-96	301
12	San Ramon	363	64	16	82	-115	267
12	Sacramento	585	33	26	153	-82	431
12	Angels Camp	725	58	27	155	-120	572
12	Stockton	538	20	26	162	-64	388
13	Bakersfield	1,048	-18	42	277	-29	782
13	Fresno	953	-11	39	256	-35	706

Table ES-2. Estimated kWh Savings from Selected RCP SF Measures by CEC Climate Zones and Weather Stations within Service Areas of SCE and SDG&E (kWh Saved per House per Year)

CEC Climate Zone	Weather Station	High Performance Windows	HVAC Diagnostics	Duct Sealing	Attic/Wall Insulation	Programmable Thermostats	Energy Star Central A/C
			SCE Service Territory				
6	Ventura	135	26	13	75	-55	60
6	Goleta	140	37	11	60	-68	61
6	El Segundo	118	3	12	79	-21	10
6	Long Beach	121	-5	20	130	-18	89
6	Westminster	121	0	19	120	-25	64
8	Santa Ana	121	-7	21	138	-18	101
9	San Dimas	135	-6	26	168	-26	282
9	Montebello	140	10	24	152	-47	253
9	Moorpark	153	46	16	89	-89	159
9	Valencia	160	22	28	172	-69	475
10	Romoland	163	22	29	181	-71	519
10	Rialto	141	-14	32	208	-21	454
13	Tulare	170	19	35	216	-73	659
14	Ridgecrest	174	-14	48	309	-41	999
14	Barstow	167	-10	43	278	-41	851
14	Lancaster	174	29	34	207	-86	629
14	Victorville	177	41	32	189	-101	587
14	Yucca Valley	174	26	35	218	-84	651
15	Cathedral City	146	-101	63	438	65	1,269
15	Blythe	155	-89	63	430	48	1,305
16	Mammoth Lakes	311	323	6	-72	-480	610
16	Rimforest	220	164	12	21	-256	340
16	Bishop	210	100	28	149	-184	683
			SDG&E Service Territory				
7		486	22	17	98	-53	89
10		687	22	29	181	-71	519
14		924	-42	48	320	-1	896

Table ES-3. Estimated Therm Savings from Selected RCP SF Measures by CEC Climate Zones and Weather Stations within Service Area of PG&E (Therms Saved per House per Year)

CEC Climate Zone	***Weather Station***	***High Performance Windows***	***Duct Sealing***	***Attic/Wall Insulation***	***Programmable Thermostats***
1	Eureka	77	62	197	0
2	Ukiah	63	57	193	17
2	San Rafael	59	53	173	6
2	Santa Rosa	58	53	174	9
3	Oakland	38	44	145	4
3	Colma	59	56	179	1
3	Potrero	38	45	147	2
3	Belmont	36	43	140	5
3	Santa Cruz	60	53	171	2
3	Salinas	54	52	166	1
4	Milpitas	36	43	140	6
4	Paso Robles	68	58	198	17
4	Cupertino	32	41	137	9
11	Chico	35	46	164	25
11	Marysville	45	49	170	20
11	Red Bluff	36	48	171	28
11	Auburn	68	58	195	16
12	Concord	41	46	156	13
12	San Ramon	48	48	161	10
12	Sacramento	36	46	158	19
12	Angels Camp	48	52	182	23
12	Stockton	30	42	147	19
13	Bakersfield	15	42	157	37
13	Fresno	18	42	155	34

Table ES-4. Estimated Therm Savings from Selected RCP SF Measures by CEC Climate Zones and Weather Stations within Service Areas of SCE and SDG&E (Therms Saved per House per Year)

CEC Climate Zone	Weather Station	High Performance Windows	Duct Sealing	Attic/Wall Insulation	Programmable Thermostats
		SCE Service Territory			
6	Ventura	44	37	121	3
6	Goleta	50	39	127	2
6	El Segundo	25	32	102	1
6	Long Beach	28	31	103	7
6	Westminster	32	31	102	5
8	Santa Ana	29	31	103	8
9	San Dimas	32	35	123	16
9	Montebello	45	37	126	13
9	Moorpark	65	43	141	7
9	Valencia	54	44	155	22
10	Romoland	54	45	158	23
10	Rialto	28	37	133	24
13	Tulare	57	46	167	30
14	Ridgecrest	38	47	178	46
14	Barstow	38	45	169	40
14	Lancaster	65	48	170	28
14	Victorville	73	49	172	26
14	Yucca Valley	64	47	170	30
15	Cathedral City	-22	36	153	62
15	Blythe	-13	39	164	63
16	Mammoth Lakes	283	95	307	1
16	Rimforest	159	65	210	4
16	Bishop	119	60	208	24
		SDG&E Service Territory			
7		43	36	120	5
10		64	45	158	23
14		43	40	155	44

Estimates were prepared of the savings resulting from two major types of MF-RCP measures installed by contractors during PY2000: lighting measures (primarily for outdoor lighting) and water heater measures.

- Energy savings for outdoor lighting measures were calculated as the difference between baseline usage and post-installation energy usage, calculated as the product of kW demand and hours of operation. In practice, expected and actual

kW demands would not differ. However, analysis of data on hours of operation showed that there were differences in the hours of operation that depended on the type of lighting control. For fixtures controlled by photocells or timers, average hours of operation are fairly comparable to the 4,380 hours that were specified in program materials for exterior lighting. However, average hours of operation for fixtures that are manually controlled (through an on/off switch) are noticeably lower (about 725 hours per year). Although average hours of operation are lower for fixtures that are manually controlled than for fixtures that are controlled by photocells or time clocks, data collected during a survey of multifamily common areas show that most of the exterior lighting fixtures in the population of multifamily housing complexes are controlled either by photocells or by timers.

- The other major type of MF-RCP measure was a controller installed on a water heater or a boiler to optimize system efficiency. In some cases, a controller could also be installed on water heaters or boilers used both for water heating and space heating (hydronic systems). Estimates of savings resulting from installation of the water controllers were developed for 13 multifamily sites. Calculated across all 13 sites, the weighted average savings per apartment unit was 46.7 therms per year, which is somewhat higher than the deemed energy savings estimate of 38 therms per year.

ES.3 SUMMARY OF DEEMED SAVINGS VS MEASURED SAVINGS FOR MF-RCP MEASURES AND INCENTIVE LEVELS FOR SUCH MEASURE

ES.3.1 Measuring Savings

While the savings estimates that are produced through the deemed savings approach simplify the requirements that contractors must meet to participate in the RCP, the estimation of savings for lighting measures and water heater controllers presented in Section 4.1 suggests that there may be questions about the accuracy of the deemed savings values for the multifamily sector.

In general, deemed savings values have been used primarily for measures for single-family houses. Because there has been considerable research and evaluation effort devoted to determining savings for single-family measures, there is a considerable body of evidence on which to establish deemed values for those measures. For the multifamily sector, however, the body of research is much smaller and is probably not as robust for establishing deemed savings value for multifamily measures.

ES.3.2 Incentive Levels

Financial incentives alone are probably not effective in influencing the decisions of apartment owners/operators to purchase energy efficient equipment. That is, the financial attractiveness of the technologies seems clear even without incentives. While providing incentives will of course add to the financial attractiveness, a program will need other features to influence decisions.

ES.4 SUMMARY OF MEASURE DIFFUSION ANALYSIS

The analysis of the diffusion of RCP measures was based on data collected through surveys of HVAC, window, and insulation contractors. Key points drawn from the results of the contractors surveys were as follows.

- In general, participating contractors have been in business longer, are larger firms, serve more residences and have more licenses than nonparticipating firms.
- For contractors as a whole, awareness of the program is in the range of 80 to 90 percent. However, 40 percent of nonparticipating contractors are not aware of the program indicating some potential for increasing awareness with this group. The nonparticipant firms typically have a single license which may make it possible to more readily identify them by using state licensing data.
- The definition of what contractors consider to be high efficiency has changed in the last two years. Participants and partial participants indicate that RCP is a factor in their changing views. Nonparticipants tend to cite other factors such as the energy crisis.
- Contractors generally consider efficient equipment and products to be cost effective in their area.
- Windows contractors indicate that they have changed their recommendations in the last two years. All types of participants are adopting low e-glass. Participants and partial participants report switching to wood and vinyl frames. Many nonparticipants reported switching to double and triple pane glass. Participants cited RCP as a factor in these changes while nonparticipants cited the energy crisis.
- The penetration of efficient HVAC systems, windows, and insulation has increased in the market. The penetration of 13 SEER rate air conditioning units is perceived to be up by three to seven percent across the three types of contractors. Indeed, according to the California Residential Efficiency Market Share Tracking HVAC report 2001, the 13 to 14 SEER efficiency category experienced noticeable increase in 2001. The percent of windows with a U-factor of 0.4 or less is believed to have increased by between 16 and 28 percent across the three types of contractors. Higher percentages of nonparticipants are reporting installation of efficient products than participants

and partial participants. Participants and partial participants cite RCP as a factor in their choosing more efficient products while nonparticipants are more motivated by the energy crisis.

- Participants and partial participant believe that there is much more potential for customers to introduce efficient products into their home than do nonparticipants. Participants and partial participants believe that higher percentages of customers will make changes with out incentive than do nonparticipants. In absolute terms, participants and partial participant perceive a larger number of customers will need incentives to install efficient equipment than do nonparticipants.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES, continued

LIST OF TABLES

LIST OF TABLES, continued

LIST OF TABLES, continued

LIST OF TABLES, continued

LIST OF TABLES, continued

LIST OF TABLES, continued

LIST OF TABLES, continued

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1. INTRODUCTION

This is the final report on an energy and market impact assessment study of the Statewide Residential Contractor Program. This study was conducted by ADM Associates, Inc. (ADM) and TecMRKT Works LLC under contract with Southern California Edison Company.

1.1 STUDY PURPOSE AND OBJECTIVES

The Statewide Residential Contractor Program as implemented in PY2000 contained two distinct elements: a Single-Family Element (SF-RCP) that applied to single-family homes, condominiums, and small attached apartments (e.g., duplex, four-plex) and a Multi-Family Element (MF-RCP) that applied to apartment and condominium complexes. Mobile homes were addressed in either program element as appropriate.

SF-RCP provided vouchers to customers to hire contractors to perform diagnostics and upgrade primarily heating/cooling/water heating systems, to improve insulation, and to install high efficiency windows. SF-RCP sought to promote and facilitate an increase in the application of "whole-systems" and "whole-house" approaches to discretionary residential retrofit activities while increasing the market penetration of individual energy-efficient products and services. In addition to vouchers to consumers, SF-RCP provided funding for information dissemination to customers and for training of contractors. SF-RCP was designed around the existing market of service providers, who are primarily local contractors.

MF-RCP was a pay-for-performance contract program whereby third party energy efficiency service providers (EESPs), energy service companies (ESCOs), or contractors provided energy efficiency services to apartment building owners and property managers. The MF-RCP intervention strategy was designed to encourage EESPs, ESCOs, and contractors to differentiate themselves and to compete with other contractors by offering higher value replacement, retrofit and renovation products and services. Incentives for measures were provided that were based on the level of savings achieved.

The purpose of this energy and market assessment study was to assess the energy and market impacts of measures installed through both elements of the RCP. There were four major objectives for this assessment study:

- To measure energy impacts from SF-RCP measures using data for measures installed under SF-RCP during PY2000;
- To measure energy impacts for MF-RCP measures using data for measures installed during PY2000;

- To examine and evaluate two approaches (i.e., deemed savings and measured savings) that could be applied for savings from measures installed under MF-RCP and to evaluate incentive levels for such measures; and
- To examine the diffusion of program-promoted measures and interest in these measures among contractors.

1.2 SUMMARY OF STUDY APPROACH

Several objectives of the project pertain to measuring the energy impacts of the measures installed by contractors participating in the Residential Contractor Program. The major issue that arises in developing estimates of gross savings impacts is that no one method of analysis used alone may be sufficient to provide robust estimates of those impacts. Using alternative analytical methods of varying complexity and data requirements allows "triangulation" on results of interest and provides backup contingencies in case some data collection and analysis efforts are less successful or more costly than expected or planned. Moreover, methods can be combined to build on their individual strengths and to avoid their individual shortcomings.

Accordingly, the gross savings impacts of measures installed under the RCP were estimated using complementary analytical methodologies (e.g., econometric analysis and engineering analysis) and alternative types of data on energy use (e.g., billing data and engineering estimates).

Estimates of the savings for measures installed under the SF-RCP were developed in several ways. One type of data analysis made use of billing data for *all* program participants. This analysis was directed at identifying major gross changes in electricity and natural gas use that could be attributed to measures installed by RCP contractors. This stage of the analysis involved using longitudinal and cross-sectional comparisons of energy consumption before and after installation of energy efficiency measures to determine how electricity and natural gas use changed *ex post* (i.e., after a measure was installed at a house). Because all participants were included in this stage of the analysis, savings estimates were developed for *all* measures installed by RCP contractors.

The analysis of savings for SF-RCP measures also included preparing independent, engineering-based estimates of energy use and savings for particular conservation measures. These estimates were developed through engineering calculations or through simulations with energy analysis models. A short mail survey was fielded to collect information from a sample of households that could be used in the analysis.

For the MF-RCP, preliminary data indicated that the number of projects was relatively small, with a few types of measures being installed. Analysis of billing data for each individual MF-RCP site was used for the analysis of savings from MF-RCP measures. The other aspect of the MF-RCP analysis was to prepare engineering-based case studies of a sample of the facilities, which was warranted by the uniqueness of multifamily complexes. Monitoring was used to inform this engineering analysis for the MF-RCP case studies.

Market changes and impacts were assessed with an approach that is based on the theory of diffusion of innovation. The theory describes a series of stages that characterize market participants according to the degree to which they have accepted/adopted an innovation or practice. Because of this, changes in the market can be tracked more closely than if one is simply attempting to count the number of widgets that are adopted. This means that there are opportunities to more carefully identify where RCP has been successful and where additional interventions may be required.

Data for examining the diffusion of program-promoted measures were obtained through a telephone survey of both participating and non-participating contractors. The survey interviews were used to gather information with which to determine why contractors chose to participate or not to participate in the program, as well as to determine from the participating contractors their opinions of the operation of the program and other evaluation issues.

1.3 ORGANIZATION OF REPORT

The remainder of this report on the results of Statewide RCP Energy and Market Impact Assessment Study is organized as follows.

- Chapter 2 provides data on the characteristics of households receiving services from RCP contractors during PY2000 RCP.
- Chapter 3 provides results from an analysis of savings from single-family RCP measures.
- Chapter 4.provides results from an analysis to measure energy impacts for MF-RCP measures.
- Chapter 5 presents results from analysis of survey data regarding diffusion of program-promoted measures.
- Appendix A summarizes the procedures used for data collection.
- Appendix B contains copies of the survey instruments used during the study.
- Appendix C provides several sets of comparisons among savings estimates for single-family RCP measures.

- Appendix D contains tabulations comparing indicators from the 2001 survey of contractors with the indicators from a similar survey conducted in 1999.

2. CHARACTERISTICS OF HOUSEHOLDS RECEIVING SERVICES FROM RCP CONTRACTORS DURING PY2000

This chapter provides information regarding the types of measures installed by RCP contractors during PY2000 and the characteristics of households that received services from RCP contractors.

2.1 TYPES OF MEASURES INSTALLED BY RCP CONTRACTORS

PG&E, SCE and SDG&E each provided data about measures installed by RCP contractors during PY2000; these data were taken from the tracking systems the utilities used to track RCP activity. These data were used to tabulate the types of measures installed by contractors in the different utility service areas and the numbers of households for which the measures were installed. These tabulations are reported in Tables 2-1, 2-2, and 2-3 for the different service areas.

Table 2-1. Types and Numbers of Measures Installed during PY2000 by RCP Contractors in PG&E Service Area

Measure	***Number of Houses with Installed Measures***
High Performance Windows	8,404
Duct Test	2,533
Basic Tune Up	1,859
Duct Seal	1,742
Attic Insulation	1,131
Programmable Thermostat	1,041
Pipe Insulation	946
Hard-Wired Fluorescents	903
Bonus Basic Tune Up	754
Air Conditioner	710
Wall Insulation	666
Gas Furnace	407
Attic/Wall Insulation Bonus	280
Gas Water Heater	80
Heat Pump	16
Shower Heads	0
Screw-In Fluorescents	0

Table 2-2. Types and Numbers of Measures Installed during PY2000 by RCP Contractors in SCE/SCG Service Area

Measure	***Number of Houses with Installed Measures***
Duct Testing	3,987
High Performance Windows	2,859
Duct Sealing	2,337
Duct Testing and Sealing	774
Programmable Thermostat	627
Attic Insulation	618
Advanced HVAC Diagnostic/Tune-up	425
AC/HP Diagnostic Bonus	419
Wall Insulation	236
AC/HP Diagnostic/Tune-up	226
Basic HVAC Diagnostic/Tune-up SCE	192
Insulation Package (Attic & Wall)	163
Energy Star Gas Furnace	65
Energy Star Air Conditioner	47
Pipe Insulation	21
2.5 gpm Showerhead	18
Efficient Gas Water Heater	17
Energy Star Heat Pump	7
Energy Star HW Fluor. Fixtures	2

Table 2-3. Types and Numbers of Measures Installed during PY2000 by RCP Contractors in SDG&E Service Area

Measure	***Number of Houses with Installed Measures***
High Performance Windows	5,186
Gas Furnace Duct Test	4,210
Air Conditioning Energy Star	3,944
Duct Testing	2,893
AC/HP Diagnostic/Tuneup	1,957
Basic HVAC Diagnostic/Tuneup	1,887
Programmable Thermostat	1,708
Duct Sealing	1,611
Air Conditioning 13 SEER	1,562
Whole-House Fan	928
Attic Insulation	843
Gas Furnace Energy Star 90% AFU	657
Diagnostic & Duct Package Bonus	378
Wall Insulation	363
Energy Star Central Air Conditioner	276
Advanced HVAC Diagnostic/Tuneup	260
Energy Star Gas Furnace	135
Insulation Package	95
Reflective Window Film	90
Refrigerator	76
Duct Testing and Sealing	75
High Efficiency Gas Water Heater	24
Energy Star Central Heat Pump	17
Energy Star Central Heat Pump	8
Screw In Compact Fluorescent Lamps	8
Pipe Insulation	7
Water Saving Showerheads	5
Hardwired Fluorescent Lighting	5

2.2 RESULTS FROM SURVEY OF RCP HOUSEHOLDS

To obtain information on the characteristics of the households and dwelling units where measures were installed under the RCP, a short mail survey was fielded to a sample of households where measures had been installed. A sample of 2,500 households was selected for each of the three service areas (i.e., PG&E,

SCE/SCG, and SDG&E). The total mail-out was therefore to 7,500 households. The survey questionnaire was a two-page sheet asking a homeowner to check off items indicating the square footage, year built, and HVAC characteristics. (A copy of this survey form is provided in Appendix B.)

Out of the total mail-out of 7,500 questionnaires, 2,779 were returned (an overall response rate of 37.1 percent). Returns and response rates by utility service area are reported in Table 2-4.

Table 2-4. Survey Response Rates

Service Area	***Number of Responses***	***Response Rate***
PG&E	990	39.6%
SCE/SCG	907	36.3%
SDG&E	882	35.3%
Total	2,779	37.1%

The distribution of survey responses by type of dwelling is shown in Table 2-5. Nearly 88 percent of the PG&E respondents occupied a one- or two-story single-family house, with just over 70 percent of SCE/SCG respondents and about 74 percent of SDG&E respondents occupying single-family houses. There were higher percentages of respondents occupying mobile or manufactured homes in the SCE/SCG and SDG&E service territories than in the PG&E service territory.

Table 2-5. Distribution of Survey Responses by Utility Service Area and Type of Dwelling

Type of Dwelling	***Utility Service Area***			
	PG&E	***SCE/SCG***	***SDG&E***	***Total***
House with 1 story	73.3%	54.4%	50.7%	59.9%
House with 2 or more stories	14.5%	16.2%	22.9%	17.7%
Duplex	3.3%	1.1%	1.9%	2.2%
Triplex	0.4%	0.1%	0.0%	0.2%
Quadplex	0.2%	0.2%	0.9%	0.4%
Townhouse	2.2%	1.4%	5.7%	3.1%
Mobile/manufactured home	3.1%	24.8%	14.4%	13.8%
Apartment in building with 1 or 2 stories	0.9%	0.2%	0.3%	0.5%
Apartment in building with 3 or more stories	0.1%	0.0%	0.1%	0.1%
Other	1.5%	1.4%	2.8%	1.9%
Type of dwelling not reported	0.3%	0.1%	0.1%	0.2%
Number of respondents	990	907	882	2,779

The distribution of household respondents by age of their dwelling unit is shown in Table 2-6. Most of the respondents occupied dwelling units that had been built before 1978.

Table 2-6. Distribution of Survey Responses by Utility Service Area and Age of Dwelling

Age of Dwelling Unit	***Utility Service Area***			
	PG&E	***SCE***	***SDG&E***	***All***
Built before 1978	73.5%	66.3%	64.2%	68.2%
Built between 1979 – 1992	21.4%	28.9%	30.0%	26.6%
Built after 1992	4.0%	3.4%	4.9%	4.1%
Age not reported	1.0%	1.4%	0.9%	1.0%
Number of Respondents	990	907	882	2,779

The distribution of households by size of dwelling is shown in Table 2-7.[1]

Table 2-7. Distribution of Survey Responses by Utility Service Area and Size of Dwelling

Area of Dwelling Unit (Square Feet)	***Utility Service Area***			
	PG&E	***SCE***	***SDG&E***	***All***
0-1,000	5.3%	8.3%	7.5%	6.9%
1,001-1,500	33.4%	35.7%	30.0%	33.1%
1,501-2,000	33.2%	28.3%	30.8%	30.9%
2,001-2,500	13.3%	11.7%	16.0%	13.6%
2,501-3,000	4.8%	5.2%	7.1%	5.7%
>3,000	2.9%	3.9%	4.6%	3.8%
Square footage not reported	7.0%	6.9%	3.9%	6.0%
All	990	907	882	2,779

[1] The average square footage of dwellings by utility service area and type of dwelling were calculated to be the following:

Type of Dwelling	***Utility Service Area***			
	PG&E	***SCE/SCG***	***SDG&E***	***All***
House with 1 story	1,682	1,779	1,826	1,750
House with 2 or more stories	2,480	2,398	2,358	2,405
Duplex	1,278	1,340	1,505	1,381
Triplex	1,405	2,000		1,524
Quadplex	1,200	1,175	1,355	1,308
Townhouse	1,482	1,270	1,414	1,408
Apartment in 1- or 2-story building	941	1,100	1,200	1,026
Other	1,444	1,544	1,261	1,430
All	1,801	1,817	1,832	1,816

The distribution of households by number of rooms in dwelling is shown in Table 2-8.

Table 2-8. Distribution of Survey Responses by Utility Service Area and Number of Rooms in Dwelling

Number of Rooms in Dwelling	***Utility Service Area***			
	PG&E	***SCE***	***SDG&E***	***All***
1-2	0.8%	0.7%	0.7%	0.7%
3-4	4.6%	7.1%	4.3%	5.3%
5-6	32.0%	35.4%	32.1%	33.1%
7-8	38.9%	35.0%	32.7%	35.6%
9-10	14.7%	14.7%	19.4%	16.2%
10-12	6.3%	5.5%	7.3%	6.3%
> 12	1.7%	1.2%	2.7%	1.9%
Number of rooms not reported	0.9%	0.6%	0.9%	0.8%
Number of respondents	990	907	882	2,779

The distribution of households by type of heating system is shown in Table 2-9. The predominant type of heating equipment reported is a natural gas furnace.

Table 2-9. Distribution of Survey Responses by Utility Service Area and Type of Heating System

Type of Heating System	***Utility Service Area***			
	PG&E	***SCE***	***SDG&E***	***All***
Natural gas wall heater	6.9%	6.6%	6.6%	6.7%
Natural gas furnace	77.5%	83.5%	83.0%	81.2%
Electric baseboard or furnace	1.3%	1.9%	1.0%	1.4%
Electric heat pump	2.5%	1.5%	3.1%	2.4%
Other	9.1%	4.6%	4.8%	6.3%
Type not known	1.7%	1.4%	0.9%	1.4%
Type not reported	1.0%	0.4%	0.7%	0.7%
Number of respondents	990	907	882	2,779

The distribution of households by type of air conditioning system is shown in Table 2-10.

Table 2-10. Distribution of Survey Responses by Utility Service Area and Type of Air Conditioning System

Type of A/C System	***Utility Service Area***			
	PG&E	***SCE***	***SDG&E***	***All***
Central air conditioner	72.3%	77.0%	66.2%	71.9%
Room air conditioners	3.0%	3.7%	4.2%	3.6%
Evaporative cooler	2.0%	7.5%	1.7%	3.7%
Combination	0.0%	0.3%	0.5%	0.3%
No air conditioning	21.7%	11.0%	26.6%	19.8%
A/C type not reported	0.9%	0.4%	0.8%	0.7%
Number of respondents	990	907	882	2,779

3. ANALYSIS OF SAVINGS FROM SINGLE-FAMILY MEASURES

This chapter presents and discusses the results from the analysis of savings for single-family measures. Savings estimates were developed through both engineering analysis and billing analysis.

3.1 ENGINEERING ANALYSIS OF SAVINGS

Engineering analysis was used to develop estimates of heating and cooling energy use and of energy savings from installed RCP measures for a sample of participant dwellings. The approach used for this engineering analysis and the results of the analysis are presented and discussed in this section.

3.1.1 Approach for Engineering Analysis

Independent, engineering-based estimates of savings were developed through engineering calculations or through simulations with energy analysis models. A short mail survey was fielded to collect information from a sample of households that could be used in the analysis.

The model used for the engineering analysis was first developed by ADM for preparing energy use and savings estimates for the CEC's Database on Energy Efficiency Resources (DEER). This model takes data on the characteristics of the houses where measures were installed under the RCP (e.g., square footage, age, and other characteristics) and prepares energy use and energy savings estimates for different climate zones in California.

The characteristics data were obtained through the mail survey. Once the input file for a house was prepared from the collected data, it was used to prepare a baseline estimate of the energy use for the house. The baseline analysis provided estimates of the energy use at the house before the particular measures had been installed. The model was then used to develop the data for determining the energy savings impacts of the different measures that may have been installed at the house, both individually and in combination.

3.1.2 Results of Engineering Analysis

The results of the engineering analysis are presented in Tables 3-1 through 3-6. There are two tables for each of three utility service areas (i.e., PG&E, SCE/SCG, and SDG&E). The first table for each service area shows kWh savings, while the second table shows therm savings. Savings are reported for regions as defined for the DEER database.

Table 3-1. kWh Savings Estimated for SF RCP Measures through Engineering Analysis: PG&E (kWh savings per house)

Measure	***Region***		
	North Coastal	***North Interior***	***All***
Bonus HVAC Diagnostic/Tune-up	16	58	57
Basic HVAC Diagnostic/Tune-up	88	227	225
Advanced HVAC Diagnostic/Tune-up			
Duct Sealing	90	187	184
Duct Testing and Sealing			
High Performance Windows	212	325	257
Attic Insulation	280	447	370
Wall Insulation	267	235	254
Insulation Package	458	470	464
Programmable thermostat	223	372	365
Number of houses	187	372	559
Average total kWh per house	6,822	9,011	8,279
Average cooling kWh per house	348	1,301	982
Average heating kWh per house	683	591	622

Table 3-2. Therm Savings Estimated for SF RCP Measures through Engineering Analysis: PG&E (Therm savings per house)

Measure	***Region***		
	North Coastal	***North Interior***	***All***
Bonus HVAC Diagnostic/Tune-up			
Basic HVAC Diagnostic/Tune-up			
Advanced HVAC Diagnostic/Tune-up			
Duct Sealing	61	69	69
Duct Testing and Sealing			
High Performance Windows	-65	-76	-70
Attic Insulation	187	218	203
Wall Insulation	150	175	159
Insulation Package	239	377	303
Programmable thermostat	149	159	158
Number of houses	190	453	643
Average total therms per house	839	810	819
Average non-conditioning therms per house	375	274	304
Average conditioning therms per house	465	537	515

Table 3-3. kWh Savings Estimated for SF RCP Measures through Engineering Analysis: SCE (kWh savings per house)

Measure	Region			
	Desert	South Coast	South Interior	All
Bonus HVAC Diagnostic/Tune-up	98	26	65	61
Basic HVAC Diagnostic/Tune-up	608	121	262	254
Advanced HVAC Diagnostic/Tune-up	872	218	376	419
Duct Sealing	319	72	190	185
Duct Testing and Sealing	235	91	277	251
High Performance Windows		257	217	242
Attic Insulation	508	344	585	493
Wall Insulation	71	308	222	247
Insulation Package	278	670	741	685
Programmable thermostat	341	347	366	359
Number of houses	52	184	285	523
Average total kWh per house	9,627	7,108	8,330	8,041
Average cooling kWh per house	3,155	661	1,507	1,378
Average heating kWh per house	474	604	526	547

Table 3-4. Therm Savings Estimated for SF RCP Measures through Engineering Analysis: SCE/SCG (Therm savings per house)

Measure	Region			
	Desert	South Coast	South Interior	All
Bonus HVAC Diagnostic/Tune-up				
Basic HVAC Diagnostic/Tune-up				
Advanced HVAC Diagnostic/Tune-up	20	15	35	31
Duct Sealing	66	27	32	34
Duct Testing and Sealing	29	28	24	27
High Performance Windows		-78	-58	-70
Attic Insulation	560	100	135	135
Wall Insulation	322	116	97	114
Insulation Package	560	151	185	185
Programmable thermostat	239	99	108	120
Number of houses	31	160	220	412
Average total therms per house	580	553	522	539
Average non-conditioning therms per house	207	251	246	245
Average conditioning therms per house	370	290	259	281

Table 3-5. kWh Savings Estimated for SF RCP Measures through Engineering Analysis: SDG&E (kWh savings per house)

Measure	Region		
	South Coastal	South Interior	All
Bonus HVAC Diagnostic/Tune-up	152	73	126
Basic HVAC Diagnostic/Tune-up	448	415	426
Advanced HVAC Diagnostic/Tune-up	419	1055	737
Duct Sealing	348	274	318
Duct Testing and Sealing			
High Performance Windows	495	333	429
Attic Insulation	401	580	456
Wall Insulation	335	229	292
Insulation Package			
Programmable thermostat			
Number of houses	216	162	378
Average total kWh per house	7,850	10,090	8,810
Average cooling kWh per house	635	1201	877
Average heating kWh per house	1,292	1,427	1,350

Table 3-6. Therm Savings Estimated for SF RCP Measures through Engineering Analysis: SDG&E (Therm savings per house)

Measure	Region		
	South Coastal	South Interior	Grand Total
Bonus HVAC Diagnostic/Tune-up			
Basic HVAC Diagnostic/Tune-up			
Advanced HVAC Diagnostic/Tune-up	32	28	30
Duct Sealing	36	374	205
Duct Testing and Sealing			
High Performance Windows	-83	-54	-72
Attic Insulation	117	144	125
Wall Insulation	151	138	146
Insulation Package			
Programmable thermostat			
Number of houses	194	135	329
Average total therms per house	541	776	637
Average non-conditioning therms per house	253	369	300
Average conditioning therms per house	288	408	337

3.2 BILLING ANALYSIS OF SAVINGS

Analysis of billing data was also used to develop estimates of the gross savings associated with particular measures installed through the SF-RCP. The approach used for the billing analysis and the results of the analysis are presented and discussed in this section.

3.2.1 Approach to Billing Analysis

The analysis of billing data involved applying regression analysis to panel data sets of electric and gas billing data to develop longitudinal and cross-sectional comparisons of energy consumption before and after installation of energy efficiency measures and to determine thereby how electricity and natural gas use changed after a measure was installed at a house. The regression analysis was directed at explaining observed electricity or gas consumption from billing records in terms of variables representing individual efficiency measures and weather. The regression analysis isolated and quantified the effects of individual measures on the changes in electricity and natural gas consumption by controlling for the effects of other factors.

The basic model used for the regression analysis was as follows:

$$AEC_t = \alpha_0 + \alpha_1 HDH_t + \alpha_2 CDH_t + E_{et}$$

$$AGC_t = \beta_0 + \beta_1 HDH_t + \beta_2 CDH_t + E_{gt}$$

where

- AEC_t is average daily electricity use for billing period t for a participant (determined by dividing billing period electricity usage by number of days in that billing period);
- AGC_t is average daily natural gas use for billing period t for a participant (determined by dividing billing period natural gas usage by number of days in that billing period);
- HDH_t is the average daily heating degree hours for billing period t for the participant (calculated at different base temperatures);
- CDH_t is the average daily cooling degree hours for billing period t for the participant (calculated at different base temperatures);
- E_{et}, E_{gt} are error terms for the electricity and natural gas equations, respectively;
- α_0, β_0 are intercept terms;
- α_1, β_1 are coefficients showing the changes in electricity or natural gas use that occur for a change in the heating degree hour variable;

- α_2, β_2 are coefficients showing the changes in electricity or natural gas use that occur for a change in the cooling degree hour variable;

The working hypothesis for the analysis was that measures installed under the RCP would affect the responsiveness to changes in weather conditions, as measured by the coefficients $\alpha_1, \alpha_2, \beta_1, \beta_2$. These coefficients reflect the effects of (1) a house's thermal integrity and (2) the efficiency of HVAC equipment. That is, improving a house's thermal integrity or the efficiency of its HVAC equipment or duct system should change the value of these coefficients.

To capture this effect, $\alpha_1, \alpha_2, \beta_1, \beta_2$ were specified as follows:

$\alpha_1 = \alpha_{11} + \alpha_{12}POST$; $\alpha_2 = \alpha_{21} + \alpha_{22}POST$; $\beta_1 = \beta_{11} + \beta_{12}POST$;
and $\beta_2 = \beta_{21} + \beta_{22}POST$

where POST is a dummy variable that is 0 if the monthly billing period is before the energy efficiency measure was installed and 1 if the monthly billing period is after the installation of the measure. With this formulation, the equations to be estimated become:

$$AEC_t = \alpha_0 + \alpha_{11}HDH_t + \alpha_{12}POST*HDH_t + \alpha_{21}CDH_t + \alpha_{22}POST*CDH_t + E_{et}$$

$$AGC_t = \beta_0 + \beta_{11}HDH_t + \beta_{12}POST*HDH_t + \beta_{21}CDH_t + \beta_{22}POST*CDH_t + E_{gt}$$

Ambient weather conditions were represented in the regression models as heating and cooling degree-hours calculated for different base temperatures. Degree-hours are used instead of degree-days because degree-hours provide a more representative measure of the effects of weather conditions. For example, the degree hour variables account for the non-linear response of electricity and natural gas usage to changes in weather conditions. Depending on their energy-efficiency characteristics and the magnitudes of their solar and internal heat gains, buildings differ in the temperatures at which they begin to require heating or cooling. Although degree-days and degree-hours are often reported for a base temperature of 65°F, degree-hour variables for the regression analysis were calculated for six different base temperatures: 50°F, 55°F, 60°F, 65°F, 70°F, and 75°F. With six measures of heating degree-hours and six measures of cooling degree-hours, there are 36 possible combinations of the weather variables and hence 36 different regression relationships to investigate. By performing individual regression calculations for 36 combinations of heating degree hours and cooling degree hours, the results could be examined to identify the "best" combination – selected according to the statistical fit of the estimated equations (as measured by the R-squared values for the regressions). The degree hours used are calculated to match the periods of time covered in the billing records.

The regression analysis was conducted using panel data sets where information from across a set of sites within each utility service area was used. That is, in the regression analysis estimation procedures were applied that take into account both the time-series and the cross-sectional dimensions of the data. The analysis of the billing data used a monthly "panel" regression model in which time-series observations (i.e., monthly consumption) were "pooled" across cross-sectional observations (i.e., houses where measures were installed). In this framework, the dependent variable is the average daily consumption of electricity or natural gas over the billing period for each house.

A fixed-effects specification was used for the panel model. In this specification, the estimated equation contains a constant term that is unique to each house. The purpose of this constant term is to capture the effects of the determinants of that household's energy use that are constant over time. In effect, this approach controls for differences that influence the average level of consumption across households. The specification of customer-specific effects allows the model to capture much of the baseline differences across households while obtaining reliable estimates of the impacts of the measures installed. This covariance approach has the advantage of bringing all of the sample information together in a consistent manner for estimation purposes.

The fixed-effects approach was implemented by using a least squares dummy variable (LSDV) covariance estimate procedure.[2] In this approach, a binary dummy variable was created for each customer in the sample, and the full set of these dummy variables was included in the regression analysis.[3] Actual sample sizes for the billing analysis regressions depended on the availability of billing data and on the number of participants who could be identified as having particular measures installed.

Standard statistical tests and regression diagnostics were used to evaluate the performance of the models and to screen for implausible results. The statistical tests and diagnostics included evaluating the t-statistics for estimated coefficients and the R^2 for equation fit and examining residuals from the fitted models. The results of the statistical testing and diagnostic screening were used to select the model that explains the data best. The results from the model providing the best "fit" were used in the analysis of electricity and natural gas savings.

[2] For a discussion of this approach, see Kmenta, J., **Elements of Econometrics**, 2nd Edition, Macmillan Publishing Company, 1986, pp. 630-635.

[3] In practice, this approach was implemented using PROC GLM in SAS, using the ABSORB option as applied to the customer identification variable.

3.2.2 Results of Billing Analysis Regressions

The "best fitting" regression models developed through the analysis of the electric and gas billing data are presented and discussed here.

Table 3-7 presents the "best" regression model estimated for the effects of high performance windows on electric use; the "best" model for gas use is presented in Table 3-8. As shown in Chapter 2, installation of high performance windows was the highest measure (or among the highest) in terms of number of houses where SF-RCP measures were installed. Moreover, households where high performance windows were installed seldom had other measures installed. For these reasons, independent regression models were developed for the three electric and three gas service areas. This allowed somewhat different formulations of the models to be developed for individual service areas. For example, the base temperatures for the heating degree hour (HDH) and cooling degree hour (CDH) variables could thereby differ across service areas. Similarly, a post-installation dummy variable could be inserted as an intercept shifter as well as a modifier of the weather response variables in some models. Introducing the post-installation dummy variable could accommodate trends common to all households that would have reduced electricity or gas use (e.g., the price increases for electricity in SDG&E's service area during 2001).

The "best" regression models estimated for other major types of SF-RCP measures are presented in Tables 3-9 and 3-10. The "best" regression model for central air conditioners is presented in Table 3-11.

- For the regression analysis, different HVAC diagnostics measures (e.g., basic, advanced, bonus) were grouped to form one measure. That is, any customer who had one of these measures was identified as having received HVAC diagnostics.
- Similarly, attic and wall insulation and the insulation package were used to define one insulation variable. As the tables in Chapter 2 show, the attic insulation and the insulation package (which includes attic and wall insulation) measures were more prevalent than the wall insulation measure. Thus, although the response coefficient for the insulation variable represents a weighting across the different measures, attic insulation is the dominant influence in determining the coefficient.
- Duct sealing and programmable thermostats were individual measures that were entered into the regression models.

For the regression analysis of other measures and of central air conditioners, data were pooled across the three service areas. This increased the number of observations for individual measures, thus making the estimated coefficients more

robust. The trade-off was that the heating degree hour and cooling degree hour variables have the same base for all service areas.

In general, the regression results appeared reasonable. The R-squared values are reasonably high. In terms of estimating savings, the weather response coefficients for the post-installation period are generally negative, indicating that energy use (electric or gas) in response to the weather was lower after the installation of the measures. The obvious exception is the electricity use for programmable thermostats, where no savings are estimated. The absence of savings for this measure may be attributable to the significant behavioral component for the use of thermostats. Also, thermostats were installed only in conjunction with other measures, so that savings from the use of programmable thermostats may be masked by the savings attributed to the other measures.

Table 3-7. Results of Electric Billing Data Regression Analysis for High Performance Windows for Individual Utility Service Areas

Results for PG&E Service Area				
Parameter	***Estimated Coefficient***	***Standard Error***	***t Value***	***Pr > |t|***
HDH per day (Base 75)	0.015234	0.00013856	109.94	<.0001
CDH per day (Base 60)	0.100405	0.00069215	145.06	<.0001
Post installation dummy	-0.625850	0.09695154	-6.46	<.0001
HDH per day (Base 75)*Post	-0.001400	0.00024431	-5.75	<.0001
CDH per day (Base 60)*Post	-0.029800	0.00109604	-27.19	<.0001
Number of households: 6,237				
Mean of dependent variable: 20.22 kWh per day				
R-squared: 0.772		Root Mean Square Error: 5.386		
Results for SCE Service Area				
Parameter	***Estimated Coefficient***	***Standard Error***	***t Value***	***Pr > |t|***
HDH per day (Base 70)	0.032959	0.000502	65.63	<.0001
CDH per day (Base 60)	0.067036	0.000645	103.96	<.0001
HDH per day (Base 70)*Post	-0.001352	0.000201	-6.74	<.0001
CDH per day (Base 60)*Post	-0.000653	0.000331	-1.97	0.0485
Number of households: 2,301				
Mean of dependent variable: 22.05 kWh per day				
R-squared: 0.795		Root Mean Square Error: 6.005		
Results for SDG&E Service Area				
Parameter	***Estimated Coefficient***	***Standard Error***	***t Value***	***Pr > |t|***
HDH per day (Base 60)	0.026177	0.000405	64.64	<.0001
CDH per day (Base 55)	0.016586	0.000254	65.41	<.0001
Post installation dummy	-0.527332	0.134669	-3.92	<.0001
HDH per day (Base 60)*Post	-0.003486	0.000652	-5.34	<.0001
CDH per day (Base 55)*Post	-0.006130	0.000425	-14.44	<.0001
Number of households: 4,081				
Mean of dependent variable: 18.50 kWh per day				
R-squared: 0.812		Root Mean Square Error: 4.580		

Table 3-8. Results of Gas Billing Data Regression Analysis for High Performance Windows for Individual Utility Service Areas

Results for PG&E Service Area				
Parameter	***Estimated Coefficient***	***Standard Error***	***t Value***	***Pr > |t|***
HDH per day (Base 60)	0.011379	0.000025	462.07	<.0001
CDH per day (Base 75)	0.000926	0.000078	11.93	<.0001
Post installation dummy	-0.135750	0.008635	-15.72	<.0001
HDH per day (Base 60)*Post	-0.001230	0.000044	-28.20	<.0001
CDH per day (Base 75)*Post	0.000695	0.000122	5.70	<.0001
Number of households: 7,339				
Mean of dependent variable: 1.86 therms per day				
R-squared: 0.752		Root Mean Square Error: 0.776		
Results for SCG Service Area				
Parameter	***Estimated Coefficient***	***Standard Error***	***t Value***	***Pr > |t|***
HDH per day (Base 60)	0.012686	0.000095	133.89	<.0001
CDH per day (Base 75)	0.000608	0.000236	2.58	0.0099
HDH per day (Base 60)*Post	-0.001933	0.000093	-20.89	<.0001
CDH per day (Base 75)*Post	0.000810	0.000266	3.05	0.0023
Number of households: 1,634				
Mean of dependent variable: 1.63 therms per day				
R-squared: 0.558		Root Mean Square Error: 0.979		
Results for SDG&E Service Area				
Parameter	***Estimated Coefficient***	***Standard Error***	***t Value***	***Pr > |t|***
HDH per day (Base 60)	0.010263	0.000083	123.42	<.0001
CDH per day (Base 70)	0.002465	0.000150	16.47	<.0001
HDH per day (Base 60)*Post	-0.001770	0.000101	-17.46	<.0001
CDH per day (Base 70)*Post	0.000269	0.000199	1.35	0.1800
Number of households: 3,652				
Mean of dependent variable: 1.36 therms per day				
R-squared: 0.758		Root Mean Square Error: 1.570		

Table 3-9. Results of Electric Billing Data Regression Analysis for Selected Types of RCP Measures

Parameter	***Estimated Coefficient***	***Standard Error***	***t Value***	***Pr > |t|***
HDH per day (Base 60)	0.027710	0.000199	139.13	<.0001
CDH per day (Base 60)	0.036032	0.000156	230.65	<.0001
Post installation dummy	-0.961650	0.043682	-22.02	<.0001
HVAC Diagnostics				
HDH per day (Base 60)*Post	-0.002280	0.000246	-9.26	<.0001
CDH per day (Base 60)*Post	0.000936	0.000181	5.16	<.0001
Duct Sealing				
HDH per day (Base 60)*Post	0.000115	0.000286	0.40	0.6865
CDH per day (Base 60)*Post	-0.000450	0.000205	-2.22	0.0266
Attic or Wall Insulation				
HDH per day (Base 60)*Post	0.000762	0.000363	2.10	0.0355
CDH per day (Base 60)*Post	-0.003220	0.000301	-10.70	<.0001
Programmable Thermostat				
HDH per day (Base 60)*Post	0.003337	0.000320	10.42	<.0001
CDH per day (Base 60)*Post	-0.000770	0.000207	-3.73	0.0002
Number of households: 10,561				
Mean of dependent variable: 21.56 kWh per day				
R-squared: 0.780		Root Mean Square Error: 6.091		

Table 3-10. Results of Gas Billing Data Regression Analysis for Selected Types of RCP Measures

Parameter	***Estimated Coefficient***	***Standard Error***	***t Value***	***Pr > |t|***
HDH per day (Base 70)	0.006740	0.000016	415.76	<.0001
CDH per day (Base 70)	0.001821	0.000037	48.56	<.0001
Post installation dummy	0.200991	0.006441	31.21	<.0001
HVAC Diagnostics				
HDH per day (Base 70)*Post	-0.001189	0.000019	-63.64	<.0001
CDH per day (Base 70)*Post	-0.000507	0.000047	-10.75	<.0001
Duct Sealing				
HDH per day (Base 70)*Post	-0.000424	0.000020	-21.43	<.0001
CDH per day (Base 70)*Post	-0.000234	0.000050	-4.69	<.0001
Attic or Wall Insulation				
HDH per day (Base 70)*Post	-0.001358	0.000026	-53.11	<.0001
CDH per day (Base 70)*Post	-0.001234	0.000087	-14.23	<.0001
Programmable Thermostat				
HDH per day (Base 70)*Post	-0.000019	0.000024	-0.76	0.4485
CDH per day (Base 70)*Post	-0.000785	0.000056	-13.91	<.0001
Number of households: 9,764				
Mean of dependent variable: 1.55 Therms per day				
R-squared: 0.690		Root Mean Square Error: 0.817		

Table 3-11. Results of Electric Billing Data Regression Analysis for Central Air Conditioning

Parameter	***Estimated Coefficient***	***Standard Error***	***t Value***	***Pr > |t|***
HDH per day (Base 55)	0.022415	0.000936	23.95	<.0001
CDH per day (Base 75)	0.085666	0.001405	60.98	<.0001
Post installation dummy	-0.069926	0.228069	-0.31	0.7592
HDH per day (Base 55)*Post	-0.005315	0.001608	-3.3	0.001
CDH per day (Base 75)*Post	-0.021830	0.002102	-10.39	<.0001
Number of households: 1,730				
Mean of dependent variable: 24.00kWh per day				
R-squared: 0.757		Root Mean Square Error: 6.978		

3.2.3 Estimates of Measure Savings Derived from Regression Analysis Results

The tables in this section provide estimates of electric and gas savings for SF-RCP measures as derived from the regression models presented in Section 3.2.2. To develop these savings estimates, values of the pertinent heating degree hour and cooling degree hour variables were calculated for different weather station locations for a given period of time. The time period used was from November 1, 1999 through October 31, 2000. This provided a period with a set of contiguous summer and winter months.

Table 3-12. Estimated kWh and Therm Savings from High Performance Windows by CEC Climate Zones and Locations within Service Area of PG&E

CEC Climate Zone	***Location***	***Estimated Annual Electric Savings (kWh/house)***			***Estimated Annual Gas Savings (Therms/house)***		
		Heating Degree Hours (Base 70)	***Cooling Degree Hours (Base 75)***	***KWh Savings***	***Heating Degree Hours (Base 60)***	***Cooling Degree Hours (Base 75)***	***Therm Savings***
1	Eureka	145,142	13	204	62,339	13	77
2	Ukiah	122,508	13,852	585	59,305	13,852	63
2	San Rafael	120,157	3,963	287	50,289	3,963	59
2	Santa Rosa	117,676	6,252	352	50,407	6,252	58
3	Oakland	102,152	2,062	205	32,169	2,062	38
3	Colma	131,172	284	193	48,487	284	59
3	Potrero	106,017	961	178	31,056	961	38
3	Belmont	97,066	3,037	227	30,978	3,037	36
3	Santa Cruz	123,928	695	195	49,023	695	60
3	Salinas	121,070	409	182	44,372	409	54
4	Milpitas	96,502	3,216	231	30,924	3,216	36
4	Paso Robles	125,970	13,812	589	63,344	13,812	68
4	Cupertino	90,247	5,591	293	29,395	5,591	32
11	Chico	91,858	20,102	728	40,053	20,102	35
11	Marysville	101,848	15,893	617	45,248	15,893	45
11	Red Bluff	93,852	23,293	826	42,362	23,293	36
11	Auburn	124,440	12,802	556	62,768	12,802	68
12	Concord	100,110	9,266	417	38,508	9,266	41
12	San Ramon	107,502	7,107	363	42,676	7,107	48
12	Sacramento	93,826	15,206	585	37,607	15,206	36
12	Angels Camp	107,097	19,279	725	49,847	19,279	48
12	Stockton	86,479	13,981	538	32,589	13,981	30
13	Bakersfield	72,504	31,765	1,048	30,155	31,765	15
13	Fresno	74,994	28,440	953	30,615	28,440	18

Table 3-13. Estimated kWh and Therm Savings from High Performance Windows by CEC Climate Zones and Locations within Service Areas of SCE/SCG

CEC Climate Zone	Location	Estimated Annual Electric Savings (kWh/house)			Estimated Annual Gas Savings (Therms/house)		
		Heating Degree Hours (Base 70)	Cooling Degree Hours (Base 60)	KWh Savings	Heating Degree Hours (Base 60)	Cooling Degree Hours (Base 75)	Therm Savings
6	Ventura	86,031	28,700	135	23,177	898	44
6	Goleta	91,389	24,855	140	26,242	303	50
6	El Segundo	74,259	27,427	118	12,757	48	25
6	Long Beach	68,110	44,140	121	15,744	3,011	28
6	Westminster	69,815	41,214	121	17,015	1,561	32
8	Santa Ana	67,290	46,569	121	16,267	3,380	29
9	San Dimas	71,978	57,288	135	21,041	11,018	32
9	Montebello	77,492	53,567	140	26,565	8,330	45
9	Moorpark	95,890	35,799	153	34,967	3,327	65
9	Valencia	88,668	61,850	160	34,998	17,432	54
10	Romoland	88,920	64,887	163	36,176	19,174	54
10	Rialto	70,472	69,872	141	22,433	18,537	28
13	Tulare	88,806	76,480	170	39,689	24,640	57
14	Ridgecrest	77,991	104,688	174	36,625	40,373	38
14	Barstow	78,173	94,490	167	34,272	34,302	38
14	Lancaster	92,432	74,493	174	43,123	22,689	65
14	Victorville	97,240	69,578	177	46,452	20,132	73
14	Yucca Valley	91,065	77,795	174	43,202	23,576	64
15	Cathedral City	40,765	138,910	146	12,621	56,800	-22
15	Blythe	47,954	137,726	155	17,606	57,639	-13
16	Mammoth Lakes	224,111	12,337	311	146,730	345	283
16	Rimforest	149,919	26,091	220	82,807	1,721	159
16	Bishop	125,418	62,627	210	69,664	19,626	119

Table 3-14. Estimated kWh and Therm Savings from High Performance Windows by CEC Climate Zones and Locations within Service Area of SDG&E

CEC Climate Zone	Estimated Annual Electric Savings (kWh/house)			Estimated Annual Gas Savings (Therms/house)		
	Heating Degree Hours (Base 60)	Cooling Degree Hours (Base 55)	KWh Savings	Heating Degree Hours (Base 60)	Cooling Degree Hours (Base 70)	Therm Savings
7	24,432	65,446	486	24,432	6,435	43
10	36,165	91,553	687	36,165	29,801	64
14	24,533	136,825	924	24,533	56,124	43

Table 3-15. Estimated kWh Savings from Selected RCP SF Measures by CEC Climate Zones and Locations within Service Area of PG&E

CEC Climate Zone	Location	Heating Degree Hours (Base 60)	Cooling Degree Hours (Base 60)	Estimated Annual Savings (kWh/house)			
				HVAC Diagnostics	Duct Sealing	Attic/Wall Insulation	Thermostat
1	Eureka	62,339	5,159	137	2	-31	-204
2	Ukiah	59,305	46,181	92	21	103	-162
2	San Rafael	50,289	25,866	90	12	45	-148
2	Santa Rosa	50,407	32,116	85	15	65	-143
3	Oakland	32,169	22,549	52	10	48	-90
3	Colma	48,487	5,914	105	3	-18	-157
3	Potrero	31,056	15,130	57	7	25	-92
3	Belmont	30,978	28,742	44	13	69	-81
3	Santa Cruz	49,023	15,283	97	7	12	-152
3	Salinas	44,372	12,344	90	6	6	-139
4	Milpitas	30,924	29,617	43	13	72	-80
4	Paso Robles	63,344	46,948	100	21	103	-175
4	Cupertino	29,395	38,551	31	18	102	-68
11	Chico	40,053	67,983	28	31	188	-81
11	Marysville	45,248	56,877	50	26	149	-107
11	Red Bluff	42,362	71,877	29	33	199	-86
11	Auburn	62,768	47,014	99	21	104	-173
12	Concord	38,508	42,476	48	19	107	-96
12	San Ramon	42,676	35,548	64	16	82	-115
12	Sacramento	37,607	56,350	33	26	153	-82
12	Angels Camp	49,847	59,809	58	27	155	-120
12	Stockton	32,589	57,922	20	26	162	-64
13	Bakersfield	30,155	93,100	-18	42	277	-29
13	Fresno	30,615	86,801	-11	39	256	-35

Table 3-16. Estimated kWh Savings from Selected RCP SF Measures by CEC Climate Zones and Locations within Service Areas of SCE, SCG and SDG&E

CEC Climate Zone	Location	Heating Degree Hours (Base 60)	Cooling Degree Hours (Base 60)	Estimated Annual Savings (kWh/house)			
				HVAC Diagnostics	Duct Sealing	Attic/Wall Insulation	Thermostat
SCE/SCG Service Areas							
6	Ventura	23,177	28,700	26	13	75	-55
6	Goleta	26,242	24,855	37	11	60	-68
6	El Segundo	12,757	27,427	3	12	79	-21
6	Long Beach	15,744	44,140	-5	20	130	-18
6	Westminster	17,015	41,214	0	19	120	-25
8	Santa Ana	16,267	46,569	-7	21	138	-18
9	San Dimas	21,041	57,288	-6	26	168	-26
9	Montebello	26,565	53,567	10	24	152	-47
9	Moorpark	34,967	35,799	46	16	89	-89
9	Valencia	34,998	61,850	22	28	172	-69
10	Romoland	36,176	64,887	22	29	181	-71
10	Rialto	22,433	69,872	-14	32	208	-21
13	Tulare	39,689	76,480	19	35	216	-73
14	Ridgecrest	36,625	104,688	-14	48	309	-41
14	Barstow	34,272	94,490	-10	43	278	-41
14	Lancaster	43,123	74,493	29	34	207	-86
14	Victorville	46,452	69,578	41	32	189	-101
14	Yucca Valley	43,202	77,795	26	35	218	-84
15	Cathedral City	12,621	138,910	-101	63	438	65
15	Blythe	17,606	137,726	-89	63	430	48
16	Mammoth Lakes	146,730	12,337	323	6	-72	-480
16	Rimforest	82,807	26,091	164	12	21	-256
16	Bishop	69,664	62,627	100	28	149	-184
SDG&E Service Area							
7		24,432	36,357	22	17	98	-53
10		36,165	64,911	22	29	181	-71
14		24,533	105,066	-42	48	320	-1

Table 3-17. Estimated Therm Savings from Selected RCP SF Measures by CEC Climate Zones and Locations within Service Area of PG&E

CEC Climate Zone	Location	Heating Degree Hours (Base 70)	Cooling Degree Hours (Base 70)	Estimated Annual Savings (Therms/house)		
				Duct Sealing	Attic/Wall Insulation	Thermostat
1	Eureka	145,142	122	62	197	0
2	Ukiah	122,508	21,544	57	193	17
2	San Rafael	120,157	7,894	53	173	6
2	Santa Rosa	117,676	11,545	53	174	9
3	Oakland	102,152	4,692	44	145	4
3	Colma	131,172	759	56	179	1
3	Potrero	106,017	2,251	45	147	2
3	Belmont	97,066	6,990	43	140	5
3	Santa Cruz	123,928	2,348	53	171	2
3	Salinas	121,070	1,202	52	166	1
4	Milpitas	96,502	7,355	43	140	6
4	Paso Robles	125,970	21,734	58	198	17
4	Cupertino	90,247	11,563	41	137	9
11	Chico	91,858	31,948	46	164	25
11	Marysville	101,848	25,637	49	170	20
11	Red Bluff	93,852	35,527	48	171	28
11	Auburn	124,440	20,846	58	195	16
12	Concord	100,110	16,238	46	156	13
12	San Ramon	107,502	12,534	48	161	10
12	Sacramento	93,826	24,729	46	158	19
12	Angels Camp	107,097	29,219	52	182	23
12	Stockton	86,479	23,972	42	147	19
13	Bakersfield	72,504	47,609	42	157	37
13	Fresno	74,994	43,340	42	155	34

Table 3-18. Estimated Therm Savings from Selected RCP SF Measures by CEC Climate Zones and Locations within Service Areas of SCE, SCG, and SDG&E

CEC Climate Zone	Location	Heating Degree Hours (Base 70)	Cooling Degree Hours (Base 70)	Estimated Annual Savings (Therms/house)		
				Duct Sealing	Attic/Wall Insulation	Thermostat
			SCE/SCG Service Areas			
6	Ventura	86,031	3,714	37	121	3
6	Goleta	91,389	2,161	39	127	2
6	El Segundo	74,259	1,089	32	102	1
6	Long Beach	68,110	8,666	31	103	7
6	Westminster	69,815	6,173	31	102	5
8	Santa Ana	67,290	9,752	31	103	8
9	San Dimas	71,978	20,385	35	123	16
9	Montebello	77,492	16,654	37	126	13
9	Moorpark	95,890	8,882	43	141	7
9	Valencia	88,668	27,680	44	155	22
10	Romoland	88,920	29,791	45	158	23
10	Rialto	70,472	30,071	37	133	24
13	Tulare	88,806	37,758	46	167	30
14	Ridgecrest	77,991	58,214	47	178	46
14	Barstow	78,173	50,550	45	169	40
14	Lancaster	92,432	35,962	48	170	28
14	Victorville	97,240	32,526	49	172	26
14	Yucca Valley	91,065	37,818	47	170	30
15	Cathedral City	40,765	79,213	36	153	62
15	Blythe	47,954	80,234	39	164	63
16	Mammoth Lakes	224,111	1,878	95	307	1
16	Rimforest	149,919	5,363	65	210	4
16	Bishop	125,418	30,541	60	208	24
			SDG&E Service Area			
7		82,356	6,435	36	120	5
10		88,898	29,801	45	158	23
14		63,431	56,124	40	155	44

Table 3-19. Estimated kWh Savings from High Efficiency Central Air Conditioning by CEC Climate Zones and Locations within Service Area of PG&E

CEC Climate Zone	***Location***	***Heating Degree Hours (Base 55)***	***Cooling Degree Hours (Base 75)***	***Estimated Annual Savings (kWh/house***
1	Eureka	30,354	13	162
2	Ukiah	34,810	13,852	487
2	San Rafael	24,834	3,963	218
2	Santa Rosa	25,289	6,252	271
3	Oakland	11,770	2,062	108
3	Colma	17,327	284	98
3	Potrero	8,592	961	67
3	Belmont	11,708	3,037	129
3	Santa Cruz	22,990	695	137
3	Salinas	18,950	409	110
4	Milpitas	12,123	3,216	135
4	Paso Robles	39,290	13,812	510
4	Cupertino	12,196	5,591	187
11	Chico	21,524	20,102	553
11	Marysville	24,546	15,893	477
11	Red Bluff	23,431	23,293	633
11	Auburn	38,677	12,802	485
12	Concord	18,546	9,266	301
12	San Ramon	20,968	7,107	267
12	Sacramento	18,721	15,206	431
12	Angels Camp	28,491	19,279	572
12	Stockton	15,501	13,981	388
13	Bakersfield	16,570	31,765	782
13	Fresno	16,036	28,440	706

Table 3-20. Estimated kWh Savings from High Efficiency Central Air Conditioning by CEC Climate Zones and Locations within Service Areas of SCE, SCG, and SDG&E

CEC Climate Zone	Location	Heating Degree Hours (Base 55)	Cooling Degree Hours (Base 75)	Estimated Annual Savings (kWh/house
SCE/SCG Service Areas				
6	Ventura	7,569	898	60
6	Goleta	10,200	303	61
6	El Segundo	1,776	48	10
6	Long Beach	4,341	3,011	89
6	Westminster	5,539	1,561	64
8	Santa Ana	5,060	3,380	101
9	San Dimas	7,882	11,018	282
9	Montebello	13,387	8,330	253
9	Moorpark	16,218	3,327	159
9	Valencia	17,836	17,432	475
10	Romoland	18,889	19,174	519
10	Rialto	9,262	18,537	454
13	Tulare	22,747	24,640	659
14	Ridgecrest	22,208	40,373	999
14	Barstow	19,167	34,302	851
14	Lancaster	25,183	22,689	629
14	Victorville	27,720	20,132	587
14	Yucca Valley	25,607	23,576	651
15	Cathedral City	5,522	56,800	1,269
15	Blythe	8,835	57,639	1,305
16	Mammoth Lakes	113,269	345	610
16	Rimforest	56,844	1,721	340
16	Bishop	47,840	19,626	683
SDG&E Service Area				
7		9,593	1,761	89
10		18,880	19,182	519
14		12,370	38,037	896

3.3 COMPARISON OF *EX ANTE* AND *EX POST* KWH SAVINGS ESTIMATES

In preparation for the RCP, Robert Mowris and Associates (RMA) prepared initial estimates of the kWh savings to be expected from different measures.[4] Energy simulations with the DOE 2 energy analysis model were used by RMA to prepare the energy savings estimates for weather-sensitive space cooling and heating measures. The *ex ante* engineering kWh savings estimates developed by RMA are compared here to the *ex post* kWh savings estimates developed through the billing analyses during this study.

Two sets of additional comparisons of savings estimates are provided in Appendix C. One set of comparisons there is between the econometric (regression analysis) estimates of savings and the engineering estimates of savings that were developed during this study. A second set of comparisons is between the engineering estimates of savings developed during this study and the engineering estimates developed by Robert Mowris and Associates.

Estimates of the annual kWh savings from different types of measures that were developed by RMA are shown in Table 3-21. RMA developed savings estimates for the 16 CEC climate zones.

Estimates of the *ex post* kWh savings from RCP measures were presented in Tables 3-12, 3-13, 3-14, 3-15, 3-16, 3-19, and 3-20. These *ex post* estimates of savings are compared in the following to the *ex ante* estimates of savings developed by RMA (as reported in Table 3-21).

[4] Robert Mowris & Associates, *Measure Incentives and Cost Effectiveness for the California Residential Contractor Program, Final Report,* September 1999.

Table 3-21. RMA Estimates of kWh Savings for RCP Measures by CEC Climate Zone

CEC Climate Zone	***Estimated Annual kWh Savings (kWh per house)***					
	High Performance Windows	***Advanced HVAC Diagnostics***	***Duct Sealing***	***Attic/Wall Insulation Package***	***Programmable Thermostat***	***Energy Star Central A/C***
1	11	187	4	-25	2	12
2	407	364	89	32	65	347
3	23	144	10	-26	5	29
4	358	266	63	-106	37	209
5	470	302	92	-116	45	263
6	93	273	106	-18	48	287
7	203	295	109	-61	56	322
8	255	333	143	98	62	378
9	320	536	251	136	96	608
10	707	557	244	598	107	650
11	1,153	1,146	464	99	212	1,276
12	860	667	224	34	121	695
13	1,205	1,174	470	209	240	1,393
14	770	844	331	470	153	920
15	1,590	2,295	1,144	2,165	475	2,937
16	84	441	54	13	42	216

3.3.1 Comparison of kWh Savings Estimates for High Performance Windows

Figure 3-1 compares the *ex ante* and *ex post* estimates of kWh savings for high performance windows.[5] The *ex ante* and *ex post* estimates of savings for high performance windows are relatively similar for most climate zones (except for climate zone 15).

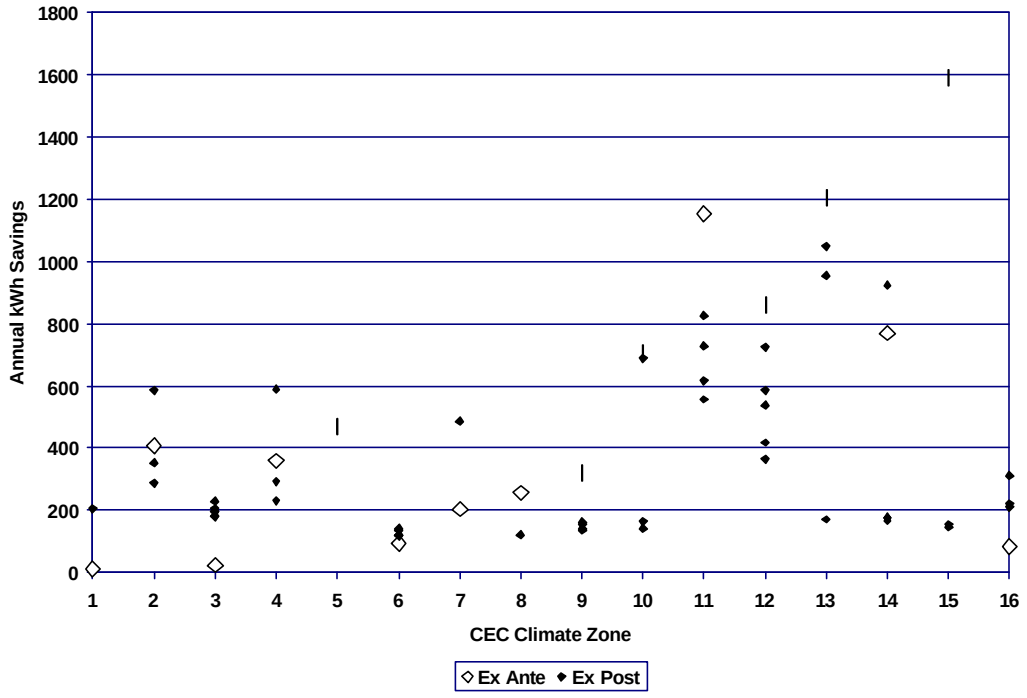

Figure 3-1. Comparison of Ex Ante and Ex Post kWh Savings Estimates for High Performance Windows

[5] As with the other figures where *ex ante* and *ex post* savings estimates are compared, there is one *ex ante* estimate for each climate zone, but there can be more than one *ex post* estimate because there could be several weather stations within a given climate zone. Moreover, points with negative savings are not plotted.

3.3.2 Comparison of kWh Savings Estimates for Advanced HVAC Diagnostics

Figure 3-2 compares the *ex ante* and *ex post* estimates of kWh savings for advanced HVAC diagnostics. The *ex ante* estimates of savings for HVAC diagnostics are higher than the *ex post* estimates for all climate zones.

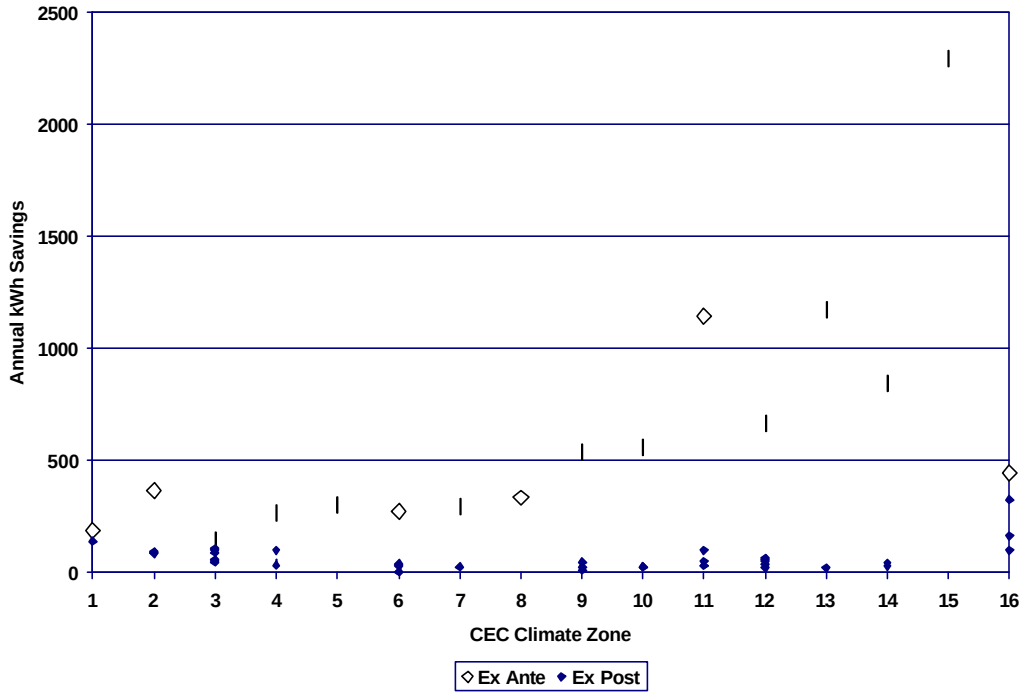

Figure 3-2. Comparison of Ex Ante and Ex Post kWh Savings Estimates for Advanced HVAC Diagnostics

3.3.3 Comparison of kWh Savings Estimates for Duct Sealing and Testing

Figure 3-3 compares the *ex ante* and *ex post* estimates of kWh savings for duct sealing and testing. The *ex ante* estimates of savings for duct sealing and testing are higher than the *ex post* estimates for all climate zones.

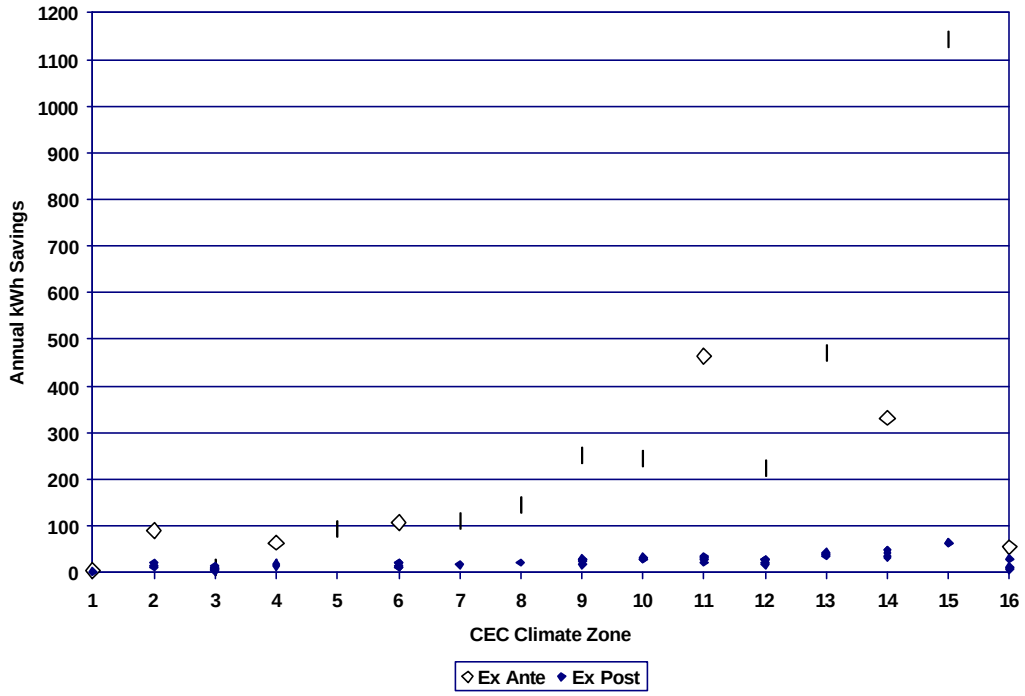

Figure 3-3. Comparison of Ex Ante and Ex Post kWh Savings Estimates for Duct Sealing and Testing

3.3.4 Comparison of kWh Savings Estimates for Attic and Wall Insulation Package

Figure 3-4 compares the *ex ante* and *ex post* estimates of kWh savings for the attic and wall insulation package. The *ex ante* and *ex post* estimates of savings for attic and wall insulation package are relatively similar for most climate zones (except climate zone 15).

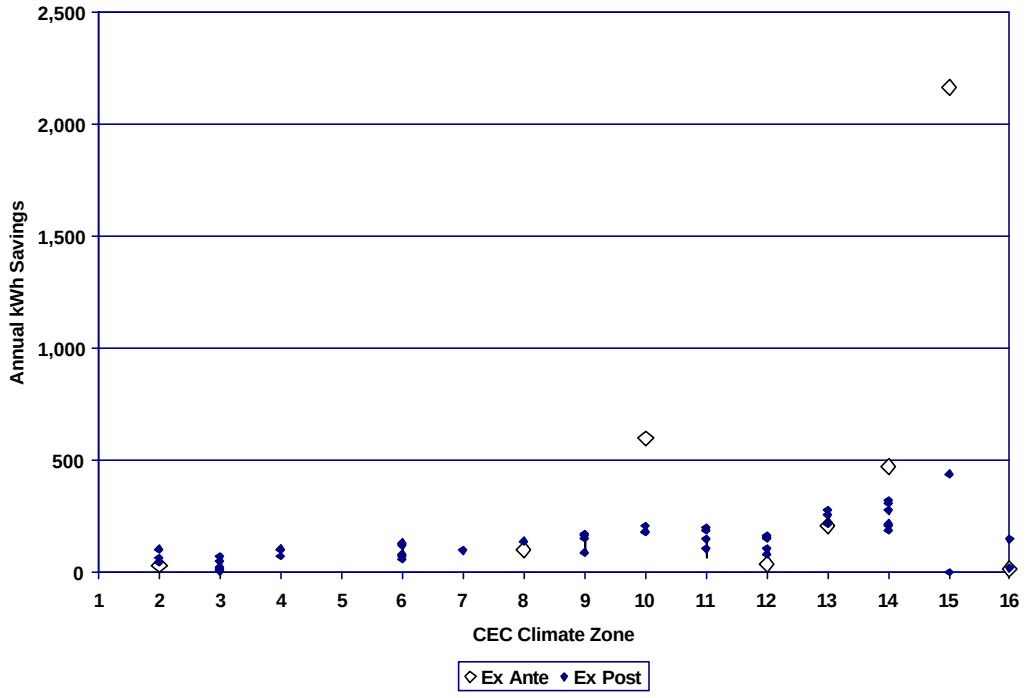

Figure 3-4. Comparison of Ex Ante and Ex Post kWh Savings Estimates for Attic and Wall Insulation Package

3.3.5 Comparison of kWh Savings Estimates for Central Air Conditioners

Figure 3-5 compares the *ex ante* and *ex post* estimates of kWh savings for central air conditioners. The *ex ante* estimates of savings for central air conditioners are higher than the *ex post* estimates for climate zones 5, 6, 7, 8, 9, 10, 11, 12, 13, and 15. *Ex ante* estimates are lower than *ex post* estimates for climate zones 1, 3, and 16. *Ex ante* estimates are bracketed by *ex post* estimates for climate zones 2, 4, and 14.

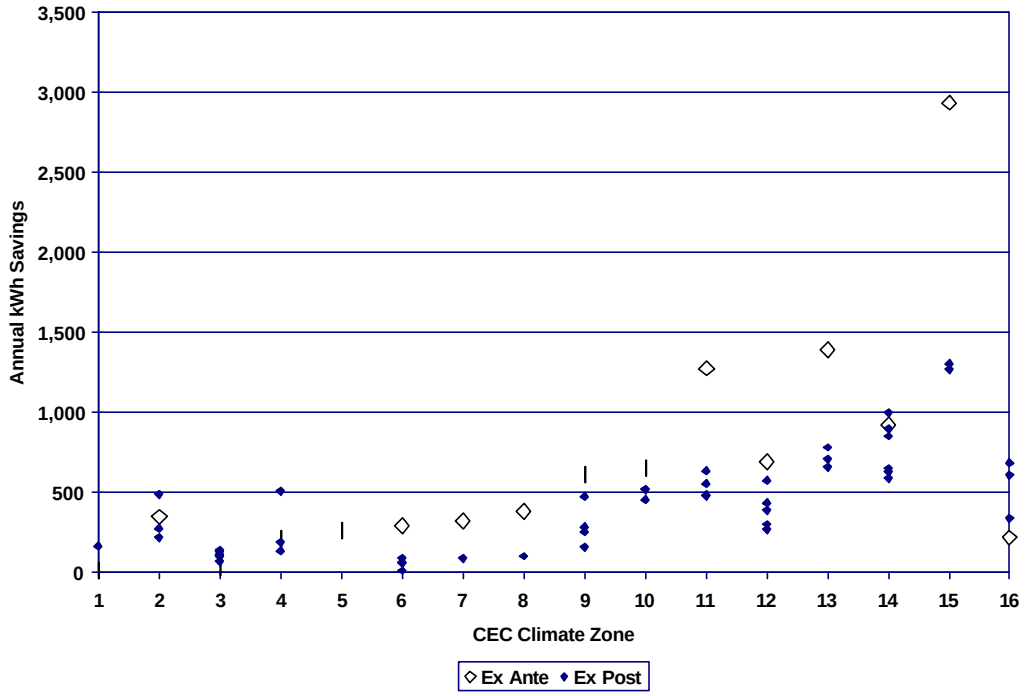

Figure 3-5. Comparison of Ex Ante and Ex Post kWh Savings Estimates for Central Air Conditioners

3.4 COMPARISON OF *EX ANTE* AND *EX POST* THERM SAVINGS ESTIMATES

The *ex ante* engineering therm savings estimates developed by RMA are compared in this section to the *ex post* therm savings estimates developed through the engineering and billing analyses during this study.

Estimates of the annual therm savings from different types of RCP measures that were developed by RMA are shown in Table 3-22.

Table 3-22. RMA Estimates of Therm Savings for RCP Measures by CEC Climate Zone

CEC Climate Zone	***Estimated Annual Therm Savings (therms per house)***			
	High Performance Windows	***Duct Sealing***	***Attic/Wall Insulation Package***	***Programmable Thermostat***
1	80	101	204	46
2	16	70	143	30
3	54	57	132	26
4	11	56	165	25
5	14	57	151	25
6	23	21	104	10
7	6	20	104	9
8	4	17	76	8
9	-5	27	130	11
10	-52	23	209	9
11	65	87	133	34
12	48	78	125	31
13	47	59	116	24
14	-37	77	220	29
15	-23	8	105	3
16	186	152	212	66

Estimates of the *ex post* therm savings from RCP measures were presented in Tables 3-12, 3-13, 3-14, 3-17, and 3-18. These *ex post* estimates of therm savings are compared in the following to the *ex ante* estimates of therm savings developed by RMA and reported in Table 3-22.

3.4.1 Comparison of Therm Savings Estimates for High Performance Windows

Figure 3-6 compares the *ex ante* and *ex post* estimates of therm savings for high performance windows. The *ex ante* and *ex post* estimates of savings for high performance windows are relatively similar for most climate zones.

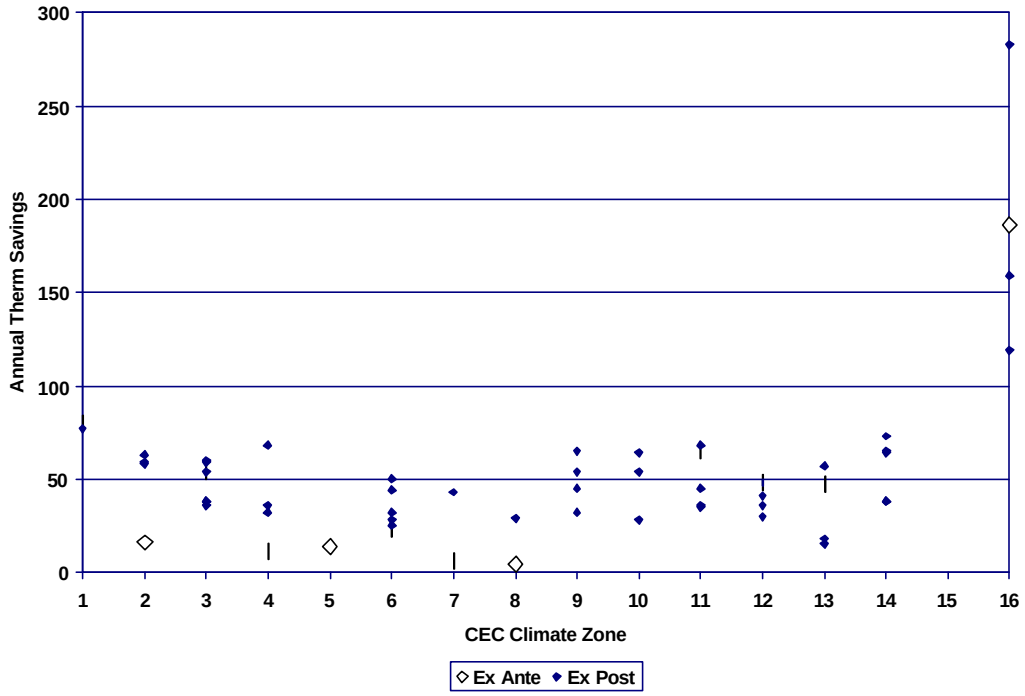

Figure 3-6. Comparison of Ex Ante and Ex Post Therm Savings Estimates for High Performance Windows

3.4.2 Comparison of Therm Savings Estimates for Duct Sealing and Testing

Figure 3-7 compares the *ex ante* and *ex post* estimates of therm savings for duct sealing and testing. The *ex ante* estimates are relatively similar to the *ex post* estimates for climate zones 1, 2, 3, 4 and 5. However, the *ex ante* estimates are lower than the *ex post* estimates for climate zones 6, 7, 8, 9, 10, and 15, but are higher for climate zones 11, 12, 13, 14, and 16.

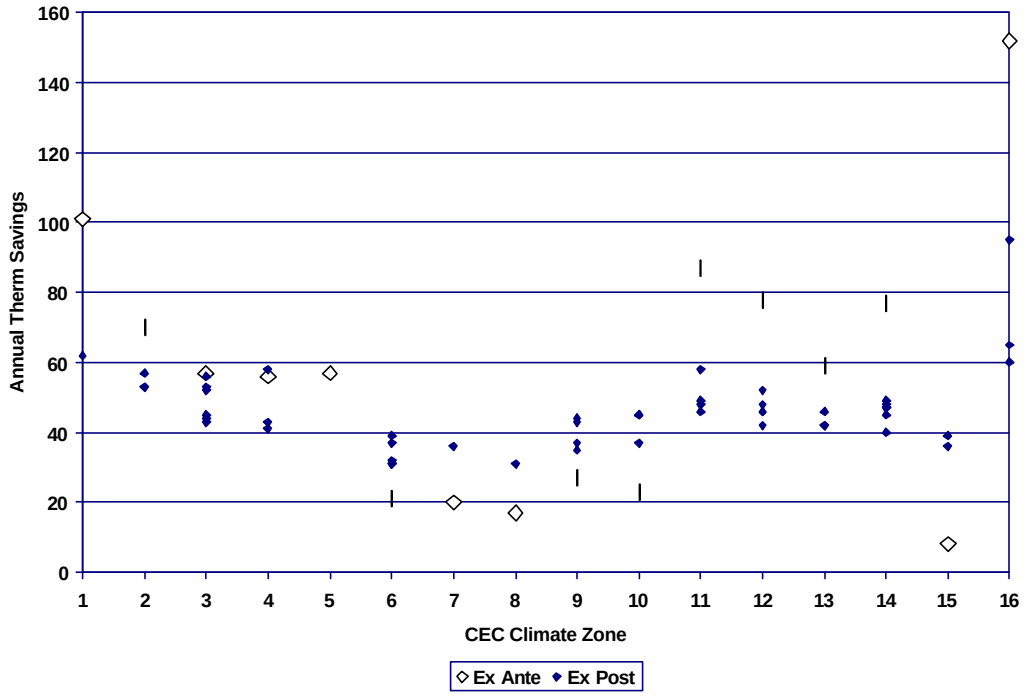

Figure 3-7. Comparison of Ex Ante and Ex Post Therm Savings Estimates for Duct Sealing and Testing

3.4.3 Comparison of Therm Savings for Attic and Wall Insulation Package

Figure 3-8 compares the *ex ante* and *ex post* estimates of therm savings for the attic and wall insulation package. The *ex ante* estimates are relatively similar to the *ex post* estimates for most climate zones, although there are differences between the estimates across climate zones.

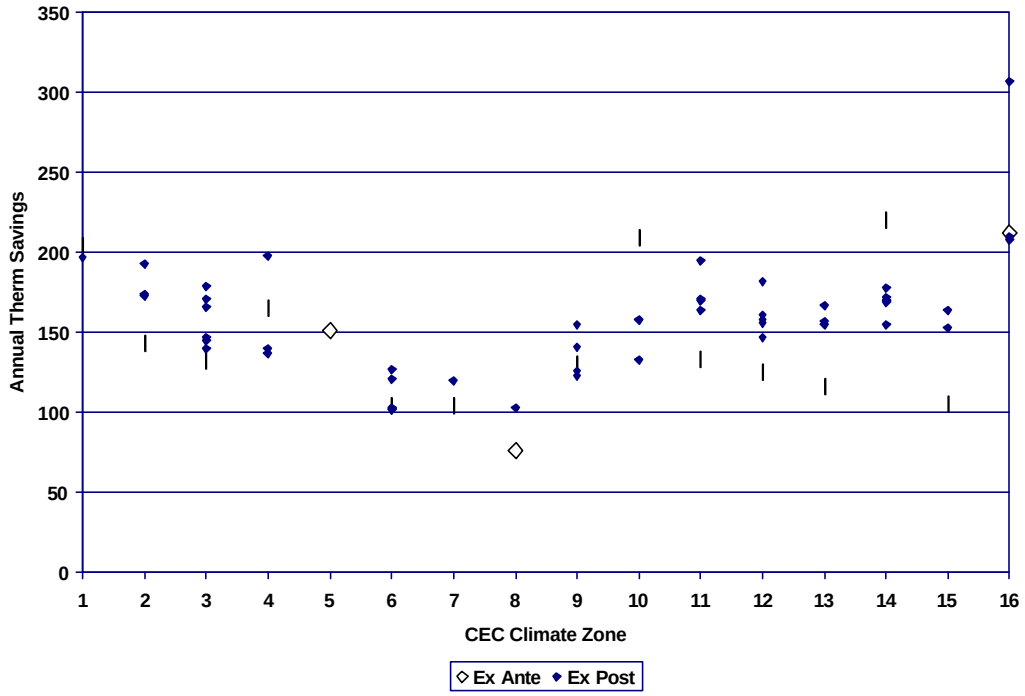

Figure 3-8. Comparison of Ex Ante and Ex Post Therm Savings Estimates for Attic and Wall Insulation Package

3.4.4 Comparison of Therm Savings Estimates for Programmable Thermostats

Figure 3-9 compares the *ex ante* and *ex post* estimates of therm savings for programmable thermostats. The *ex ante* estimates are relatively similar to the *ex post* estimates for most climate zones, although there are differences between the estimates across climate zones. For example, the *ex ante* estimates are somewhat higher than the *ex post* estimates for climate zones 1, 2, 3, and 4.

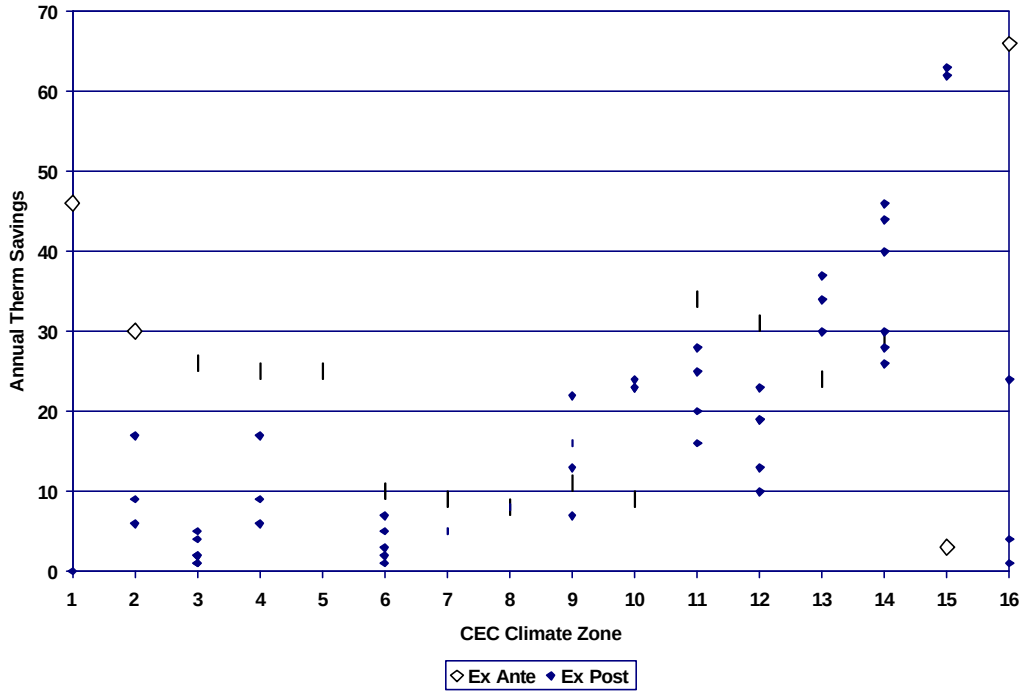

Figure 3-9. Comparison of Ex Ante and Ex Post Therm Savings Estimates for Programmable Thermostats

4. ANALYSIS OF MULTI-FAMILY RCP MEASURES

There were several aspects to the analysis of savings from MF-RCP measures. One aspect was to estimate the savings for the two types of MF-RCP measures installed by contractors during PY2000 (i.e., lighting measures and water heater measures). A second aspect was to examine deemed and measured savings approaches for MF-RCP measures. The third aspect was to examine incentive levels for MF-RCP measures. Each aspect is discussed in turn in this chapter.

4.1 ENERGY SAVINGS IMPACTS OF MF-RCP MEASURES

Information provided by the utilities on MF-RCP projects during PY2000 indicated that there were 103 multifamily sites with such projects. The distribution of these sites by utility and by type of measure installed is shown in Table 4-1. Two major types of MF-RCP measures were installed by contractors during PY2000: lighting measures and water heater measures. Estimates of the savings resulting from these measures are presented and discussed in this section.

Table 4-1. Distribution of MF-RCP Sites by Utility and Type of Measure Installed

Utility	***Type of Measure***			***Totals***
	Lighting	***Water Heater***	***Other***	
PG&E	11	15	0	26
SCE/SCG	7	0	9	16
SDG&E	54	6	1	61
Totals	72	21	10	103

4.1.1 Energy Savings for MF-RCP Lighting Measures

Energy savings for lighting measures are calculated as the difference between baseline usage and post-installation usage. Energy usage is calculated as the product of kW demand and hours of operation. Utilities provided information on kW demand and hours of operation to applicants for MF-RCP lighting projects in program materials for calculation of expected savings.

- Baseline and post-installation kW demand values for lighting efficiency measures were determined using data on standard wattages for commonly used lighting fixtures, ballasts, and lamps. A standard table of lighting fixture and lamp wattages was included in Appendix H of the *Policy and Procedures Manual* for the Multifamily Element of the 2000 Residential Contractor Program.
- Data on hours of operation for lighting measures installed in different types of spaces were provided in the spreadsheet that applicants could use to prepare the application for lighting measures. Hours of operation were provided for different space types as follows:

- Indoor Common Area 8,760 hours per year
- Indoor Dwelling Unit 1,090 hours per year
- Indoor Special Use 3,190 hours per year
- Exterior Area 4,380 hours per year

Actual savings achieved for MF-RCP projects could be different from the expected savings, depending on whether kW demands or hours of operation were different from expected. In practice, expected and actual kW demands would not differ. However, hours of operation could be different. Accordingly, monitoring was conducted at a randomly sampled number of sites where MF-RCP lighting projects had been undertaken to verify hours of use for the lighting measures.

As shown in Table 4-1, there were 72 sites where MF-RCP lighting projects were undertaken by contractors. Most of these projects involved changing exterior lighting (e.g., by installing CFLs). Monitoring was conducted at 17 of the sites. Time-of-use loggers were installed at different types of fixtures at each site to measure lighting hours of operation. Table 4-2 shows the numbers of sites monitored in each utility service territory and the numbers of loggers installed.

Table 4-2. Numbers of Sites with MF-RCP Lighting Projects Monitored by Utility Service Territory

Utility	***Number of Sites Monitored***	***Number of Loggers Installed***
PG&E	4	30
SCE/SCG	5	20
SDG&E	8	52
Totals	17	102

Analysis of the data collected on hours of lighting operation showed that there were differences in the hours of operation that depended on the type of lighting control. Table 4-3 shows the average hours of operation for lighting fixtures with different types of controls. For fixtures controlled by photocells or timers, average hours of operation are fairly comparable to the 4,380 hours that were specified in program materials for exterior lighting. However, average hours of operation for fixtures that are manually controlled (through an on/off switch) are noticeably lower (about 725 hours per year).

Table 4-3. Average Hours of Operation for Exterior Lighting Fixtures with Different Types of Controls

Type of Control	***Number of Observations***	***Average Hours of Operation per Year***	***Standard Deviation for Hours of Operation***
Manual (on/off switch)	77	725	1,346
Photocell	13	4,887	2,347
Timer	11	4,279	2,264
No control (safety light)	1	8,760	-

Although average hours of operation are lower for fixtures that are manually controlled than for fixtures that are controlled by photocells or time clocks, data collected during a survey of multifamily common areas show that most of the exterior lighting fixtures in the population of multifamily housing complexes are controlled either by photocells or by timers.[6] Table 4-4 reproduces the survey data on the numbers of outdoor lighting fixtures controlled by different methods and the total connected loads of those fixtures. Outdoor lighting fixtures controlled by photocells or time clocks account for 81 percent of the number of fixtures and for 76 percent of the connected load.

Table 4-4. Number of Outdoor Lighting Fixtures and Connected Load for Different Types of Lighting Controls by Utility Service Territory (Fixtures in thousands; Load in megawatts)

Type of Lighting Equipment	***Combined Service Areas***	***Individual Utility Service Areas***		
		PG&E	***SCE/SCG***	***SDG&E***
Number of Fixtures by Types of Lighting Controls				
On/off switch	780	83	650	47
Time clock	1,099	390	552	156
Occupancy sensor	8	6		2
EMS	11	11		
Photo cell	2,373	585	1,599	189
Total number of fixtures	4,271	1,076	2,801	394
Connected Load by Types of Lighting Controls				
On/off switch	48.8	5.8	40.7	2.3
Time clock	56.0	19.1	29.1	7.8
Occupancy sensor	0.7	0.5		0.2
EMS	0.3	0.3		
Photo cell	104.5	23.5	72.8	2
Total connected load	210.2	49.3	142.5	18.4

[6] ADM Associates, Inc. and TecMRKT Works LLC, *Statewide Survey Of Multi-Family Common Area Building Owners Market, Volume I: Apartment Complexes*, June 2000.

4.1.2 Energy Savings for MF-RCP Water Heater Controllers

As a MF-RCP water heater measure, a controller would be installed on a water heater or a boiler to optimize system efficiency. In some cases, a controller could also be installed on water heaters or boilers used both for water heating and space heating (hydronic systems). Table 4-5 reproduces the calculated energy savings expected for water heater controllers from the program materials.

Table 4-5. Calculated Energy Savings for Water Heater Controllers
(Savings in therms per dwelling unit)

CEC Climate Zone	*Hot Water Savings*	*Space Heating Savings*	*Combined Savings*
1	38	40	78
2	38	36	74
3	38	38	76
4	38	39	77
5	38	41	79
6	38	29	67
7	38	19	57
8	38	23	61
9	38	22	60
10	38	27	65
11	38	42	80
12	38	39	77
13	38	34	72
14	38	40	78
15	38	16	54
16	38	52	90

Two types of water heater controllers were installed at multifamily sites by RCP contractors during PY2000.

- The Raypak Economaster is a control system that turns off the hot water circulation pump when there is no demand for hot water. It is a circulating pump delay for use in either hydronic heating or hot water supply applications. It is designed to keep the boiler pump running until the residual heat has been transferred from the boiler to the system or storage tank. This measure was installed only at multifamily sites in SCE's service territory.
- The other type of water heater controller installed at multifamily site was a boiler temperature controller, which is an adaptive controller that monitors the hot water demand for the water heaters or boiler and adjusts the temperature of the hot water based on the demand. This is expected to save energy by matching water temperature to demand throughout a day. Pro-Temp controllers of this type were installed at sites in the service territories of SDG&E and SCE. EDC Technologies manufactures a similar type of controller in-house and installed its controller at several sites in PG&E's service territory.

To obtain data with which to determine how well these controllers performed and how much savings (either in electricity and natural gas) they provided, monitoring was conducted at 15 sites. The data collected were used to develop algorithms for calculating savings that take into account such factors as the methods used by the manufacturers of the controllers, the applicability of the controllers, the size of the water heaters, and the number of units served by the water heater.

To evaluate the savings resulting from installation of an Economaster, run times were monitored for a period of one week for five sites where the Economasters had been installed. The power consumption of each pump was assumed to be that claimed by contractors. Pump run times were verified through the monitoring. (The percentages of time that each pump was running were calculated from the monitored data, and these percentages were applied to the number of hours in a year to obtain an estimate of annual on hours for the pumps.)

In all cases, the contractor claimed that the Economaster would shut the pumps off for 2/3 of the time. However, the run time data obtained through the monitoring showed on-times that were relatively higher than the claimed. Table 4-6 shows the claimed and verified values for run times and savings for the five sites that were monitored. The overall average savings realization rate for the five sites was 32 percent.

Table 4-6. Comparison of Claimed and Verified Run Times and Savings for Pumps with Economasters Installed

Site	***Number of Pumps***	***On Hours***		***Savings***		
		Claimed	***Measured***	***Claimed kWh***	***Verified kWh***	***Realization Rate***
1	4	2,891	8,747	21,010	47	0.2%
2	4	2,891	7,498	21,010	4,586	21.8%
3	7	2,891	5,867	42,819	21,428	50.0%
4	8	2,891	5,337	28,723	17,004	59.2%
5	4	2,891	7,906	28,723	2,279	7.9%

As noted above, a boiler (water heater) temperature controller is an adaptive controller that will monitor the hot water demand for the boiler (water heater) and adjust the temperature of the hot water based on the demand. The savings that result from installation of a boiler temperature controller were evaluated using data provided by the contractors and data obtained through monitoring.

The amount of data that the contractors could supply differed among contractors.

- EDC Technologies, which had installed several of the controllers that it manufactures at sites in PG&E's service territory, supplied a relatively comprehensive set of data. These data included temperature and actual gas valve runtime data before and after the controller was installed.. EDC's

controller has an extensive monitoring capability, and these data could be uploaded to their website. Moreover, because EDC's controllers can be turned off and on by modem, it was possible to manage the controllers to provide data for before- and after-installation scenarios that could be used in the evaluation of savings.

- ETE, the contractor who installed controllers in SCE's service territory, provided temperature and gas valve runtime data after the installation of the controller.
- Thomas Energy Management, the contractor who installed controllers in SDG&E's service territory, provided temperature and relay data downloaded from the controllers they had installed.

To complement and verify the data provided by the contractors, data on the run time of boilers was collected through monitoring at four sites. (This monitoring was conducted by installing thermopile sensors on the boilers.) The run time profiles developed from the monitored data were similar to the profiles generated from the data provided by the contractors for those sites. Based on this comparison, it was concluded that the data provided by the contractors was valid and could be used for the evaluation of savings.

To establish the average savings, regular domestic hot water usage (e.g., for showering and hand washing) was excluded from the calculations. The reasoning for excluding regular domestic hot water usage was as follows. It was hypothesized that the lower water temperature induced by the controller will cause people to use more hot water, since they usually go by the "feel" for the warmth of water they are used to, instead of the actual temperature. As a result, since the temperature of the hot water is lower, they will mix more hot water with water from mains. Data for the controllers installed at PG&E sites were consistent with this hypothesis in that water usage per apartment was significantly higher when the controller was turned on.

Savings were hypothesized to come mainly from two components:

- Laundry and dishwashing; and
- Heat losses through circulation pipes.

The equation used to calculate energy savings related to laundry and dishwashing was as follows:

$$ESa = N * U * (Tb - Ta) * Cp * C1 * C2 * C3 / (EFF * C4)$$

where

N = number of units

U = usage from apartment (This value, which was calculated from data for sites in PG&E's service area when the controllers were off, was taken to be 49 gallons/day/apartment unit.)

Tb = hot water temperature before controller was installed, °F

Ta = average hot water temperature after the controller was installed, °F

Cp = specific heat of water, 1 Btu/lb°F

C1 = conversion constant, 8.3 lb/gal

C2 = conversion constant, 365 days/yr

C3 = fraction of water going to laundry and dishwashing, (This value was assumed to be 0.37.[7].

EFF = efficiency of the hot water heater, assumed to be 0.8

C4 = conversion constant, 100,000 Btu/Therm

The equation used to calculate energy savings related to heat losses through circulation pipes was as follows:

$$Esb = N^* U * (Tb-Ta) * Cp * C1 * C2 * HL / (EFF * C4)$$

where HL = is the fraction of daily use attributed to circulation losses and the other terms are as defined above.

HL was calculated by taking the average of hourly boiler energy consumption when the use is at the lowest, typically during the early hours of the morning. This loss consumption is subtracted from the average hourly use throughout the day, which gives the energy going to heating the water. The equation for calculating HL is:

$$HL = L / (HU - L)$$

where

L = hourly energy consumption going to losses (in therms);

HU = average hourly consumption (in therms);

Using data for sites in PG&E's service territory, the average value for HL was calculated to be 1.15.

Some possible limitations to the methodology for calculating savings associated with heat losses through circulation pipes can be noted.

[7] This value was developed from data in Department of Housing and Urban Development, Office of the Assistant Secretary for Research and Technology, *Residential Energy Consumption, Phase I Report*, March 1972.

- HL will not apply to high-rise buildings, as the pipes will be indoor. The losses will be much less
- The methodology may not apply if a building uses the hot water for space heating.
- The methodology may not apply if there is excessive mixing between the cold water supply and higher temperature return water.
- The methodology may not apply if the boiler is a modulating boiler.

The results of applying these equations to calculate savings resulting from installation of the water controllers are shown in Table 4-7 for 13 multifamily sites. Installation of the controllers resulted in lower water temperatures at all of the sites. The savings calculation methodology shows that most of the savings resulting from the lower water temperatures are associated with reductions in heat losses. The savings per apartment unit are somewhat higher than the deemed energy savings of 38 therms per year (cf. Table 4-5). Calculated across all 13 sites, the weighted average savings per apartment unit is 46.7 therms per year.

Table 4-7. Savings from Installation of Water Heater Controllers Calculated per ADM Methodology

Site Number	Number of Apartment Units	Water Temperature		Savings (Therms per Year)			Savings per Apartment Unit
		Before Controller Installation	After Controller Installation	Clothes and Dish Washing Savings	Heat Loss Savings	Total Savings	
PG&E Service Territory							
1	68	142	127.6	634	2,100	2,734	40
2	84	135	127.9	386	1,279	1,665	20
3	34	145	127.4	387	1,284	1,672	49
4	80	133	118.0	776	2,574	3,350	42
5	100	130	117.8	789	2,617	3,406	34
SCE Service Territory							
1	84	150	117.4	1,794	5,879	7,673	91
2	306	130	119.5	2,103	6,891	8,995	29
SDG&E Service Territory							
1	514	138	121.0	5,720	18,741	24,461	48
2	685	138	119.0	8,520	27,914	36,434	53
3	502	138	123.0	4,930	16,150	21,080	42
4	234	138	118.0	3,064	10,038	13,101	56
5	224	135	118.0	2,493	8,167	10,660	48
6	136	140	121.0	1,692	5,542	7,234	53

The savings calculated per ADM's methodology are compared in Table 4-8 to annual site usage, to contractor claimed savings, and to savings estimated from billing data.

- For sites in the PG&E and SCE service territories, claimed savings were greater than the savings estimated from analysis of billing data or from application of ADM's savings calculation methodology. ADM's estimates fall between the claimed savings and the savings estimated from analysis of billing data.
- For sites in SDG&E's service territory, billing data were not available for the sites. Claimed (i.e., deemed) savings for the SDG&E sites are based on the program-specified calculated savings of 38 therms per unit and are less than the savings estimated through ADM's calculations.

Table 4-8. Comparison of Claimed and Estimated Savings for Water Heater Controllers

Site Number	Annual Gas Usage (Therms)	Savings (Therms per Year)		
		Claimed	Per Analysis of Billing Date	Per ADM Calculation
PG&E Service Territory				
1	19,365	5,815	1,863	2,734
2	7,430	4,516	649	1,665
3	12,339	2,905	2,206	1,672
4	26,230	5,387	2,976	3,350
5	23,253	12,985	2,716	3,406
SCE Service Territory				
1	28,069	9,156	4,134	7,673
2	79,570	30,622	17,834	8,995
SDG&E Service Territory				
1	171,065	19,532		24,461
2	227,976	26,030		36,434
3	167,071	19,076		21,080
4	77,878	8,892		13,101
5	71,855	8,512		10,660
6	46,353	5,168		7,234

4.2 COMPARISON OF DEEMED AND MEASURED SAVINGS APPROACHES

During PY2000, calculated savings and simplified forms were introduced for MF-RCP measures as an approach to savings determination that was alternative to the previous measured savings approach that required measurement and verification (M&V). Measures covered under the calculated savings approach included lighting, water heater controllers, refrigerators, clothes washers, and dishwashers.

While the savings estimates that are produced through the calculated savings approach simplify the requirements that contractors must meet to participate in the RCP, the estimation of savings for lighting measures and water heater controllers

presented in Section 4.1 suggests that there may be questions about the accuracy of the deemed savings values for the multifamily sector.

For example, the method used in the calculated savings approach to determine savings for outdoor lighting measures uses a posited value of 4,380 as the operating hours for outdoor lighting. This represents an outdoor light being on for 12 hours a day, 365 days a year. The data presented in Section 4.1 showed that these number of operating hours may be appropriate for lights controlled by photocells or time clocks. However, outdoor lights controlled by manual, on/off switching were shown to operate significantly fewer hours in the year. Calculating savings for manually controlled lights on the assumption that they operate 4,380 hours a year would significantly overstate the amount of savings that would be realized.

In general, deemed savings values have been used primarily for measures for single-family houses. Because there has been considerable research and evaluation effort devoted to determining savings for single-family measures, there is a considerable body of evidence on which to establish deemed values for those measures. For the multifamily sector, however, the body of research is much smaller and is probably not as robust for establishing deemed savings value for multifamily measures.

4.3 IMPORTANCE OF INCENTIVE LEVELS FOR MF-RCP MEASURES

In their review of the roles of incentives and information in DSM programs, Mast and Ignelzi pointed out that:[8]

> "Recent evidence supports the idea that incentives indeed have a role in attracting customers to consider energy efficiency measures. This evidence strongly suggests, however, that the customer's decision-making process is far more complex than a simple payback analysis. It also incorporates factors such as risk, aesthetics, convenience, and transaction costs. Thus, financial incentives alone are ineffective in moving customers to take efficiency measures. Factual information and utility implementation methods appear far more influential in the decision-making of these customers, limiting the role of incentives to improving customer awareness or attention and perhaps accelerating their actions."

Evidence supporting this view as it applies to the multifamily sector was obtained during the Statewide Building Owners/Common Areas Multifamily Survey that

[8] Mast, B., and Ignelzi, P., "The Roles of Incentives and Information in DSM Programs," *Proceedings, ACEEE Summer Study on Energy Efficiency in Buildings, 1994.*

ADM and TecMRKT Works conducted in 2000.[9] This survey provided information with which to identify and analyze barriers that might discourage operators of apartment complexes from purchasing energy efficiency equipment. For example, operators may not know about efficient equipment options. They may perceive that efficient equipment may come with a cost premium. They may not have capital or they may perceive that efficient equipment is less reliable than standard equipment. These perceptions, beliefs and experiences represent potential roadblocks to owners/operators of multifamily complexes in making decisions about investing energy efficient appliances and equipment.

As part of the telephone interview for the multifamily survey, respondents were asked to rate six potential barriers on a 10-point scale. The results are shown in Table 4-9. Reliability was rated the most important barrier (7.8) to making efficiency improvements. Forty-three percent of the respondents rated this as "very important".

Table 4-9. Barriers to Purchasing Energy Efficient Equipment

Barrier	***Mean rating[1]***	***Percent of complexes rating as a 10***
Reliability concerns	7.8	43%
Low or non-existent payback	6.8	27%
Higher cost of energy efficient equipment	6.6	19%
Lack knowledge of energy efficient options	5.8	15%
Lack capital	5.7	21%
Lack experience with energy efficient equipment	5.7	17%

[1] Based on a 1 - 10 scale where one means not at all important and ten means very important

Lower or non-existent paybacks and the perceived higher cost of energy efficient equipment were rated next highest, although the average scores of 6.8 and 6.6 are somewhat lower than for reliability. About ten percent more of the respondents rated low or non-existent paybacks as "very important" than rated perceived higher cost of energy efficient equipment as "very important." Lack of knowledge, lack of capital and lack of experience had average importance ratings of about 5.7. Between 15 and 21 percent of the respondents rated these as "very important."

As average relative importance scores go, none of these scores is very high. An average importance score of 5 can be interpreted to mean that a barrier is neither important nor unimportant. Thus, the last three items in the list are barriers but

[9] ADM Associates, Inc. and TecMRKT Works, LLC., *Statewide Survey Of Multi-Family Common Area Building Owners Market, Volume I: Apartment Complexes,* June 2000.

caution should be exercised about attaching too much importance to them relative to energy efficiency. Perhaps one way of interpreting the results for the last three items is to say that capital, knowledge, and experience are concerns but not overriding ones.

The important finding here is that reliability is perceived to be the most important obstacle to using energy efficient equipment, and it is perceived to be more important than the cost of the equipment or low or non-existent payback. Reliability represents a “hassle factor" that potentially imposes costs on apartment operators in terms of increased maintenance. These costs can be substantially greater than the cost of the piece of equipment. Reliability is a key "relative advantage" of a product.

The importance respondents attached to low or non-existent payback can be interpreted in at least three different ways:

- They do not believe that they will recoup the increased marginal costs of efficient equipment.
- They do not understand the relationship between increased cost of equipment and long-term savings.
- There is a predisposition to the short-term gains associated with lower cost as opposed to the longer-term gains from savings.

Evidence with which to sort out the relative importance of these three explanations are not available, but each explanation requires a different intervention in terms of program design.

A factor analysis of the data on market barriers as perceived by owners/operators of apartment complexes suggested that the survey respondents did not really differentiate among the barriers. When barriers were examined by the key characteristics of firms, there were few statistically significant differences in the means. Indeed, there were so few statistically significant relationships that probabilistically, the significant correlations could have happened by chance.

There is further evidence that would suggest that the financial aspects of incentives may not be important for owners/operators of apartment complexes. In their work on the multifamily sector, Battelle Pacific Northwest Laboratories summarized information on the first costs and cost premiums of appliances that are sold into the multifamily market. PNL’s data are summarized in Table 4-10.

*Table 4-10. First Costs and Cost Premiums for Energy Efficient Appliances Sold in Multifamily Market**

Appliance	***Retail Price (First Cost)***	***Cost Premium***
ENERGY STAR Subcompact Fluorescent Light Bulbs	$5-$8	$2-$12 less
Super-efficient apartment-sized refrigerator	< $400	$0-$20
ENERGY STAR built-in dishwasher	< $200	$0-$30
ENERGY STAR window/wall air conditioner	~ $360	$0-$60
ENERGY STAR-equivalent coin-op family size clothes washer	$600-$800	$100-$300

*Data from Parker, G. and Currie, B., "Market Transformation Program Design and Implementation for the Historically Underserved Multifamily Sector", Presentation to 20th Annual Utility Energy Forum, May 2000.

Except for the clothes washer, the incremental costs of the energy efficient technologies in Table 4-10 over the standard efficiency counterparts are relatively low. Because the savings associated with these energy efficient technologies are significant, the rates of return that owners/managers of multifamily facilities might expect from purchasing them are likely to exceed any investment hurdle rates.

These data reinforce the point raised by Mast and Ignelzi that financial incentives alone are probably not effective in influencing the decisions of apartment owners/operators to purchase energy efficient equipment. That is, the financial attractiveness of the technologies seems clear even without incentives. While providing incentives will of course add to the financial attractiveness, a program will need other features to influence decisions.

5. DIFFUSION OF PROGRAM-PROMOTED MEASURES

Part of the work effort for this assessment of the RCP was to examine the diffusion of program-promoted measures. To provide the data for this examination, samples of both participating and non-participating contractors were surveyed by telephone to obtain relevant information. The survey interviews were used to gather information with which to determine why contractors chose to participate or not to participate in the program, as well as to determine from the participating contractors their opinion of the operation of the program and other evaluation issues.

The results of the survey are presented and discussed in this chapter. Results are presented for three types of contractors: HVAC contractors, window contractors and insulation contractors.

5.1 SURVEY CONSIDERATIONS

The initial design for the survey of contractors called for a sample of 40 participating contractors to be drawn from each utility service territory. The samples were divided into two sub samples: one including the most active contractors and the second including less active contractors. An attempt was to be made to complete interviews with a census of the most active contractors and with a random sample of the less active contractors.

- Active contractors were represented by RCP participant contractors who had residential contractor program (RCP) training and/or submitted RCP vouchers.
- Less active contractors were divided into two groups.
  - Partial participants were defined as contractors who may have received RCP training but who had submitted no vouchers. Partial participants were identified by comparing training and qualification records with records of firms receiving payments.
  - Nonparticipants were contractors who received no training and who did not submit vouchers. The sample of nonparticipants was drawn from licensing board data and was made up of firms who did not appear on any of the participant lists.

The total sample of participants and nonparticipants was to be 300 contractors across the HVAC, windows, and insulation disciplines, comprised of 40 participant from each of the three utilities, 20 partial nonparticipants from each utility, and 40 nonparticipants from each utility. The samples were drawn from lists of firms and contacts from previous studies of RCP, firms who had had one or more employees complete the RCP training, firms who had qualified for the RCP, firms that had been reimbursed for RCP projects and a list of all HVAC, window

and insulation contractors. In practice, interviews were completed with 288 contractors, of which 168 were HVAC contractors, 81 were window contractors and 39 were insulation contractors.

The survey interviews were completed by telephone by in-house staff. In fielding the survey of contractors, we were cognizant of the fact that the beliefs, attitudes and behaviors of contractors may be influenced not only by the RCP training but by other factors as well (e.g., the "energy" crisis). Because of the "energy crisis" contractors' customers may be more interested in energy efficiency. In turn contractors may be more interested in selling efficient equipment and may also be interested in promoting energy efficient installation practices. As a result, contractors may seek information through the RCP Program or they may obtain the same or similar information in other ways. Thus, an increase in the specification of 12 SEER air-conditioners could be almost entirely due to RCP training, could be almost entirely due to the California "energy crisis", could be due to some independent combination of these factors, or could be an independent combination of these factors as well as an interaction effect between the factors.

In order to isolate and gauge the effect of the RCP program, it was important to rule out effects from such other factors as the "energy crisis". This required a comparison sample of RCP participating contractors and nonparticipating contractors. In addition to a comparison group, we also needed information about behaviors before and after training/qualification/RCP participation or in the case of nonparticipants in information from parallel time periods.

For each of three contractor disciplines (i.e., HVAC, windows, and insulation) and three contractor types (i.e., participants, partial participants, and nonparticipants), we examined firmographics, including the length of time in business, the number of employees, the number of residences served annually, and the type and number of licenses. Other items explored included the following:

- Awareness of the residential contractor program
- Perceptions of customer awareness of the RCP
- Changes in contractor and/or customer awareness of the RCP between 1999 and 2001
- Contractors' definitions and contractors' perceptions of customers' definitions of efficient equipment and products, and the effects of the RCP on these
- How contractors' definitions of efficient equipment and products changed between 1999 and 2001, and the influence of the RCP on these changes
- Contractor perceptions of the cost effectiveness of efficient equipment and products

- Contractor perceptions of customers' views of the cost effectiveness of efficient equipment and products
- Changes in contractor perceptions and contractors' perceptions of customers' views of cost effectiveness of efficient equipment and products between 1999 and 2001 and the effect of the RCP on these
- Recommendations to customers, changes in recommendations between 1999 and 2001 and the effect of the RCP on these
- Efficiency levels of products and equipment installed and changes in the levels of efficiency between 1999 and 2001 and the effect of the RCP on these
- The market potential for efficient equipment and products and the need for incentives to gain the adoption of efficient equipment and products
- Barriers to the market that reduce the potential for efficient equipment and products in the market

5.2 SUMMARY OF RESULTS FROM CONTRACTORS SURVEY

A number of key points can be drawn from the results of the contractors survey.

- In general, participating contractors have been in business longer, are larger firms, serve more residences and have more licenses than nonparticipating firms.
- For contractors as a whole, awareness of the program is in the range of 80 to 90 percent. However, 40 percent of nonparticipating contractors are not aware of the program indicating some potential for increasing awareness with this group. The nonparticipant firms typically have a single license which may make it possible to more readily identify them by using state licensing data.
- The definition of what contractors consider to be high efficiency has changed in the last two years. Participants and partial participants indicate that RCP is a factor in their changing views. Nonparticipants tend to cite other factors such as the energy crisis.
- Contractors generally consider efficient equipment and products to be cost effective in their area.
- Windows contractors indicate that they have changed their recommendations in the last two years. All types of participants are adopting low e-glass. Participants and partial participants report switching to wood and vinyl frames. Many nonparticipants reported switching to double and triple pane glass. Participants cited RCP as a factor in these changes while nonparticipants cited the energy crisis.
- The penetration of efficient HVAC systems, windows, and insulation has increased in the market. The penetration of 13 SEER rate air conditioning units is reported to be up by three to seven percent across the three types of

contractors. The percent of windows with a U-factor of 0.4 or less has increased by between 16 and 28 percent across the three types of contractors. Higher percentages of nonparticipants are reporting installation of efficient products than participants and partial participants. Participants and partial participants cite RCP as a factor in their choosing more efficient products while nonparticipants are more motivated by the energy crisis.

- Participants and partial participant believe that there is much more potential for customers to introduce efficient products into their home than do nonparticipants. Participants and partial participants believe that higher percentages of customers will make changes with out incentive than do nonparticipants. In absolute terms, participants and partial participant perceive a larger number of customers will need incentives to install efficient equipment than do nonparticipants.

The survey of contractors conducted for this study updates an earlier study, *Volume 6 – Appendix G: Residential Contractor Program Market Effects Evaluation*, that was completed by Regional Economic Research, Inc. The content of the 2001 survey is largely identical to that of the 1999 survey. Most of the same questions have been included. The format, but not the content, of many questions was modified for the 2001 survey to make the implementation of the survey easier. The contents of a few questions were modified to permit the collection of more specific information. The most notable of these were modifications to questions about the percent efficiency of HVAC equipment, the efficiency of windows, and the type of insulation being installed and how these had changed since 1999. The 2001 report presents specific information about the installation rates of products with different levels of efficiency and how that has changed since 1999. This information is not in the 1999 report.

In Appendix D we present three sets of tables that list and compares survey results for some key indicators from the 1999 and the 2001 studies. The three sets of tables are for HVAC, for windows, and for insulation. Readers may want to examine the tables in Appendix D to obtain an overview of some of the indicators that are being examined. Readers may also want to compare the 1999 and 2001 results listed in the tables in Appendix D after reading the following sections on the results of the 2001 survey for HVAC, window, and insulation contractors.

5.3 RESULTS FOR HVAC CONTRACTORS

There were 169 contractors who responded to the HVAC contractor survey. These contractors have been placed into three groups: participants, partial participants, and nonparticipants. Participants have had RCP training and have submitted RCP vouchers. Partial participants have received training but have not submitted vouchers, and nonparticipants have not received vouchers or training.

5.3.1 Characteristics of HVAC Contractors

In comparison to nonparticipants, participants have been in business longer, are associated with larger firms, and serve more customers. Participants have been contractors an average of 21 years, are members of firms with an average of 19 people, and serve an average of 1,239 homes per year. Nonparticipants have been contractors an average of 18 years, are members of firms with an average of 8 people, and serve less than half of the number of homes annually that participants do.

Table 5-1. Experience and Size of HVAC Firms

	Nonparticipant	***Partial participant***	***Participant***
Average years worked as a contractor	18 1.12 72	17 1.30 35	21 1.65 62
Average years as a contractor in California	17 1.15 71	16 1.33 34	22 1.67 61
Average number of people in the company	8 0.81 71	15 2.99 35	19 2.73 62
Average number of single family residences served	520 104 71	1,000 193 35	1,239 179 62

The three values in the cells are the average, the standard error, and the number of cases.

Nonparticipants are more likely than participants to have a single type of contractor license.

Table 5-2. Percent with Number of Contractor Licenses by Participation Status

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
One contractor license	71	46	35
Two contractor licenses	18	37	44
Three or more contractor licenses	11	17	21
Total	100	100	100
Number of respondents	72	35	62

Participant HVAC contractors are most likely to have some combination of an HVAC (C20), refrigeration (C38), plumbing (C36), general contractor (B1), and home improvement (HIC) license. Partial participants tend to have plumbing, general contractor, or home improvement licenses in addition to an HVAC license. Nonparticipants are mostly restricted to a single license.

Firms with just one license serve fewer customers than firms with more licenses. Contractors with two or more licenses serve nearly a thousand or more customers annually.

Table 5-3. Average Number of Customers Served by Number of Contractor Licenses

	Average annual number of customers served
One contractor license	710
Two contractor licenses	1,121
Three or more contractor licenses	982

Nonparticipants are typically "small contractors." Small contractors may have fewer resources to deal with the program, for example, paperwork generated by the program, the cost of training, customers who are interested, etc.

The fact that nonparticipants have a tendency to have just an HVAC license can be used to better target nonparticipants. Lists of firms with just HVAC licenses can be obtained from the California State Licensing Board. These contractors are more likely to be nonparticipating contractors than other types of contractors.

5.3.2 General Awareness of RCP among HVAC Contractors

HVAC contractors were asked if they are aware of the RCP. Eighty-five percent of all contractors say that they are aware. Logically, participants and partial participants have to be aware. Only nonparticipants can be unaware. Still, sixty-five percent of nonparticipants are aware of the RCP program. Thus, we conclude that most contractors including nonparticipants are aware of the RCP program. This indicates that the RCP program has been successful in reaching contractors although there is still a small percentage of contractors who are unaware.

5.3.3 Perceived Customer Awareness

HVAC contractors were asked how aware of the RCP they think their customers are on a scale of 1 to 5 where "1" means "not at all aware" and "5" means "very aware" (Table 5-4). Overall, respondents gave an average rating of 2.7 to customer awareness of the RCP program. Participant contractors think that customers are more aware (3.3 out of 5), and nonparticipant contractors think customers are less aware (2.2). Generally, HVAC contractors perceive that their customers have modest levels of awareness. If this is true, customer awareness of RCP could be increased.

Table 5-4. Average Customer Awareness Perceived by Contractor

Nonparticipants	***Partial participants***	***Participants***	***Total***
2.2	2.6	3.3	2.7
0.14	0.22	0.13	0.10
67	33	61	161

Average on a 1 to 5 scale where 5 is very aware and 1 is not at all aware. The three values in the cells are the average, the standard error, and the number of cases.

5.3.4 What Is High Efficiency Air Conditioning Equipment?

We asked respondents what SEER rating for air conditioning units they currently consider to be high efficiency. The overall average SEER rating that respondents currently (early 2002) believe to be high efficiency is 12.6. Participants reported a higher average SEER rating for high efficiency equipment than did partial participants and nonparticipants, 12.9, 12.7, and 12.1, respectively. The difference between participants, partial participants, and nonparticipants is statistically significant. However, the difference between participants and partial participants is not. Thus, nonparticipants have a lower standard for what they believe is high efficiency air conditioning.

We asked respondents if their view of what constitutes high efficiency equipment has changed from what it was in 1999. Overall, 21 percent of the respondents say that they have changed their view of what high efficiency is in the last two years. Interestingly, nonparticipants were more likely to have changed their view of what constitutes high efficiency air conditioning than were participants or partial participants.

Table 5-5. Percentage Who Have Changed Their View of What Constitutes High Efficiency Air Conditioning Since 1999

	Non-participant percent	***Partial participant percent***	***Participant percent***	***Total***
Yes	26	17	18	21
No	74	83	82	79
Total	100	100	100	100
N	62	35	72	169

We examined the SEER rating assigned to air conditioning equipment for contractors who changed their views about what constitutes high efficiency between 1999 and 2001 and those who did not. Those who changed their views about what constitutes a high SEER rating between 1999 and 2001 were

nonparticipants and partial participants who believed in 1999 that high efficiency air conditioners had an average SEER rating between 10 and 11. RCP participants believed that high efficiency equipment was a SEER of 12 or greater in 1999. On average, nonparticipants, partial participants, and participants who did not change their beliefs about what constitutes high efficiency air conditioning believed that a SEER 12 or higher air conditioner was high efficiency air conditioning in 1999.

Table 5-6. Average SEER Rating for High Efficiency Equipment in 1999 for Those Who Changed Their View of High Efficiency Between 1999 And 2000

Changed View?	***Nonparticipants***	***Partial participants***	***Participants***	***Total***
Yes	10.2	10.8	12.3	11.2
N	12	6	14	32
No	12.2	12.5	12.6	12.4
N	58	29	45	132

For those who changed their views about what constitutes high efficiency air conditioning equipment, we asked how much more efficient they believe efficient equipment to be. Partial participants changed their view of what constitutes high efficiency equipment by an average of 2.67 SEER points. Participants changed the least, 1.57 SEER points. However, participants started from a point that was an average of 1.9 SEER points higher than partial participants and nonparticipants. In other words, contractors who changed their views about what constitutes high efficiency equipment in the last two years are contractors who believed high efficiency equipment to be less efficient two years ago than did other contractors. Thus, the views of what contractors consider to be high efficiency equipment are becoming more homogeneous.

Table 5-7. Average Change in SEER Points for Those Who Changed Their Definition Of High Efficiency Equipment

	Nonparticipants	***Partial participants***	***Participants***	***Total***
Yes	2.25	2.67	1.57	2.03
N	12	6	14	32

An important question is whether the RCP program has impacted contractor's views of what high efficiency means or if they have changed their views for other reasons. The 35 respondents who changed views were asked why their views changed. Table 5-8 shows that nonparticipants mostly changed their views of what high efficiency air conditioning is in response to the energy crisis. A few learned about it through other sources including RCP. The partial participants are too few in number to draw firm conclusions about the reasons for their changing views.

Unlike nonparticipants, participants changed their views for multiple reasons. Experience with products and response to the energy crisis were the reasons most often given but customers asking for more efficient equipment and the RCP program were also cited frequently.

Table 5-8. Percent of Respondents Giving Reason for Changing Their Views of What Efficient Air Conditioning Is

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Have more experience with the products	30	33	56
Customers are asking for it more	7	17	44
Changed in response to the energy crisis	84	33	56
Learned about it through the RCP program	23		44
Learned about it from trade magazines or trade shows	23		
Other			6
N	13	6	16

Respondents could provide more than one response so that percentages may sum to more than 100 percent. Percentages are percent of cases rather than percent of responses. Some contractors may not have provided a reason.

Finally, we asked respondents who volunteered a reason or reasons other than the RCP program if the RCP program was a factor in their decision. Half of the 22 respondents said "yes." Of those respondents, seven of the 11 were participants. When you combine the participants who volunteered RCP and those who indicated RCP was a factor when asked directly, all 16 participants in this table were influenced by RCP.

The conclusions to be drawn from this analysis are that the definition of what constitutes high efficiency air conditioning equipment is changing. Nonparticipants, who two years ago thought that high efficiency air conditioning was a 10 SEER unit, are now more likely to believe that it is a 12 SEER unit or greater. Likewise, partial participants, who two years ago believed that high efficiency was a 10 SEER unit, now believe that it is a 12 SEER or higher. Equally important is a shift among some RCP participants in the direction of believing that high efficiency is defined by equipment that is a 13 SEER unit or higher. It is pretty clear from these data that 12 SEER or higher now defines high efficiency air conditioning for most contractors. For RCP participants, RCP was one of several factors that caused them to change their views about efficiency. Experience with products, customer

demand, and the energy crisis were also factors. Nonparticipants changed their views in response to the energy crisis.

5.3.5 Contractor Views of Cost Effectiveness

Contractors were asked for their judgment about the cost effectiveness of four different types of high efficiency equipment and practices: air conditioners, furnaces, heat pumps, and duct testing. Respondents were asked to rate cost effectiveness on a scale of 1 to 5 where "1" means "not at all cost effective" and "5" means "very cost effective." Respondents gave an average rating of about four to the cost effectiveness of 12 SEER air conditioning. There were no differences among participants and nonparticipants.

In contrast to the air conditioning ratings, nonparticipants gave higher ratings of cost effectiveness to furnaces than did participants. The cost effectiveness of heat pumps received mid-scale ratings probably reflecting lack of experience with heat pumps. Participants reported that they felt duct sealing was more cost effective than other efficient equipment.

Table 5-9. Cost Effectiveness of Efficient Equipment in Respondent's Region

	Nonparticipants	***Partial participants***	***Participants***
How cost effective for your region is central air conditioning with a SEER of 12 or more?	4.09 0.16 69	4.15 0.15 34	4.05 0.11 62
How cost effective for your region are gas furnaces with an AFUE rating of 90 or more?	4.16 0.16 69	3.82 0.23 34	3.80 0.12 61
How cost effective for your region are high efficiency heat pumps?	3.29 0.19 68	3.64 0.25 28	3.14 0.20 56
How cost effective is duct testing and sealing in existing homes in your region.	4.03 0.24 69	3.65 0.21 34	4.17 0.14 60

The three values in the cells are the average, the standard error, and the number of cases.

For air conditioning, furnaces, and heat pumps, about 20 percent of the respondents indicate that they changed their view about what is cost effective within the last year. A slightly higher percentage of respondents, between 30 and 35 percent, indicate that they changed their minds about the cost effectiveness of duct sealing. There are no really significant differences among nonparticipants, partial participants, and participants in terms of the percentages of those changing their view on cost effectiveness.

Table 5-10. Percent of Respondents Changing Their View of the Cost Effectiveness of Efficient Equipment

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
How cost effective for your region is central air conditioning with a SEER of 12 or more?	19	20	21
How cost effective for your region are gas furnaces with an AFUE rating of 90 or more?	19	23	18
How cost effective for your region are high efficiency heat pumps?	19	17	15
How cost effective is duct testing and sealing in existing homes in your region.	36	31	29
N	13	8	17

Percentages are percent of cases.

Those who changed their minds about the cost effectiveness of energy efficient HVAC equipment were asked why they changed their views. Nonparticipants (see Table 5-11) reported that they were motivated mostly by the energy crisis and a few were motivated by what they learned at trade shows. Neither participants nor partial participants reported that trade shows were instrumental in changing their views about cost effectiveness. Participants and partial participants were motivated by what they learned through RCP and in response to the energy crisis. About a quarter of participants cited experience with the products as being important.

If respondents gave a response other than RCP, we asked specifically if RCP was a factor. When asked directly, many of the participants and partial participants said that RCP was a factor. When we added these responses to those that had already indicated that RCP was a factor, 76 percent of participants and 87 percent of partial participants said that RCP was a motivating factor in the change. No nonparticipants indicated that RCP was a factor when asked directly. Thus, it appears that RCP has been a factor in encouraging contractors to change their minds about the cost effectiveness of equipment.

Table 5-11. Reason for Changing Their View of What Is Cost Effective As a Percentage of Participants Who Changed Their Minds

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Have more experience with the products	8	12	24
Changed in response to the energy crisis	77	50	47
Learned about it through the RCP program	8	50	41
Learned about it from trade magazines or trade shows	31	12	6
Other	0	12	18
N	13	8	17

Respondents could provide more than one response. Percentages are percent of cases.

Motivations for contractors to change their views on the cost effectiveness of duct sealing were analyzed separately (Table 5-12). Clearly the energy crisis was a key motivator for all three groups. For nonparticipants, there is a dramatic departure from the previously reported patterns. About sixty percent of nonparticipants reported that they were motivated to change their views about the cost effectiveness of duct sealing as a result of their experience with the products. On average, about 25 percent of respondents volunteered that RCP was a motivation to change their views about the cost effectiveness of duct sealing. It was most important among participants (36 percent) and least important among nonparticipants (11 percent).

Table 5-12. Reason for Changing Views on the Cost Effectiveness of Duct Sealing As a Percent of Participants Who Changed Their Minds

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Have more experience with the products	61	18	27
Changed in response to the energy crisis	55	63	68
Learned about it through the RCP program	11	27	36
Learned about it from trade magazines or trade shows	16	9	9
Other	16	9	4
N	18	11	22

Respondents could provide more than one response. Percentages are percent of cases.

5.3.6 Efficient Installations

Respondents were asked about installation practices and the different types of equipment that they install. Table 5-14 shows the percentage of installations for nonparticipants, partial participants, and participants in each of two years for air conditioners rated 13 SEER or higher, 12 SEER air conditioners, furnaces at AFUE 90+, and diagnostic services for air conditioning.

Participants are installing more efficient equipment than partial participants and nonparticipants. For example, participants say that about 30 percent of their air conditioner installations in 2001 were 13 SEER or higher. This compares with 18 percent for partial participants and 11 percent of nonparticipants. In 2001, the participants installed 13 SEER air conditioners at three times the rate of nonparticipants and one and a half times the rate of participants. If the percentages of air conditioners at SEER 12 or higher are combined, 85 percent of participant installations in 2001 were 12 SEER or higher compared to 75 percent for partial participants and 45 percent for nonparticipants. More than half of the nonparticipant installations are less than 12 SEER.

We can also see that each group is shifting toward more efficient units. For example, there was a seven percent increase in the percentage of SEER 13+ installations between 1999 and 2001 for participants compared to three percent for partial participants and six percent for nonparticipants. A similar pattern is evident for 12 SEER air conditioners. Partial participants and nonparticipants evidence larger two-year increases than do participants. However, that is not surprising. Participants were already installing 12 SEER air conditioners at an average rate of 72 percent compared to 59 percent and 31 percent for partial participants and nonparticipants, respectively. Thus, nonparticipants and partial participants had more opportunity to shift from lower efficiency equipment to higher efficiency equipment.

Table 5-13. Percent of Installations by SEER

	Nonparticipant			***Partial participants***			***Participants***		
	1999	***2001***	***D***	***1999***	***2001***	***D***	***1999***	***2001***	***D***
Air conditioners rated at SEER 13 or higher	5	11	6	15	18	3	23	30	7
	0.87	1.85		2.73	3.17		4.06	3.93	
	69	67		25	31		40	53	
Air conditioners rated at SEER 12	26	35	9	44	57	13	49	55	6
	3.10	3.76		4.95	4.60		3.33	3.75	
	69	70		32	34		54	58	

The symbol "Δ" stands for percent change. The three values in the cells are the average percent, the standard error, and the number of cases.

The same trends emerge when the raw number of installed units is considered although the percentages and ratios change. Thirteen plus SEER units were 26 percent of the units installed by this sample in 2001. Participants installed sixty percent of the 13 plus SEER units. Sixteen percent of the units installed were less than 12 SEER units, and about half of these were installed by partial participants. For this sample, 58 percent of all units installed in 2001 were 12 SEER units. About 40 percent of the units are 12 SEER or higher and were installed by participants. Participants are installing 12 SEER units at one and a half times the rate of partial participants and nonparticipants.

Table 5-14. Number and Percent of All Air Conditioning Units by Efficiency and Participation Status Installed by Firms in the Sample in 2001

	Nonparticipants	***Partial participants***	***Participants***	***Total***
Air conditioners rated at SEER 13 or higher	1,906	2,114	6,113	10,133
	4.8	5.4	15.5	25.7
Air conditioners rated at SEER 12	6,501	6,494	9,780	22,775
	16.5	16.5	24.8	57.8
Air conditioners rated below 12 SEER	2,698	1,551	2,243	6,492
	6.9	3.9	5.7	16.5
Total	11,105	10,159	18,136	39,400
	28.2	25.8	46.0	100.0

The numbers in the cells are the total number of units and the percentage of all units.

There is a similar pattern for efficient furnaces. Participants say that for 2001, 40 percent of their installations were AFUE 90+ compared to 29 and 21 percent for partial participants and nonparticipants, respectively. Furthermore, the installation of efficient furnaces has increased more rapidly among participants than partial participants or nonparticipants. Between 1999 and 2001, the percent increase was 18 percent for participants compared to 14 and 13 percent for partial participants and nonparticipants, respectively.

Table 5-15. Percent of Furnaces Installed That Are Rated at AFUE 90+

Nonparticipants			***Partial participants***			***Participants***		
1999	***2001***	***Δ***	***1999***	***2001***	***Δ***	***1999***	***2001***	***Δ***
8	21	13	15	29	14	22	40	18
1.2	2.8		4.6	4.8		3.7	4.0	
69	71		25	34		42	57	

The symbol "Δ" stands for percent change. The three values in the cells are the average percent, the standard error of the average percent, and the number of cases.

Duct sealing and testing techniques also vary by the participation status of the firm. Only about two-thirds of nonparticipants report doing duct sealing and testing, whereas more than 90 percent of the participants do duct sealing (Table 5-16).

For those respondents who reported doing duct sealing and testing, we asked about the percentage of installations where they do duct sealing and testing. The results are displayed in the second row of Table 5-16. Participants clearly do the most (46 percent of installations) followed by partial participants (40 percent) and nonparticipants (21 percent). When they do it, participants and partial participants do about twice as much duct sealing and testing as do nonparticipants. In the last two years, the practice of duct sealing and testing has increased most rapidly among participants (28 percent) followed by partial participants (22 percent) and then nonparticipants (six percent).

Thus, participants are more likely to do duct sealing and testing than nonparticipants and partial participants. When participants do duct sealing, they do more of it than partial participants or nonparticipants. Finally, in the last two years participants have increased the number of homes where they do duct sealing and testing significantly more than nonparticipants and partial participants.

Table 5-16. Percentage of Firms Doing Duct Sealing and Average Percent of Installations Receiving Duct Sealing and Testing Services for Those Firms Doing Duct Sealing and Testing

	Nonparticipants			***Partial participants***			***Participants***		
	1999	***2001***	***Δ***	***1999***	***2001***	***Δ***	***1999***	***2001***	***Δ***
Percent of firms doing duct sealing		67			77			94	
		72			35			61	
Duct sealed and tested	15	21	6	18	40	13	18	46	19
	2.87	3.38		3.93	6.45		3.09	4.19	
	48	48		27	27		57	56	

The symbol "Δ" stands for percent change. The three values in the cells are the average, the standard error, and the number of cases.

Among those who do not do duct sealing and testing, approximately 35 respondents indicated a reason for not offering it. All three groups of participants cited the cost of the equipment as a key reason for not offering duct sealing and testing. Participants were more likely to cite the equipment's costs than the other two groups and also cited a lack of customer demand. This suggests that equipment costs and the perceived lack of demand may be a barrier. Modest percentages of partial participants and nonparticipants gave other reasons. It should be noted that

the number of participants and partial participants responding to this questions is small so that caution needs to be exercised in interpreting the results.

Table 5-17. Percent of Respondents Giving Reasons for Not Doing Duct Sealing and Testing

	Nonparticipants	***Partial participants***	***Participants***
Cost of equipment	48	50	75
No customer demand	30		50
Waiting for classes	4	25	
Don't have the training	4	12	
Other	26	38	1
N	23	8	4

Respondents could provide more than one response. Percentages are percent of cases.

There were 31 respondents who said that they had started to offer duct testing and sealing services in the last two years. Table 5-18 shows the distribution of reasons they gave for doing this. Most of those reporting having started offering the service (61 percent) in the last two years were participants. Both participants and partial participants reported multiple reasons for starting to offer the service. For these two groups, the two most common reasons were participation in the RCP program and that duct sealing is a good selling tool. A number of participants who started offering the service said they did so because of customer demand. About a quarter of the participants and partial participants reported that they did it in response to customer demand triggered by the energy crisis. Nonparticipants say they started to offer the service because of the energy crisis. However, there are only three nonparticipant responses.

Table 5-18 Percent of Respondents Providing Reasons for Adding Duct Sealing and Testing to Their Offerings

	Nonparticipants	***Partial participants***	***Participants***
Good selling tool		44	53
Customer demand			37
Customers had heard of it because of the energy crisis	100	22	26
Energy crisis made it a good opportunity		11	10
Started as part of the RCP program		77	58
N	3	9	19

Respondents could provide more than one response. Percentages are percent of cases.

Those who said that they offered the service because of RCP were asked if they would continue to offer the service. Ninety-five percent of those who responded (18 individuals) indicated that they would continue to offer the service.

Respondents who told us that their duct sealing and testing business had increased were asked why they thought it had increased. Table 5-19 shows the responses.

Each participant group volunteered a range of reasons. A majority of the participating contractors (56 percent) reported that the RCP vouchers were a reason. Just one or two nonparticipants or partial participants reported that vouchers were a reason for the increase in their duct sealing and testing business.

Nonparticipants (58 percent) were most likely to report that customers were asking for it as a solution to the energy crisis, but partial participants and nonparticipants also indicated that customers were asking for duct sealing (about 40 percent each). Partial participants most frequently reported that customers were asking for it as a solution to the energy crisis or that they were pushing it as a solution to the energy crisis. However, there are no statistically significant differences among participant types in terms of their reporting pushing duct sealing and testing as a solution to the energy crisis.

Table 5-19. Percent of Respondents Providing Reasons for an Increase in The Duct Sealing and Testing Business

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Marketing it more	37	12	40
Pushing it as a solution to the energy crisis	37	38	36
Customers were asking for it	26	25	16
Customers were asking for it as a solution to the energy crisis	58	38	40
The RCP vouchers created an interest	10	12	56
N	19	8	25

Respondents could provide more than one response. Percentages are percent of cases.

Even if respondents did not change the frequency with which they provided duct sealing services, they may have changed the way in which they provide the service. Respondents were asked if they had changed how they perform duct sealing. About twice as many participants and partial participants (approximately 35 percent each) indicated that they changed the methods they use to perform duct sealing and testing than did nonparticipants (17 percent).

Table 5-20. Percent of Respondents Who Say They Changed the Methods That They Use to Perform Duct Sealing and Testing

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Percent saying yes	17	37	34
Total N	56	27	48

Respondents who indicated having changed their duct sealing methods were asked what they had changed. The most common response across the three types of contractors was that they were using different methods or products. Partial participants were most likely to have done this. About a quarter of the respondents in each of the three groups reported that they were now offering duct sealing. A higher percentage of nonparticipants reported changing the equipment they use than did participants and partial participants although the number of nonparticipant cases is small indicating the need for caution in interpreting this finding. Likewise, participants and partial participants reported that they were offering more comprehensive services but again the number of cases for partial participants is small.

Table 5-21. Percent of Respondents Indicating How They Changed the Way in Which They Do Duct Sealing and Testing

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Now offer duct sealing	25	30	27
Use different methods or products to seal ducts	50	80	58
Use different equipment to test ducts	38	10	16
Provide a more comprehensive service	25	40	32
Other	12	0	21
N	8	10	19

Respondents could provide more than one response. Percentages are percent of cases.

These respondents were also asked why they had made the changes. The energy crisis was clearly a factor for all three groups. With one exception, it was the only reason cited by nonparticipants. Participants and partial participants reported combinations of reasons including RCP training, awareness and receptiveness of customers, and the energy crisis. RCP training was one of the clear reasons for participants. It was the most cited reason by partial participants.

Table 5-22. Percent of Respondents Indicating Why They Changed the Way in Which They Do Duct Sealing and Testing

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
The competition is doing it	12		
Learned it in RCP training		30	47
Customers are more aware and receptive		20	47
In response to the energy crisis	100	70	47
More profitable	0	0	5
N	8	10	19

Respondents could provide more than one response. Percentages are percent of cases.

5.3.7 Diagnostics and Air Conditioning Maintenance

Respondents were asked if they provide a service where they check and correct refrigerant charge and evaporator coil airflow. As can be seen in Table 5-23, row 1, nonparticipants offered this service more often than participants in 2001. This is somewhat of a surprise as we had expected the percentages to trend in the other direction.

While more nonparticipants say they offer the service, on average they provide this service to their customers less often than partial participants and nonparticipants (row 2, Table 5-23). On average in 2001, participants provided air conditioning diagnostic services to about 34 percent of their customers and partial participants provided the service to an average of 30 percent of their customers. Participants and nonparticipants offered the service between two and two-and-a-half times more often than nonparticipants.

In the two-year period between 1999 and 2001, participants and partial participants reported a six to seven percent increase in the number of customers receiving diagnostic services while nonparticipants reported none.

Table 5-23. Percentage of Firms Doing Air Conditioning Diagnostics and the Average Percentage of Installations for Which Diagnostics Are Done for Firms Doing Diagnostics

	Nonparticipants			***Partial participants***			***Participants***		
	1999	**2001**	**D**	**1999**	**2001**	**D**	**1999**	**2001**	**D**
Percent of firms doing diagnostics for air conditioning maintenance		83			74			69	
		72			35			61	
Diagnostic service for AC maintenance	13	13	0	24	30	6	27	34	7
	2.01	1.47		4.85	5.71		4.65	4.90	
	58	60		23	24		35	41	

The symbol "Δ" stands for percent change. The three values in the cells of row 2 are the average, the standard error, and the number of cases.

There were seven respondents who reported starting air conditioning diagnostic services. Six of these were participants and one was a partial participant. Five of the seven reported that they started the service because of RCP.

There were 34 respondents who reported an increase in the number of customers they served between 1999 and 2001. They were asked why they thought air-conditioning diagnostic services increased (see Table 5-25). RCP vouchers and customer demand were the two most common reasons cited by participants. Partial participants most commonly indicated that there was an increase because they were marketing it and customers were asking for it because of the energy crisis. An additional participant and a partial participant who volunteered other reasons for the increase indicated that RCP was also a reason when asked directly about it. When these two participants are added to the table, half of the participants and 40 percent of the partial participants say that RCP programs were a reason for having increased their level of air conditioning diagnostic services. Nonparticipants most commonly cited the energy crisis as the reason for having increased the frequency of offering the service. Because the number of respondents is small, caution is needed in interpreting these findings.

Table 5-24. Reasons Offered for an Increase in Air Conditioning Diagnostic Services between 1999 And 2001

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total***
Marketing it more	31	60	23	32
Pushing it as a solution to the energy crisis	13	40	23	21
Customer are asking for it because the heard about it	19	20	46	29
Customers are asking for it because of the energy crisis	50	60	31	50
RCP vouchers are creating interest in it		20	46	
Other	6		8	6
Total N	13	5	16	34

Respondents could provide more than one response. Percentages are percent of cases.

When the participants and partial participants were asked if they thought the increases would be maintained in the absence of the RCP program, all of them said that they thought they would.

In addition to the small increase in the frequency with which the service is offered, the nature of the services that are offered changed as well. Overall, about 22 percent of those providing the service say that they have changed the way they perform the service in the last two years. More than a third of the participants say they have changed the way that they perform the service compared to an eighth of the nonparticipants.

Table 5-25. Percent of Firms Offering Air Conditioning Diagnostic Services Who Have Changed the Way That They Perform the Service in the Last Two Years

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total***
Yes	12	21	37	22
No	88	79	63	78
Total percent	100	100	100	100
Total N	56	27	48	131

We asked those who changed the way that they are providing the service how they changed what they offer. Because the numbers are small for the nonparticipants and partial participants, some caution needs to be exercised in interpreting these

findings. All three groups reported providing more in-depth and accurate services and that they were using better equipment.

Table 5-26. Changes to Diagnostic Services among Those Who Changed What They Do

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total***
More in-depth or accurate	43	100	67	68
Use better equipment	57	67	67	64
Total N	7	6	15	28

Respondents could provide more than one response. Percentages are percent of cases.

We asked this group why they changed what they were doing. Participants and partial participants noted that they did this in response to the RCP program and cited some other reasons. Nonparticipants attributed their actions to the energy crisis. When we asked those who cited reasons other than RCP if RCP had contributed to their decision, an additional person indicated that RCP was a factor.

Table 5-27. Reason for Changes to Diagnostic Services among Those Who Changed What They Do

	Nonparticipants	***Partial Participants***	***Participants***	***Total***
Able to charge more in response to the RCP program	14		13	11
Because of the energy crisis	86	33	27	43
Because customers are asking for it	14	16	2	14
Other			7	4
Total N	7	6	15	28

Respondents could provide more than one response. Percentages are percent of cases.

Finally, we asked those who changed in response to the RCP program if they would continue the changes if RCP were discontinued. Overall, 89 percent of those who made changes as a result of RCP indicated that they would continue the changes. Only two participants indicated that they would discontinue the changes.

Table 5-28. Will Those Who Changed Because of RCP Continue the Changes in the Absence of RCP?

	Partial participant percent	***Participant percent***	***Total***
Yes	100	86	89
No		15	11
Total N	5	13	18

If the RCP program were to be discontinued, some of the diagnostic jobs might be discontinued. Table 5-29 shows that about 60 percent of those who changed what they are doing because of RCP believe that the demand for diagnostic jobs will continue if RCP is discontinued.

Table 5-29. Will the Number of Diagnostic Jobs Continue If RCP Is Discontinued?

	Partial participant percent	***Participant percent***	***Total***
Yes	60	62	61
No	40	38	39
Total N	5	13	18

Thus, the number of firms offering diagnostic services has not increased in the last two years. This is not surprising since most firms were offering diagnostic services. However, more participating and partially participating firms have changed the type of services that they offer than have nonparticipants. Most participants and partial participants who have changed what they offer say that the RCP program was a reason for having changed. Nonparticipants generally cite the energy crisis as motivating their change.

5.3.8 Combustion Safety Testing

Overall in 2001, combustion safety testing was completed in approximately 21 percent of homes. Nonparticipants are least likely to do combustion safety testing. Partial participants performed more combustion safety inspections in homes two years ago, an average of 31 percent of customers, than participants (15 percent) or nonparticipants (eight percent). However, participants had the largest percentage change in the number of homes where this was offered in the last two years (18 percent).

Table 5-30. Percent of Installations for Which Combustion Safety Testing Is Done

Nonparticipants			***Partial participants***			***Participants***		
1999	***2001***	***D***	***1999***	***2001***	***D***	***1999***	***2001***	***D***
8	11	3	31	41	10	15	33	18
2.1	3.5		9.5	10		4.3	6.3	
29	29		15	16		32	35	

The symbol "Δ" stands for percent change. The three values in the cells are the average percent, the standard error, and the number of cases.

5.3.9 Whole-System Treatments

Respondents were asked if they consider their customer's energy usage when making recommendations for heating and cooling systems. There was almost no difference among participants, partial participants, and nonparticipants (Table 5-31).

Table 5-31. Percentage Who Consider the Energy Usage of Their Customers When Making Recommendations for Heating and Cooling Systems

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Yes	83	86	83
No	17	14	17
N	61	35	72

Respondents were then asked if they consider changes to the distribution system that may affect the overall efficiency of the HVAC system (Table 5-32). Here too, the finding was that there were no statistically significant differences. There is a slight tendency for partial participants to be more likely to consider changes to the distribution system than participants and nonparticipants.

Table 5-32. Percentage Who Consider Changes to the Distribution System That May Affect the Overall Efficiency of the HVAC System

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Yes	87	94	86
No	13	6	14
N	61	35	72

Respondents who do consider changes to the distribution system were asked for what percentage of systems they currently consider changes as well as for what

percentage of systems this was done two years ago (Table 5-33). In 2001 participants considered changes for an average of 48 percent of distribution systems with which they dealt which is slightly higher than for partial participants and more than double that for nonparticipants. Partial participants show the greatest percentage increase in consideration for changes to the distribution system that may affect the overall efficiency of the HVAC system.

Table 5-33. Average Percentage of Distribution Systems Considered for Changes That May Affect the Overall Efficiency of the HVAC System

Nonparticipants			***Partial participants***			***Participants***		
1999	***2001***	***Δ***	***1999***	***2001***	***Δ***	***1999***	***2001***	***Δ***
18	23	5	30	43	13	40	48	8
3.38	3.58		5.33	6.07		5.21	5.52	
60	62		32	33		48	52	

The symbol "Δ" stands for percent change. The three values in the cells are the average, the standard error, and the number of cases.

Respondents who showed a percentage increase were asked why the rate at which they consider changes to the distribution system increased. For 77 percent of participants, it was due to RCP vouchers. Partial participants cited two main reasons, RCP vouchers and the energy crisis. Seventy-seven percent of nonparticipants claim it is because of the energy crisis. Those respondents who did not cite the RCP as a reason were asked if the RCP program was a factor. With the exception of nonparticipants, the number of responses to this question was too small to result in any meaningful findings. Eighty-six percent of nonparticipants said that the RCP program was not a factor. Almost all of the respondents who cited the RCP program as a factor said that they would continue these changes if the RCP program were discontinued.

5.3.10 Market Potential for HVAC Upgrading

Respondents were asked what percentage of homes in their area could still upgrade their cooling and heating equipment for a reasonable cost (Table 5-36). Participants and partial participants believe that an average of two-thirds of homes could still be upgraded compared to an average of 39 percent of nonparticipants.

Table 5-34. Average Percentage of Homes That Could Upgrade Their Cooling and Heating Equipment for a Reasonable Cost

Nonparticipants	*Partial participants*	*Participants*	*Total*
39	67	66	55
3.84	4.18	2.51	2.13
69	34	61	164

The three values in the cells are the average percent, the standard error, and the number of cases.

Respondents were then asked for what percentage of these homes they believe owners are likely to upgrade in the absence of an incentive (Table 5-35). Nonparticipants indicated that upgrades without incentives are likely in just 19 percent of these homes while partial participants thought upgrades without incentives were possible in 32 percent of homes.

Table 5-35. Average Percentage of Homes That Are Likely to Have a Heating and Cooling Upgrade in the Absence of an Incentive

Nonparticipants	*Partial participants*	*Participants*	*Total*
19	32	25	24
2.48	4.49	2.10	1.65
67	35	58	160

The three values in the cells are the average percent, the standard error, and the number of cases.

If we multiply the percentages in Table 5-36 by those in Table 5-35, we obtain the percentage of the market that is likely to be changed without an incentive. The percentages for participants, partial participants, and nonparticipants are 17, 21, and 7 percent, respectively. In other words, participants and partial participants are more optimistic about the size and likelihood that the market will upgrade without incentives than are nonparticipants.

We can also look at it in terms of the number of households that are perceived to be candidates for upgrades that will require incentives. If participants believe that 66 percent can upgrade and that 25 percent will, then 66 percent minus 66 percent times 25 percent will require upgrades. Participants, partial participants, and nonparticipants see the percentages of households as being 49, 46, and 32 percent, respectively. In other words, participants and partial participants see more of a need for households to be incentivized to participate than do nonparticipants. The bottom line is that participants and partial participants see a large market for

upgrades, and they see a greater number of households being served without incentives than do nonparticipants. However, their view of the size of the market also means that more households in absolute numbers will need to be incentivized.

Respondents were asked if the percent of customers likely to have the work done has changed over the past year (Table 5-36). About two-thirds of each of the contractor groups thought that the likelihood had increased.

Table 5-36. Has The Percentage of Customers Likely to Have the Work Done Changed over the Past Year?

	Nonparticipants	***Partial participants***	***Participants***
Yes	65	69	62
No	35	31	38
N	61	35	72

Those who thought the likelihood had changed were asked why they thought so (Table 5-37). For participants and partial participants, the reasons were comprised of some combination of contractors educating and selling customers on it, the energy crisis, customers wanting to save energy costs, and RCP vouchers. Nonparticipants claimed much the same combination of reasons with the exception of RCP vouchers.

Table 5-37. Reason the Percentage of Customers Likely to Have the Work Done Has Changed over the Past Year

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Contractors educate customers and sell them on it	32	29	45
Utilities have been educating customers	11		13
RCP vouchers	4	21	53
The energy crisis	79	54	61
Customers want to save energy costs	43	50	58
Other		8	
N	47	24	38

Respondents could provide more than one response. Percents are percent of cases.

Contractors who did not cite the RCP program as a reason were asked if the change in the percentage of customers likely to have the work done was due to the RCP program (Table 5-38). Ninety-seven percent of participants said the change was

due to the RCP program, compared to 69 percent of partial participants and 32 percent of nonparticipants. If we combine those who volunteered RCP as a reason and those who indicated RCP was a reason when asked directly, 97 percent of participants, 94 percent of partial participants and 36 percent of the nonparticipants indicated that RCP was a factor. The RCP program was an important motivator for participants and partial participants and much less of a motivator for nonparticipants.

Table 5-38. Was the Change in the Percentage of Customers Likely to Have the Work Done Due to RCP?

	Nonparticipants	***Partial participants***	***Participants***
Yes	31	65	94
No	69	35	6
N	45	17	18

Respondents were asked what percentage of homes in their area could reduce their duct leakage for a reasonable cost (Table 5-39). Participants believe that almost two-thirds of homes could reduce their duct leakage compared to 57 percent of partial participants and 39 percent of nonparticipants. Thus, participants and partial participants believe the market for duct sealing and testing is much larger than do nonparticipants.

Table 5-39. Average Percentage of Homes that Could Reduce Duct Leakage for a Reasonable Cost

Nonparticipants	***Partial participants***	***Participants***	***Total***
32	57	66	49
3.61	4.97	2.75	2.43
68	31	59	158

The three values in the cells are the average percent, the standard error, and the number of cases.

Respondents were asked for what percentage of these homes the owners are likely to have work done in the absence of an incentive (Table 5-40). Overall, respondents believe that 22 percent of households will take action to reduce duct leakage in the absence of an incentive. Partial participants are most likely to believe that customers will take action in the absence of an incentive. Nonparticipants are the least likely.

Table 5-40. Average Percentage of Homes Likely to Be Worked on in the Absence of an Incentive

Nonparticipants	*Partial participants*	*Participants*	*Total*
18	28	23	22
2.60	3.64	1.94	1.52
61	28	57	146

The three values in the cells are the average percent, the standard error, and the number of cases.

If we multiply the percentages in Table 5-39 and Table 5-40, we get the percentages of the expected market for people who need duct sealing and who will pay for it without incentives. Nonparticipants see this market as about 16 percent of households while participants and partial participants see it as about 15 percent of households. The market requiring incentives to do duct sealing and testing is believed by participants, partial participants, and nonparticipants to be 51, 26, and 41 percent, respectively.[10]

5.3.11 Overall Influence of RCP on Customer Demand

Respondents were asked to rate on a 1 to 5 scale, where "1" indicates "no influence" and "5" indicates a "great deal of influence", the overall influence that the RCP program has had on customer demand for high efficiency equipment, duct sealing, and air conditioning diagnostic services (Table 5-44). For high efficiency equipment, participants rated the level of influence as 3.9, followed by partial participants (3.4) and then nonparticipants (3.1). For participants, this suggests that the program has had a fair amount of influence on demand.[11] Participants gave a similar rating to the effects of duct sealing and testing on demand. For air conditioning diagnostics, the perceived level of influence for all three groups is about the same and rated between some influence and a little bit of influence. This suggests that there are other factors at work in this area. Overall, participants feel that in comparison to other factors, the RCP program is having a greater than average influence on customer demand for high efficiency equipment and duct sealing. Partial participants also attribute some influence from the RCP program to customer demand for efficient equipment. Nonparticipants largely see the RCP program as just another factor in the market.

[10] These percentages were calculated by multiplying the percentage of homes where there is potential multiplied by the percentage of homes likely to do the work and then subtracted from the percentage of homes with potential.

[11] We characterize this as a fair amount of influence assuming that the respondents considered the five points on the scale to be "no influence," "a little bit of influence," "some influence," "a fair amount of influence" and "a great deal of influence."

Table 5-41. What Influence Has RCP Had on the Following:

	Nonparticipants	***Partial participants***	***Participants***	***Total***
High efficiency equipment	3.1 0.11 71	3.4 0.24 34	3.9 0.11 61	2.6 0.11 162
Duct sealing and testing	2.8 0.19 68	2.9 0.24 34	3.8 0.14 61	3.2 0.11 163
Air conditioning diagnostics	2.6 0.17 70	2.6 0.24 34	2.7 0.17 58	3.5 0.11 166

The three values in the cells are the average percentage, the standard error, and the number of cases.

5.3.12 Barriers to Increasing Efficiency in the Market Place

The reader can see from Table 5-42 that very few of the contractors (12 percent overall) feel that they would have trouble meeting a surge in demand for high efficiency HVAC retrofits.

Table 5-42. If You Were to Experience High Demand for HVAC Retrofits, Would You Have Trouble Expanding Your Services?

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total percent***
Yes	14	14	10	12
No	86	86	90	88
N	72	35	61	168

Likewise, only 12 percent of the respondents overall (Table 5-43) thought they would have trouble meeting a burgeoning demand for air conditioning diagnostics.

Table 5-43. Would You Have Trouble Expanding for a High Demand of Diagnostic Services for Air Conditioning Maintenance?

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total percent***
Yes	15	9	10	12
No	85	91	90	88
N	72	35	61	168

However, contractors suggest that their ability to respond to a surge in demand for duct testing and sealing is slightly different. About a quarter of nonparticipants and

partial participants believe that they might experience difficulties in meeting demand for duct testing and sealing. This is roughly double the percentage of participants who indicate that they might have trouble meeting higher customer demand.

Table 5-44. Would You Have Trouble Expanding for a High Demand of Duct Testing and Sealing?

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total percent***
Yes	28	23	12	21
No	72	77	88	79
N	72	35	60	167

Respondents were also asked if they would have or have had trouble finding high efficiency air conditioning and heating units. Overall, very few respondents believe they would have or have had trouble (four percent). There are only minor differences among the three groups of respondents.

Table 5-45. Would You Have or Have You Had Trouble Finding High Efficiency Air Conditioning and Heating Units?

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total percent***
Yes	8	3	5	6
No	92	97	95	95
N	72	34	61	167

Respondents were asked if they would have or have had trouble acquiring diagnostic equipment. Overall, very few respondents believe they would have or have had trouble (five percent).

Table 5-46. Would You Have or Have You Had Trouble Acquiring Diagnostic Equipment?

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total percent***
Yes	7		5	5
No	93	100	95	95
N	72	34	61	167

Respondents were asked if they would have or have had trouble finding qualified labor. Overall, almost half of the respondents believe they would have or have had

trouble finding qualified labor. There are only small differences among the three groups of respondents. According to a number of informants with whom we talked in the last couple of years, this appears to reflect a general lack of interest in this type of work among workers in the labor pool. This appears to be a general problem and not one specific to the installation of efficient equipment.

Table 5-47. Would You Have or Have You Had Trouble Finding Qualified Labor?

a	*Nonparticipants*	*Partial participants*	*Participants*	*Total percent*
Yes	46	50	44	46
No	54	50	56	54
N	72	34	61	167

Thus, there appear to be few structural barriers in the market place. Few contractors believe that they would have any problem meeting customer demand for efficient equipment and services with the possible exception of duct sealing and testing where partial participants and nonparticipants indicate that there might be difficulties in meeting demand. Mostly, respondents do not think there are any difficulties associated with obtaining equipment. Labor is a key issue for all groups of contractors. Based on information in other studies and information from other sources, this appears to be a general problem in this sector and not one related to high efficiency equipment.

5.3.13 Summary and Conclusions for RCP HVAC Contractors

In this section we have examined the effects of the Residential Contractor Program on the delivery of HVAC installations and services ranging from specification of efficient air conditioning to providing diagnostic services. The findings address both the penetration of services in the market and trends between 1999 and 2001.

Between 1999 and 2001, there was a clear and strong trend toward using more efficient equipment and providing more efficient services among residential contractors. Contractors who are RCP participants are clearly in the forefront of this trend and there is no doubt that RCP has influenced their behaviors. However, other factors, such as the energy crisis and changes in customer demand, contribute to these trends. Even so, it is clear that RCP is an important causal factor.

We found that participating HVAC firms have been in business longer and are larger than partial participants or nonparticipants. Participating contractors are more likely to have multiple licenses than nonparticipants. The fact that nonparticipant firms tend to have a single license means that these contractors can be identified through licensing data if program implementers should decide to target them.

Awareness of RCP is high among HVAC contractors. However, about a third of the nonparticipating contractors have not heard of the program. Thus, awareness remains an issue in the nonparticipant contractor community.

Generally, HVAC contractors perceive that their customers have modest levels of awareness. If this finding is borne with customers, customer awareness of RCP could be increased.

On average in 2001, nonparticipants perceived that high efficiency air conditioning has a 12.1 SEER rating compared to participants who believe high efficiency air conditioning is nearly 13 SEER. Between 1999 and 2001, nonparticipants were more likely to have changed their minds about what constitutes high efficiency air-conditioning than were other types of participants. Nonparticipants, who two years ago thought that high efficiency air conditioning was a 10 SEER unit, are now more likely to believe that it is a 12 SEER unit or greater. Likewise, partial participants, who two years ago believed that high efficiency was a 10 SEER unit, now believe that it is a 12 SEER or higher. Equally important is a shift among some RCP participants who believe high efficiency is defined by equipment that is a 13 SEER unit or higher. Based on these data, we believe that most contractors perceive a 12 SEER rating or higher as defining high efficiency air conditioning. For participants, RCP was one of several factors that caused them to change their views about efficiency. Experience with products, customer demand, and the energy crisis were also factors. Nonparticipants changed their views in response to the energy crisis.

Participants are installing 13 SEER air conditioners at three times the rate of nonparticipants and one-and-a-half times the rate of partial participants.

Participants and partial participants do about twice as much duct sealing and testing as do nonparticipants. In the last two years, the practice of duct sealing and testing has increased most rapidly among participants (28 percent increase), followed by partial participants (22 percent increase), and then nonparticipants (six percent increase)

The cost of equipment and perceived low customer demand appear to be barriers to increased duct sealing. Among those who started doing duct sealing in the last two years, RCP was a motivation for selling duct sealing as well as duct sealing being a useful selling tool. A majority of the participating contractors (56 percent) who reported increases in duct sealing business reported that RCP vouchers were the reason. All participating groups cited other reasons including more active selling of duct sealing and the energy crisis as factors contributing to increased duct sealing business.

Participants and partial participants were twice as likely to report having changed the way they offer duct sealing. The most common change was the use of new materials.

Participants and partial participants reported combinations of reasons including RCP training, the awareness and receptiveness of customers, and a response to the energy crisis as reasons for changing duct sealing practices. Nonparticipants changed duct sealing practices mostly in response to the energy crisis.

The number of firms offering air conditioning diagnostic services has not increased in the last two years. However, more participating and partially participating firms have changed the type of diagnostic services that they offer than have nonparticipants. Most participants and partial participants who say that they have changed what they offer say the RCP program was a reason. Nonparticipants generally cite the energy crisis as motivating changes in their practices.

Combustion safety testing is done in a modest percentage of homes (20 percent) and is least often done by nonparticipants.

Participants and partial participants see a large market for HVAC efficiency upgrades. They also see a greater percentage of households potentially being served without incentives than do nonparticipants. However, because they see the potential market as being larger than nonparticipants, they believe that more households in absolute numbers will need to be incentivized than do nonparticipants.

Overall, participants feel that in comparison to other factors, the RCP program is having a greater than average influence on customer demand for high efficiency equipment and duct sealing. Partial participants also attribute some influence on customer demand for efficient equipment to the RCP program. None of the three types of participants see the influence of the RCP program as a major influence on diagnostic testing.

There has been a lot of commentary about market barriers. There appear to be few structural barriers in the market place. Only a small percentage of contractors believe that they would have any problem meeting customer demand for efficient equipment and services. The possible exception is duct sealing and testing where a slightly higher percentage of partial participants and nonparticipants indicate that there might be difficulties in meeting demand. Mostly, respondents do not think there are any difficulties associated with obtaining equipment. However, labor is a key issue for all groups of contractors. Based on information in other studies and information from other sources, this appears to be a general problem in this sector and not one related to high efficiency equipment.

5.4 RESULTS FOR WINDOW CONTRACTORS

There were 81 contractors who responded to the window contractor survey. Like the HVAC contractors, the window contractors have been placed into three groups: participants, partial participants, and nonparticipants. Participants have had RCP training and have submitted RCP vouchers. Partial participants have received training but not submitted vouchers, and nonparticipants have not received vouchers or training.

5.4.1 Characteristics of the Window Contractors

Overall, window contractors have been in business (Table 5-48) an average of about fifteen years. Nonparticipant window contractors have been in the business longer, an average of 17 years, and are associated with smaller firms, an average of 14 employees, when compared to participants who have been in business an average of 14 years and employ an average of 22 people. Partial participants fall in between nonparticipants and participants in terms of years of experience but are more like nonparticipants in terms of the number of employees in a firm. Participant firms serve an average of 976 homes per year, compared to an average of 960 homes served by partial participants and 813 homes served by nonparticipants.

Table 5-48. Experience and Size of Window Firms

	Nonparticipants	***Partial participants***	***Participants***
Average years worked as a contractor	17 2.02 16	15 1.49 20	14 0.98 43
Average years as a contractor in California	16 1.78 16	15 1.49 20	15 1.18 43
Average number of people in the company	14 2.80 16	13 1.98 20	22 4.76 45
Average number of single family residences served	813 425 16	960 236 20	976 148 45

The three values in the cells are the average, the standard error, and the number of cases.

Nonparticipants are more likely than participants to have a single type of contractor license (Table 5-49). Fifty-six percent of nonparticipants have a single license compared to 36 percent of participants. Firms with just one license serve fewer customers than firms with multiple licenses. Window contractors with two or more licenses serve nearly a thousand customers annually compared to slightly more than 850 for contractors who have a single license.

Table 5-49. Participant Status and Number of Contractor Licenses

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
One contractor license	56	50	36
Two or more contractor licenses	44	50	64
N	16	20	45

Table 5-50. Average Number of Customers Served by Number of Contractor Licenses

	Average number of customers served
One contractor license	853
Two or more contractor licenses	999

Participants are most likely to have some combination of a glazing (C17), general contractor (B1), and home improvement (HIC) licenses. Partial participants tend to have glazing and general contractor licenses. Nonparticipants are mostly restricted to a single license. Thirteen of the 16 nonparticipants have C17 licenses and six have B1 licenses. Only two have HVAC (C20) licenses.

Participating window contractors offer a broader range of services than partial or nonparticipating contractors (Table 5-55). A number of participants and partial participants provide additional services other than window services, but nonparticipants say they only install high performance windows. Nearly all of the respondents said that they install high performance windows.

Table 5-51. Services Provided by Window Contractors

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Check/correct refrigerant and evaporator coil on ac and heat pumps			7
Duct sealing			4
Duct testing		5	4
Installing Energy Star furnaces		5	7
Installing Energy Star central ac and heat pumps		5	9
Installing programmable thermostats		5	4
Installing attic and wall insulation		5	4
Installing high performance windows	100	100	98
Installing efficient gas water heaters		5	4
Installing pipe insulation		5	2
N	16	20	45

Percents are percent of cases. Respondents could provide more than one response.

5.4.2 General Awareness of RCP among Window Contractors

Window contractors were asked if they are aware of the RCP. Ninety-one percent of all windows contractors say that they are aware. Logically, participants and partial participants have to be aware. Only nonparticipants can be unaware. Fifty-six percent of nonparticipants are aware of the RCP program. Thus, awareness is lacking among about half of the nonparticipating windows contractors. However, if this sample is representative of windows contractors generally, then awareness is an issue for just nine percent of the contractor population. In other words, contractors mostly know about RCP.

5.4.3 Contractors' Assessment of Customer Awareness

Respondents were asked to rate the level of their customers' awareness of the RCP program on a 1 to 5 scale where "1" is "not at all aware" and "5" is "very aware." Participating contractors rated their customers' average awareness the highest (3.4) followed by partial participants (3.3) and then nonparticipants (3.1). None of the three groups rated their customer's awareness very highly. A score of three is in the middle of the awareness scale. The differences among the three groups are not statistically significant.

5.4.4 Perceived Customer Awareness

Respondents were asked if their customers are more aware of the benefits of installing high performance windows now than two years ago. Ninety percent or more of each of the three groups think that their customers are more aware today than two years ago.

When asked why their customers are more aware, participants and partial participants most frequently cited the RCP program and contractors educating the customers as the reasons why customers are more aware (Table 5-54). A majority of contractors in all three groups agree that contractors educating and selling customers on the benefits of installing high performance windows is an important reason why customers are more aware. Nonparticipants said that the energy crisis as well as contractors promoting efficient windows are reasons customers are more aware. By contrast, about 20 percent of participants and partial participants cited the energy crisis as motivating customers. The bottom line is that all contractors tend to agree that their efforts in educating customers are important in creating customer awareness but participants and nonparticipants do not agree as to whether it is the energy crisis or the RCP program that is creating the awareness.

Table 5-52. Reasons Why Respondents Think Their Customers Are More Aware

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Contractors educate them	53	61	60
Information from utilities	7	11	21
Other utility programs	13	6	2
The energy crisis	53	22	17
The RCP program	27	83	74
Learned from the internet or other media	20	6	14
N	15	18	42

Respondents could provide more than one response.

We directly asked the contractors who gave a response other than RCP whether RCP may have influenced their customers' awareness. When these responses are combined with the responses from contractors who had volunteered RCP, 93 percent of participants, 89 percent of partial participants, and 53 percent of nonparticipants said that they thought RCP was a factor that influenced their customers.

5.4.5 What Are Energy Efficient Windows?

Window contractors were asked about the U-factor for windows that they currently consider (2002) to be energy efficient. Overall, respondents believe that windows with U-factor of 0.40 are efficient. Participants and partial participants reported average U-factor for windows that they believed to be energy efficient windows that were lower than the average U-factor for nonparticipants, 0.37 and 0.38 compared to 0.51, respectively.[12] The difference between participants, partial participants, and nonparticipants is statistically significant. However, the difference between participants and partial participants is not. The important point is that nonparticipants have a lower standard for what constitutes an efficient window.

We asked respondents if their view of what constitutes an energy efficient window changed from what it was in 1999. Overall, 32 percent of the respondents say that they have changed their view of what constitutes an energy efficient window from two years ago. Partial participants were slightly more likely to have changed their view of what energy efficient windows are than were participants or nonparticipants, but this finding is not statistically significant. Thus, about one-

[12] Lower U-factors indicate more efficient windows.

third of all contractors have changed their views about what constitutes an efficient window.

Table 5-53. Percentage Who Changed Their View Since 1999 of What Are Energy Efficient Windows

	Nonparticipants	***Partial participants***	***Participants***	***Total***
Yes	31	35	31	32
No	69	65	69	68
N	16	20	45	81

For this study, the important question is whether RCP has impacted contractors' views of what high efficiency means. The 26 respondents who changed views were asked why their views have changed. Table 5-54 shows the responses. Respondents could provide more than one response.

First, it should be noted that the number of cases is small. Partial participants and nonparticipants most commonly said that they changed their views in response to the energy crisis. Nonparticipants also learned from trade magazines or trade shows. A few partial participants said that they gained experience as customers asked for more efficient equipment and also cited RCP.

For participants, RCP was the most common reason for changing their views about what constitutes an energy efficient window, but they also cited the energy crisis and other reasons about equally as often. One respondent said it was due to technological improvements in window manufacturing.

Table 5-54 Reason for Changing One's View of What Are Energy Efficient Windows

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Gain more experience as customers ask more		43	7
Changed in response to the energy crisis	80	71	29
Learned about it through the RCP program		29	36
Learned about it from trade magazines or trade shows	40		7
Other			29
N	5	7	14

If respondents volunteered a reason other than RCP, they were subsequently asked if RCP was also a factor. When the volunteered responses are combined with the

responses of those who were asked directly, 79 percent of the participants, 86 percent of the partial participants, and 60 percent of the nonparticipating contractors thought that RCP had influenced the awareness of their customers. Thus, windows contractors think that RCP is a factor in customer awareness.

5.4.6 Contractor Views of Cost Effectiveness

On a scale of 1 to 5 where "5" is "very cost effective" and "1" is "not at all cost effective," respondents were asked how cost effective they believe windows with a U-factor of 0.4 or less are for their region (Table 5-55). The overall average value is 4.2. Participants think it is the least cost effective (4.0), followed by partial participants (4.2) and then nonparticipants (4.5) who think it is the most cost effective. Thus, there appears to be general agreement that windows with a U-factor of less 0.4 are at least somewhat cost effective.

Table 5-55. Average Cost Effectiveness of Windows with U-Factor of 0.4

	Nonparticipants	***Partial participants***	***Participants***
How cost effective are windows with a U-factor of 0.4 or less in your region?	4.5	4.2	4.0
	0.17	0.14	0.14
	15	20	43

The average is based on a five-point scale where "1" is "not at all cost effective" and "5" is "very cost effective." The three values in the cells are the average, the standard error, and the number of cases.

About a quarter of all contractor respondents said that they changed their minds from two years ago about whether windows with a U-factor of less than 0.4 are cost effective (Table 5-56). There is virtually no difference in the percent who changed their minds among the three groups of respondents.

Table 5-56. Percentage Who Changed Their View Since 1999 of How Cost Effective Windows with a U-Factor of 0.4 Are

Would you have answered differently two years ago?	***Nonparticipants***	***Partial participants***	***Participants***	***Total***
Yes	25	25	28	27
No	75	75	72	73
N	16	20	43	79

Those who changed their view were asked to explain why (Table 5-57). Note that a total of just 21 contractors indicated having changed their minds. For participants, the main reasons are the energy crisis and RCP training. About a third reported that customers more often asked for efficient windows. For partial participants and nonparticipants, the energy crisis is the main reason. One partial participant cited product quality as the reason. Nonparticipants also cited

customers asking for more efficient windows. The respondents are too few in number to draw firm conclusions about why contractors changed their views although the nonparticipants and partial participants seemed to shift their views in response to the energy crisis.

Table 5-57. Reason Why Respondents Changed Their View Since 1999 of How Cost Effective Windows with a U-Factor of 0.4 Are

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Gained more experience as customers ask for it more	50	20	33
The energy crisis	75	60	42
Learned from RCP training	25		42
Learned from trade magazines/shows	25		17
Other		20	17
N	4	5	12

Percents are percentages of cases. Respondents could provide more than one response.

Respondents who did not cite RCP training as a reason were asked directly if customers are asking for it more due to the RCP program. When the initial response and the direct query are taken into account, 11 out of 12 participants (92 percent) and four of five partial participants said that RCP was a factor. This compares to three out of four nonparticipants who said that RCP was a factor. This suggests that RCP is a factor for all groups.

Respondents were then asked on a 1 to 5 scale where "1" is "not cost effective" and "5" is "very cost effective", how cost effective they thought the customers in their region consider windows with a U-factor of 0.4 or less to be (Table 5-58). The overall average value is 4.1 and there are no differences among the types of participants.

Table 5-58. Contractor's Assessments of Their Customers' Views of the Cost Effectiveness of Windows with U-Factor of 0.4

	Nonparticipants	***Partial participants***	***Participants***
How cost effective do you think your customers consider windows with a U-factor of 0.4 or less in your region?	4.1	4.2	4.1
	0.16	0.18	0.16
	16	20	45

The average is based on a five-point scale where one is not at all cost effective and five is very cost effective. The three values in the cells are the average, the standard error, and the number of cases.

Respondents were also asked if two years ago they would have answered differently the question about how cost effective customers in their region consider windows with a U-factor of 0.4 or less (Table 5-59). Participants were least likely to indicate that customers changed their view (24 percent) while about 30 percent of nonparticipants and partial participants believe customers changed their views. The differences are not significant.

Table 5-59. Percentage of Contractors Who Have Changed Their View Since 1999 of How Cost Effective They Think Their Customers Consider Windows with a U-Factor of 0.4

Would you have answered differently two years ago?	***Nonparticipant percent***	***Partial participant percent***	***Participant percent***	***Total***
Yes	31	30	24	27
No	69	70	72	73
N	16	20	45	81

Participants who changed their views (Table 5-60) most frequently indicated that the RCP program was the reason followed by customers being more informed due to contractor promotions and RCP vouchers. Partial participants think customers are more informed due to the RCP program and contractor promotion. For nonparticipants, the energy crisis is the main reason. The respondents are too few in number to draw firm conclusions but participants and partial participants did cite the RCP program more often.

Table 5-60. Reason Why Respondents Changed Their View Since 1999 of How Cost Effective They Think Their Customers Consider Windows with a U-Factor of 0.4

	Nonparticipants percent	***Partial participant percent***	***Participant percent***
Customers are more informed by the internet		33	27
Customers are more informed from the RCP	40	50	73
Customers are more informed from contractor promotion		50	55
The energy crisis and media discussion	80	33	18
Customers are more informed from utilities and other organizations			18
RCP vouchers	20		46
N	5	6	11

Percents are percentages of cases. Respondents could provide more than one response.

Respondents who did not cite the RCP program or vouchers as a reason were asked directly if customers believe windows with a U-factor of 0.4 or less are cost effective due to the RCP program. One of two participants and two of three partial participants said yes compared to one of three nonparticipants. When combined with the responses of those who volunteered RCP as a factor, 89 percent of the participants, 84 percent of the partial participants, and 60 percent of the nonparticipants who believe their customers changed their views as to how cost effective a U-factor of .4 is, cited RCP as a factor in customers changing their minds. The reader will want to keep in mind that the number of cases is small which may limit the ability to generalize this finding.

5.4.7 Efficient Installations

All three participation types said that the percentage of their businesses doing window installations in existing homes had increased by four percent between September 1999 and September 2000. Participants and partial participants reported that about 70 percent of their total business before September 1999 was from installing windows. As indicated, the percentage had increased slightly in September 2000. Nonparticipants said that 42 and 46 percent of their business was from installing windows in the two periods, respectively.

Table 5-61. Percent of Total Business from Installing Windows in Existing Homes

Nonparticipants			***Partial participants***			***Participants***		
1999	***2001***	***Δ***	***1999***	***2001***	***Δ***	***1999***	***2001***	***Δ***
42	46	4	66	70	4	74	78	4
9.66	9.81		6.66	6.07		3.89	3.19	
16	16		19	20		44	45	

The symbol "Δ" stands for percent change. The three values in the cells are the average percent, the standard error, and the number of cases.

Respondents who increased the percentage of their total business from installing windows in existing homes were asked why it had increased (Table 5-62). Respondents cited the energy crisis as the main reason (58 percent), followed by RCP vouchers (42 percent). Other reasons included customers being more receptive to the benefits of replacement windows, the company more heavily promoting retrofits, and business in general increasing. Partial participants reported all of the reasons except that of customers being more receptive to the benefits. Nonparticipants cited all of the reasons with the most common reason being the energy crisis (63 percent).

Table 5-62. Primary Reason for the Increase in Total Business from Window Installations in Existing Homes

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Customers are more receptive to the benefits	38		25
Company is promoting retrofits more	13	67	33
The energy crisis	63	33	58
RCP vouchers	13	33	42
Company's reputation	13	33	
Business in general is increasing	38	33	17
N	8	3	12

Respondents could provide more than one response.

Respondents who did not volunteer RCP vouchers as a reason were asked if the increase is due to the RCP program. One hundred percent of participants and partial participants said "yes" compared to only 29 percent of nonparticipants. When these were combined with the responses of those who volunteered RCP as a response, 100 percent of the participants, 75 percent of the nonparticipants and 38 percent of the partial participants who had an increase said that RCP was a factor.

Respondents who did not cite RCP vouchers as a reason were then asked if the increase in the number of window installation jobs would continue if the RCP program were discontinued. Sixty-four percent of participants said "yes," compared to 100 percent of partial participants and nonparticipants.

Respondents who decreased the percentage of their total business from installing windows in existing homes were asked why. The one nonparticipant for whom there is data said that there was not enough business for window installation in existing homes.

5.4.8 Changes in Recommendations to Customers

Window contractors were asked if they had made any changes in the last two years to their recommendations to customers as to what to install. Nonparticipants were most likely to have made changes (75 percent), followed by participants (67 percent) and then partial participants (60 percent).

Table 5-63 Percentage Who Said That They Changed Their Recommendations to Customers Since 1999

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total***
Yes	75	60	67	27
No	25	40	33	73
N	16	20	45	81

Those who said they had made changes were asked what those changes were (Table 5-64). The use of low-e coating was the most commonly cited change for all three groups followed by changing from metal to wood or vinyl framing and then the use of double pane glass. More participants and partial participants shifted their recommendations to wood or vinyl framing than did nonparticipants. It appears that nonparticipants were more likely to change their recommendations about glazing. This may reflect the fact that participants and partial participants may already have changed to double or triple glazing. One nonparticipant cited the use of inert gas such as argon.

Table 5-64. Revised Recommendations Made to Customers Regarding What to Install for Those Who Changed Their Recommendations in the Last Two Years.

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Change from metal to wood or vinyl framing	25	42	40
Change to double pane glass	25	17	7
Change to triple pane glass	8		
Use inert gas			3
Use low-e coatings	83	92	90
Other			7
N	12	12	30

Percents are percentages of cases. Respondents could provide more than one response.

Respondents were asked why they changed their recommendations (Table 5-65). When asked in an open-ended manner, factors other than RCP were cited as having influenced the groups. Half or more of those who changed cited the energy crisis. All three participation types who said that they changed, but particularly the partial participants (75 percent), cited greater customer awareness as a factor. It is also notable that a small percentage, about 20 percent, of the three participation types perceives efficient windows to be more profitable.

Table 5-65. Reason Why Respondents Made Changes in the Last Two Years to Recommendations Regarding What to Install

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Competitor does it	17	8	10
Learned from RCP training	8	8	23
Customers are more aware	42	75	37
Media attention to the energy crisis	50	58	50
It is more profitable	25	17	20
Other	8		17
N	12	12	30

Respondents could provide more than one response.

Respondents who did not volunteer RCP training as a reason for changing their recommendations were asked if the changes in the last two years to recommendations regarding what to install were due to the RCP program. Of the 19 participants who did not volunteer RCP as a reason, 17 said that RCP was a factor when asked directly. Thus, 24 of 30 participants, or 80 percent, either volunteered that RCP was a factor or indicated that RCP was a factor in changing their recommendations. For the 12 nonparticipants and 12 partial participants who changed their recommendations, the percentages who volunteered or directly attributed the change to RCP was 42 percent and 83 percent, respectively. Thus, for participants and partial participants, RCP is clearly a factor in changing recommendations.

Respondents who did not cite RCP training as a reason were then asked if they would continue these changes even if the RCP program were discontinued. One hundred percent of participants, partial participants, and nonparticipants said "yes."

5.4.9 Installation of Efficient Windows

Respondents were asked what percentage of the windows installed in 1999 and in 2001 had a U-factor of 0.4 or less. In 2001, participants said that 80 percent of their installations had a U-factor of 0.4 or less. This compares to an average of 43 percent of installations for nonparticipants in the same time period. Partial participants indicated the highest average percentage increase (28 percent) in installations between 1999 and 2001, followed by participants (28 percent) and then nonparticipants (16 percent). Clearly, participants are installing a higher percentage of efficient windows than nonparticipants. Also, participants and partial participants increased their rate of efficient installations in the two-year period between 1999 and 2001 much more rapidly than did nonparticipants. These

data would imply that high efficiency windows are beginning to reach saturation with certain contractors.

Table 5-66. Percent of Windows Installed Having a U-Factor of 0.4 or Less

Nonparticipants			***Partial participants***			***Participants***		
1999	***2001***	***D***	***1999***	***2001***	***D***	***1999***	***2001***	***D***
27	43	16	41	69	28	55	80	25
5.41	7.26		7.26	4.12		5.41	3.33	
16	16		17	18		44	44	

The symbol "Δ" stands for percent change. The three values in the cells are the average percent, the standard error, and the number of cases.

Respondents were asked about changes they may have made to window installations (Table 5-67). All but five respondents, all of whom were participants, indicated that they had made some changes. The most common change for all three groups is the use of low-e coatings, followed by changing metal to wood or vinyl framing. It appears that nonparticipants moved from single glazing to double or triple glazing. Based on earlier work, we believe that many participants and partial participants had already adopted double pane technology. Thus, these changes for nonparticipants represent a form of catch-up.

Table 5-67. Changes to Windows Installed in the Last Two Years

	Nonparticipants	***Partial participants***	***Participants***
Change from metal to wood or vinyl framing	38	50	35
Use double pane glass	25	15	10
Use triple pane glass	25		5
Use inert gas	6	10	15
Use low-e coatings	75	90	95
Change how caulking is applied	13	10	15
Change the use of flashing	13	5	10
Change material of flashing	6		8
Other			3
N	16	20	40

Respondents could provide more than one response.

Respondents who made changes were asked why they changed. The most common reason for all three groups is that customers are more aware. For participants and nonparticipants, the next most common reason is the energy crisis, but for partial

participants, it is a combination of being more profitable (15 percent) and competitive (15 percent).

Table 5-68. Reason Why Respondents Made Changes to the Window Installation Process

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Competitor does it	13	15	13
Learned from RCP training		10	25
Customers are more aware	63	65	45
Media attention to the energy crisis	25	10	28
It is more profitable	19	15	18
Other	6	10	10
N	16	20	40

Percents are percentage of cases. Respondents could provide more than one response.

Once again, participants and partial participants were the only ones to volunteer that RCP was a factor. Those who did not cite RCP training as a reason were then asked if the changes made were due to the RCP program. Eighty-nine percent of participants who did not cite RCP and 83 percent of partial participants said the changes were due to the RCP program, while only 36 percent of nonparticipants said the changes were due to the RCP program. Thus, 85 percent of participants, 80 percent of partial participants, and 43 percent of nonparticipants either volunteered or gave direct indication that RCP was a factor in their having changed installation practices.

When those who did not cite RCP training as a reason were asked if these changes will continue if the RCP program is discontinued, 100 percent of all three groups said "yes."

5.4.10 RCP Training for Window Installation

Respondents were asked if they or their employees had taken the training offered by the RCP for installing windows (Table 5-69). Seventy-eight percent of respondents, 65 percent of partial participants, and 31 percent of nonparticipants have taken the training. These difference are statistically significant.

Table 5-69. Percentage Who Have Taken the RCP Training for Installing Windows

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total***
Yes	31	70	78	27
No	69	35	22	73
N	16	20	45	81

Respondents were asked how many of their employees had taken the training. Both participants and partial participants have an average of less than four employees who have taken the training. Surprisingly, nonparticipants have the largest average number of employees who have taken the training (6.2 employees). The average for nonparticipants may be high because there are so few firms in our sample and two of the firms had 10 employees who had been trained.

5.4.11 Market Potential for High Performance Windows

Respondents were asked if their customers are more willing now than they were two years ago to install high efficiency windows. All sixteen nonparticipants said their customers are more willing now than two years ago to install high efficiency windows. This compares to 95 percent of partial participants and 87 percent of participants.

When asked why their customers are more willing to install efficient windows, the most frequent reason given by all three groups more than 65 percent of the time is that their customers want to save energy (Table 5-70). For participants, the second most common reason is RCP vouchers followed by contractors educating their customers on the benefits of installing high performance windows. For partial participants and nonparticipants, the second most common reason is that contractors educate their customers. None of the respondent groups saw utilities or utility programs as playing a role.

Table 5-70. Reason Why Respondents Think Their Customers Are More Willing to Install High Performance Windows Now Than They Were Two Years Ago

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Contractors educate them	63	61	38
Utilities educate them	13	11	3
Utility programs other than RCP	6		11
The energy crisis	25	11	30
RCP vouchers		22	51
Customers want to reduce energy costs	69	72	65
N	16	18	37

Percents are percentages of cases. Respondents could provide more than one response.

Respondents who did not cite RCP vouchers as a reason were asked if their customers are more willing to install high performance windows due to the RCP program. Among those who did not initially volunteer RCP vouchers, 11 out of 17 participants (77 percent), 11 out of 14 partial participants (79 percent), and eight out of 15 nonparticipants (54 percent) said it was due to the RCP program. This

means that 97 percent of participants, all of the partial participants and about half of the nonparticipants said that RCP influenced the willingness of their customers to participate. Thus, RCP plays a role although it is not among the first things that contractor respondents cite when asked about what makes a difference.

5.4.12 Contractor Assessment of Market Potential for Window Upgrades

Respondents were asked what percentage of the homes in their area could still upgrade their windows to high efficiency windows and achieve a reasonable payback (Table 5-71). Participants and partial participants believe that nearly three-fourths of homes could still be upgraded compared to nonparticipants who believe 41 percent of homes could be upgraded.

Table 5-71. Average Percentage of Homes That Could Upgrade Their Windows to High Efficiency Windows and Receive a Reasonable Payback

Nonparticipants	***Partial participants***	***Participants***	***Total***
41	74	72	66
8.11	3.38	2.85	2.77
16	20	44	80

The three values in the cells are the average percent, the standard error, and the number of cases.

Respondents were then asked what percentage of these homes owners are likely to upgrade in the absence of an incentive (Table 5-72). Nonparticipants indicated that upgrades without incentives were likely in just 21 percent of these homes while participants and partial participants thought they were possible in about 30 percent of homes.

If we multiply the percentages in Table 5-72 by those in Table 5-73, we obtain the percentage of the market that is likely to change to more efficient windows without an incentive. The percentages for participants, partial participants, and nonparticipants are 22, 22, and nine percent, respectively. In other words, participants and partial participants are more optimistic about the size and likelihood that the market will upgrade without incentives than are nonparticipants.

Table 5-72. Average Percentage of Homes That Are Likely to Have a Window Upgrade in the Absence of an Incentive

Nonparticipants	***Partial participants***	***Participants***	***Total***
21	30	31	28
5.04	4.66	2.86	2.22
16	20	43	79

The three values in the cells are the average, the standard error, and the number of cases.

Respondents were asked if the percent of customers likely to have a window upgrade has changed since 1999 (Table 5-73). Three-fourths of nonparticipants and partial participants and almost two-thirds of participants thought the market had increased.

Table 5-73. Has the Percentage of Customers Likely to Have the Work Done Changed over The Past Year?

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Yes	75	75	63
No	25	25	37
N	16	20	45

Those who thought the market had changed were asked why they thought it had changed (Table 5-74). For participants and nonparticipants, the main reason is that customers want to reduce their energy costs. Partial participants most frequently felt the reason was that contractors are educating and selling customers on it. The energy crisis was clearly a factor. RCP vouchers were mentioned without prompting by a third of participants and partial participants but not at all by nonparticipants.

Table 5-74. Reason the Percentage of Customers Likely to Have the Work Done Has Changed Since 1999

	Nonparticipants	***Partial participants***	***Participants***
Contractors educate customers and sell them on it	58	80	32
Utilities have been educating customers	17	20	14
Utility programs other than the RCP	8	7	7
The energy crisis	41	27	43
RCP vouchers		33	43
Customers want to reduce energy costs	100	47	50
N	12	15	28

Respondents could provide more than one response.

Those who did not cite the RCP program as a reason were asked if the change in the percentage of customers likely to have the work done was due to the RCP program (Table 5-75). Eighty percent of these participants and 89 percent of partial participants said the change was due to the RCP program, compared to 50 percent of nonparticipants. Overall, this means that 31 percent of nonparticipants, 65 percent of partial participants, and 53 percent of participants believe that customers were influenced by RCP vouchers.

Table 5-75. Was the Change in the Percentage of Customers Likely to Have the Work Done Due to the RCP?

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Yes	45	89	80
No	55	11	20
N	11	9	15

Respondents were asked if homeowners would continue with this tendency in the absence of RCP vouchers. Eighty-four percent of participants and one hundred percent of partial participants and nonparticipants believe homeowners would continue with this.

5.4.13 Influence of RCP on Demand for High Performance Windows

Based on a 1 to 5 scale where "1" is "no influence" and "5" is "a great deal of influence," respondents were asked what influence the RCP program has had on customer demand for high performance windows. Participating contractors gave RCP an influence rating of 3.8 followed by partial participants (3.5) and then nonparticipants (3.1). Thus, nonparticipants seem to suggest that RCP has had some influence while participants and partial participants seem to suggest that RCP has had more than just some influence. The difference between participating contractors and nonparticipating contractors is statistically significant.

5.4.14 Ability of Contractors to Respond to High Demand

Respondents were asked if they have had trouble expanding their services if they were to experience high demand for high performance window retrofits. Very few respondents in each of the three groups said "yes." Nonparticipants appear to have the most difficulty expanding their services (13 percent) compared to participants (four percent) and partial participants (five percent), but keep in mind the Ns are small.

Respondents were also asked if they have had any trouble obtaining high performance windows. Participants and partial participants have had no trouble but six percent of nonparticipants indicate they have had trouble obtaining high performance windows.

When respondents were asked if they have had any trouble finding qualified labor, participants have had the most difficulty (38 percent) followed by partial participants (20 percent) and nonparticipants (19 percent). Thus, it does appear that finding qualified help at the time the survey was completed was a problem.

5.4.15 Summary and Conclusions for Window Contractors

Participating firms have an average of 14 years of experience, slightly fewer years of experience than nonparticipant firms, and are larger firms that sell more jobs, about 1,000 per year, compared to nonparticipants who sell slightly more than 800.

Participants are more likely to have multiple contractor licenses and offer more services than nonparticipants. Participating window contractors offer a broader range of services than partial or nonparticipating contractors.

If this sample is representative of windows contractors in general, then awareness is an issue for just nine percent of the contractor population. Most contractors know about RCP. However, about half of the nonparticipating contractors are not aware of RCP.

Contractors rated the average awareness of their customers at about three on a five-point scale. This means that contractors believe there is room for customers to become more aware. In general, contractors believe customers are more aware of RCP than they were two years ago. All contractor groups agree that this is partially due to contractor efforts. Participants also think it is due to RCP while nonparticipants attribute this to the energy crisis.

When asked to provide the U-factor of an efficient window, participants and partial participants indicated that an average window U-factor of less than 0.4 would be efficient while nonparticipants indicated that an average U-factor greater than 0.5 would be efficient. About 30 percent of contractors indicated that they changed their view of what constitutes an efficient window between 1999 and 2001.

When asked about the cost effectiveness of windows with a U-factor of less than 0.4, contractors gave an average rating of windows with this U-factor a four or greater on a five-point scale. Nonparticipants gave the highest average cost effectiveness ratings. About a quarter of the contractors had changed their minds about the cost effectiveness of windows in the last two years but there was no difference in the percentages of contractors who changed their minds among the different types of contractors. Contractors also indicated that they thought their customers view of windows with a U-factor less than 0.4 is cost effective.

About two-thirds of all window contractors have changed the window recommendations they make to their customers in the last two years. Between 80 and 90 percent of those in all three contractor groups who changed their recommendations say that they now recommend low-E glass. About 40 percent of the participant and partial participant contractors who changed their recommendations are now recommending wood or vinyl framing instead of metal compared to 25 percent of nonparticipants who changed to wood or vinyl. About 33 percent of nonparticipants who changed said that they were now recommending double or triple glazing. This is higher than for participants and nonparticipants. These data would suggest that some nonparticipants may have been slower to change to wood or vinyl framing materials than partial and full participants and may now be changing their practices.

Participants say that in 2001 about 80 percent of the windows they sell have a U-factor of less than 0.4. This compares to 68 percent for partial participants and 43 percent for nonparticipants. Partial participants had the biggest increase in the sale of windows with a U-factor of less than 0.4 (25 percent), and nonparticipants had the smallest percentage increase (16 percent). The next most common change was from metal framing to wood or vinyl. A higher percentage of nonparticipants reported moving from single pane to double or triple pane windows than participants or partial participants.

Contractors believe that an average of 66 percent of homes can upgrade their windows with reasonable expectation of payback. Participants and partial participants believe that the windows in about three-fourths of the homes in their area can be upgraded cost effectively while nonparticipants believe that only about 40 percent of homes in their area can be upgraded cost effectively. Participants and partial participants believe that about 30 percent of the windows in homes in their area can be upgraded without an incentive. Slightly more than 20 percent of nonparticipants believe this.

Contractors did not identify any significant structural barriers that would prevent them from providing more efficient product or services.

Thus, the overall trends are that the percentage of efficient windows being installed is increasing. It is increasing the most among partial and full participants in the RCP program. The RCP program is encouraging the use of efficient windows but other factors such as the energy crisis have had effects as well.

5.5 RESULTS FOR INSULATION CONTRACTORS

There were 39 contractors who responded to the insulation contractor survey. As with HVAC and windows contractors, these contractors have been placed into three groups, participants, partial participants, and nonparticipants. Participants have had RCP training and have submitted RCP vouchers. Partial participants have received training but not submitted vouchers, and nonparticipants have not received vouchers or training.

5.5.1 Characteristics of Insulation Contractors

In comparison to nonparticipants and partial participants, participants have been in the business longer but are associated with smaller firms (Table 5-76). Participants have been contractors an average of 21 years and are members of firms with an average of 15 people. However, there are three participants who have been in business for more than 35 years who skew the average because of the small number of cases. When these three participants are removed, the average number of years participants have been in business is 16 years. Participants and partial participants serve more customers, an average of 661 and 629 homes per year, respectively, compared to nonparticipants who serve an average of 543 homes.

Table 5-76. Experience and Size of Insulation Firms

	Nonparticipants	***Partial participants***	***Participants***
Average years worked as a contractor	14	13	21
	1.30	2.14	3.74
	19	6	14
Average years as a contractor in California	14	14	21
	1.30	1.99	3.74
	19	6	14
Average number of people in the company	18	19	15
	6.27	3.52	4.04
	19	6	14
Average number of single family residences served	543	629	661
	255	177	127
	19	6	14

The three values in the cells are the average, the standard error, and the number of cases.

Nonparticipants are more likely than participants and partial participants to have a single type of contractor license (Table 5-77). Eighty-four percent of nonparticipants have a single license compared to 50 percent of participants and partial participants. Firms with just one license serve fewer customers (564) than firms with more licenses (667). On average, contractors with two or more licenses serve an additional one hundred or more customers annually.

Table 5-77. Participant Status and Number of Contractor Licenses

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
One contractor license	84	50	50
Two or more contractor licenses	16	50	50
N	19	6	14

Table 5-78. Average Number of Customers Served by Number of Contractor Licenses

	Average number of customers served
One contractor license	564
Two or more contractor licenses	667

Participants and partial participants are most likely to have a combination of an insulation (C2) and general contractor (B1) license. Two participants also have plumbing (C36) licenses in addition to the insulation licenses. There are two nonparticipants with an insulation license and a glazing or HVAC license. A third nonparticipant has glazing, HVAC, and home improvement licenses.

When asked about the types of services respondents provide, participants and partial participants said that they only provide attic and wall insulation installation. There are 11 nonparticipants who provide just insulation services, and eight nonparticipants who say they provide some combination of installing attic and wall insulation and other services. In other words, the nonparticipants tend to be less specialized.

5.5.2 General Awareness of RCP among Insulation Contractors

Insulation contractors were asked if they are aware of the RCP. Eighty percent of all respondents say that they are aware of the program. Logically, participants and partial participants have to be aware. Only nonparticipants can be unaware. Fifty-eight percent of nonparticipant contractors are aware of the RCP program. Thus, we conclude that most contractors are aware of the RCP program although about forty percent of the nonparticipants are not aware. Of the eight who are not aware, six of the eight have licenses such as general contracting, home improvement, or HVAC. Thus, they may install insulation as an adjunct to their business and possibly may not have received information.

5.5.3 Perceived Customer Awareness

Respondents were asked on a scale of 1 to 5 where "1" is "unaware" and "5" is "very aware", how aware they perceive their customers are of the RCP program. Participants gave the highest rating (3.6), followed by partial participants (3.2), and then nonparticipants (1.9).

Respondents were asked if their customers are more aware of the benefits of installing attic insulation now than in the past (Table 5-79) One hundred percent of partial participants said their customers are more aware than in the past compared to 71 percent of participants and 84 percent of nonparticipants.

Respondents were asked the same question for wall insulation. Again, one hundred percent of partial participants said their customers are more aware compared to 57 percent of participants and 74 percent of nonparticipants. Thus, fewer participants than nonparticipants or partial participants think their customers are more aware than in the past. This could be because participants already think that their customers are aware.

Table 5-79 Percentage of Contractors Saying Customers Are More Aware Than in the Past of the Benefits of Attic and Wall Insulation by Contractor Status

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total***
Customers more aware of the benefits of attic insulation	84	100	71	82
Customers more aware of the benefits of wall insulation	74	100	57	72
N	19	6	14	39

When respondents were asked without a prompted response (Table 5-80) why they think their customers are more aware, the most common reason for participants was the RCP program (80 percent) followed by contractors educating their customers (60 percent).[13] For partial participants, equal percentages of respondents reported that the RCP program and contractors educating their customers (83 percent) is a reason. For nonparticipants, the main reason is information from utilities to their customers (56 percent) followed by the energy crisis (44 percent) and contractors educating their customers (44 percent). None of the nonparticipants volunteered RCP as a factor.

Table 5-80 Contractors' Reasons for Believing That Their Customers Are More Aware by Contractor Status

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Contractors educate them	60	83	60
Information from utilities	56	16	10
Other utility programs	6	17	10
Items about the energy crisis in the news	44		30
RCP		83	80
Learn from the internet or media	12		20
N	16	6	10

Respondents could provide more than one response. Percents are percentages of cases.

If the respondents did not volunteer the RCP program as a factor, they were then asked directly if the RCP program was a factor. When combined with those who had volunteered the answer, all participants who said their customers are more aware said RCP was a factor. About 83 percent of partial participants who said their customers are more aware said that RCP was a factor. Just 37 percent of the

[13] These total to more than 100 percent because respondents were allowed more than one response.

nonparticipants who said their customers are more aware said RCP was a factor when asked directly. Thus, for participants and partial participants, RCP was a factor in customer awareness and to some extent a factor according to nonparticipants as well. Nonparticipants cited other reasons, especially the energy crisis, for customers becoming more aware.

5.5.4 Vendor Perceptions of Customers' Willingness to Install

Respondents were asked if their customers are more willing to install attic insulation now than they were two years ago. Eighty-four percent of nonparticipants said "yes" compared to 50 percent of participants and partial participants who said "yes" (Table 5-81). Respondents were then asked the same question for wall insulation. Again, 84 percent of nonparticipants said yes compared to fifty percent of participants and 33 percent of partial participants who said "yes."

Table 5-81 Percentage of Contractors Saying Customers Are Willing to Install Attic and Wall Insulation by Contractor Status

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total***
Customers more willing to install attic insulation	84	50	50	67
Customers more to install wall insulation	84	33	50	64
N	19	6	14	39

For those who said their customers are more willing, we asked why they were more willing. Participants who said their customers are more willing said it was due mainly to RCP vouchers (57 percent) and the contractors educating them (57 percent). Partial participants who said their customers are more willing said it was mainly due to wanting to save on energy costs but there were only three of these customers. The 16 nonparticipants who said that their customers are more willing said it was primarily due to the energy crisis (62 percent) or the fact that the contractors are educating customers (31 percent).

Table 5-82 Contractors' Reasons for Believing That Their Customers Are More Willing to Install Insulation by Contractor Status

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Contractors educate and sell them	31	67	57
Utilities educate them	12		14
Other utility programs			14
Energy crisis convinced them	62	33	29
RCP	6	33	57
They want to save energy	38	100	29
N	16	3	7

Respondents could provide more than one response. Percents are percentages of cases.

Those participants who did not volunteer RCP vouchers as a reason were asked directly if the RCP program was a factor. When those who were asked directly are combined with those who volunteered that RCP vouchers were a factor, 100 percent of participants, 67 percent of partial participants, and 25 percent of nonparticipants think that RCP vouchers are a factor in customers being willing to install insulation. Once again it appears that RCP is a factor for participants and partial participants but not so much for nonparticipants.

5.5.5 How Cost Effective Is Energy Efficient Insulation?

We asked contractors on a 1 to 5 scale where one is "not at all effective" and "5" is "very cost effective," how cost effective various attic and wall insulation treatments are in their area. All three contractor groups believe that R-30 insulation is more cost-effective than R-19 insulation. For R-19 attic insulation, respondents currently (2001) believe the average cost effectiveness score is 3.54. Participants had the highest average cost effectiveness score (3.79), followed by partial participants (3.50), and then nonparticipants (3.35). For R-30 insulation, nonparticipants reported the highest average cost effectiveness score (4.35), followed by participants (4.21), and then partial participants (3.83).

For R-13 wall insulation, nonparticipants also reported the highest cost effective score (4.13), followed by partial participants (3.67). It would appear that nonparticipants believe R-30 attic insulation and R-13 wall insulation to be more cost effective than participants.

Table 5-83 Average Cost-Effectiveness Score for Various Insulation Treatments by Contractor Participation Status.

	Nonparticipants	***Partial participants***	***Participants***
R-19 attic insulation	3.4 .32 17	3.5 .43 6	3.8 .32 14
R-30 attic insulation	4.4 0.23 17	3.8 0.31 6	4.2 0.19 14
R-13 wall insulation	4.1 .20 18	3.7 .42 6	3.4 .29 14

The three values in the cells are the average of scores on a scale of 1 to 5, the standard error, and the number of cases.

We asked respondents if their view of the cost effectiveness of insulation has changed from what it was in 1999 (Table 5-84). Overall, 26 percent of the respondents say that they changed their views of the cost effectiveness of insulation. Fifty percent of partial participants say they changed their views and 16 percent of nonparticipants say they changed their views. In other words, what constitutes cost effective insulation has changed for a relatively small percentage of people.

Table 5-84. Percentage Who Changed Their View of What Is Cost Effective Insulation Since 1999

	Nonparticipant percent	***Partial participant percent***	***Participant percent***	***Total***
Yes	16	50	29	26
No	84	50	71	74
N	19	6	14	39

For this study, an important question is whether RCP has impacted contractor's views of what cost effective insulation is. Of the 16 respondents who changed their views, six provided reasons why their views changed. These six respondents include participants and partial participants but not nonparticipants. Respondents could provide more than one response. Four respondents cited the energy crisis and more customers asking for it as reasons. One participant cited RCP training as a reason. The respondents are too few in number to draw firm conclusions about their changing views.

Finally, when we asked respondents who provided a reason other than the RCP program if the RCP program was a factor, four of the six respondents said "yes."

Of those respondents, three were participants. Thus, there is evidence that RCP is having some influence on what contractors consider to be cost effective insulation.

5.5.6 Customer's Views of Cost Effectiveness

Respondents were asked how cost effective they think their customers consider R-19 attic insulation, R-30 attic insulation, and R-13 wall insulation. Table 5-85 shows the responses. On a 1 to 5 scale, where "1" is "not at all cost effective" and "5" is "very effective," participants gave the highest rating (3.6), followed by partial participants (3.5), and then nonparticipants (3.3). For R-30 attic insulation, partial participants gave the highest rating (4.7), followed by participants, and nonparticipants who both gave an average rating of 4.1. For R-13 wall insulation, participants provided the highest rating (3.5), followed by partial participants (3.0), and then nonparticipants (2.3). Clearly, contractors believe that customers think R-30 attic insulation is quite cost effective or very cost effective. With respect to wall insulation, participants and partial participants, on average, perceive that their customers believe wall insulation is cost effective or somewhat cost effective, while nonparticipants perceive that their customers believe wall insulation is not very effective.

Table 5-85. How Cost Effective Do You Think Customers Consider the Following to Be:

	Nonparticipants	***Partial participants***	***Participants***
R-19 attic insulation	3.3 0.42 19	3.5 0.43 6	3.6 0.20 14
R-30 attic insulation	4.1 0.44 19	4.7 0.21 6	4.1 0.25 14
R-13 wall insulation	2.3 0.45 18	3.0 0.45 6	3.5 0.23 14

The three values in the cells are the average of scores on a scale of 1 to 5, the standard error, and the number of cases.

When asked if they would have answered differently two years ago, only 10 percent of respondents said "yes." Of those who said "yes," one participant and one nonparticipant said the reason they would have answered differently is because customers are more informed. Another participant and partial participant said it is because customers are more informed from contractor promotion of efficient insulation.

Thus, contractors believe R-30 attic insulation to be quite or very cost effective and they believe R-19 insulation is cost effective as well. Similarly, they perceive that

their customers believe R-30 attic insulation to be quite or very cost effective, and they believe R-19 insulation is cost effective as well.

5.5.7 Efficient Installations

Respondents were asked what percentage of their total business was from installing insulation in existing homes in 1999 and in 2001 (Table 5-86). In 1999, 70 percent of partial participants' total business was from residential insulation retrofits compared to 49 percent for participants and 24 percent for nonparticipants. In 2001, the percentage for partial participants fell three percent, increased five percent for participants, and increased one percent for nonparticipants. There appears to have been no statistically significant change in the proportion of business in any contractor group during this period.

Table 5-86. Percent of Total Business from Residential Insulation Retrofits

Nonparticipants			***Partial participants***			***Participants***		
1999	***2001***	***D***	***1999***	***2001***	***D***	***1999***	***2001***	***D***
24	25	1	70	67	-3	49	54	5
7.90	8.41		8.47	13.41		9.31	9.24	
16	15		6	6		14	14	

The three values in the cells are the average percent, the standard error, and the number of cases.

There were a total of 10 customers who indicated a change in their business. Because the numbers are so small, the results are not very meaningful. Respondents who experienced an increase in the percentage of their total business from residential insulation retrofits were asked why it had increased (Table 5-87). The main reason for participants is the energy crisis (71 percent) followed by contractors promoting retrofits more. For partial participants and nonparticipants, the main reason was both the energy crisis and customers being more receptive to the benefits of insulation retrofits. Only two contractors said that it was related to RCP vouchers.

Table 5-87. Reason why respondents made changes in the last two years to recommendations regarding what to install

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Customer more receptive to benefits	100	100	29
Company promoting retrofits more			43
The energy crisis	100	100	71
RCP vouchers			29
Business in general			29
N	1	2	7

Respondents could provide more than one response. Percents are percentages of cases.

If respondents did not volunteer RCP vouchers as a reason, they were asked directly if RCP was a factor. All five participants and both of the partial participants said it is due to the RCP program. The lone nonparticipant said it is not due to the RCP program. These respondents were then asked if the increase would continue if the RCP program is discontinued. Three of the five participants said the increase would continue and both of the partial participants said it would continue. Thus, participants and partial participants see RCP as a factor.

Respondents who said the percentage had decreased were asked why. One participant and one nonparticipant said it was not cost effective. Another nonparticipant said it was due to mild weather.

5.5.8 Changes in Recommendations

Respondents were asked if they had made any changes to the recommendations they make to customers for installing attic and wall insulation in the last two years. Participants were most likely to have claimed to have made changes, 36 percent for both attic and wall insulation recommendations, followed by nonparticipants (26 percent for attic insulation and 16 percent for wall insulation). None of the six partial participants claimed to have made any changes to either wall or attic insulation recommendations.

Those who said they had made changes were asked what those changes were. The five participants and six nonparticipants who changed their recommendations said that they were recommending higher R levels than before.

Respondents who made changes were asked why they did so (Table 5-88). The most common reason cited by participants and nonparticipants is the energy crisis followed by customers being more aware. RCP was mentioned by only one of the eleven respondents.

Table 5-88. Reason Why Respondents Made Changes to Insulation Retrofit Recommendations

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Competitor does it	60	-	
Learned from RCP training	20	-	
Customers are more aware	60	-	50
More profitable	20	-	
Because of the energy crisis	80	-	67
N	5	-	6

Respondents could provide more than one response. Percents are percentages of cases.

Those who did not volunteer RCP training as a reason were then asked directly if the changes made are due to the RCP program. Four participants and one of the six nonparticipants said the changes are due to the RCP program. When asked if these changes would continue if the RCP program is discontinued, three of the five participants and one nonparticipant said that they would.

5.5.9 Installation of insulation

Respondents were asked about installation practices and the different types of insulation that they install. Table 5-90 shows the percentage of installations for nonparticipants, participants, and partial participants in each of two years for R-19 to R-29 attic insulation, R-30 and greater attic insulation, and R-13 and greater wall insulation.

Surprisingly, nonparticipants are installing much more efficient insulation than partial participants and nonparticipants. For example, nonparticipants say that about 66 percent of their attic insulation retrofits in the last two years were R-30 or greater. This compares with 48 percent for partial participants and 34 percent for nonparticipants. However, we note that if you combine the percentages for R-19 and R-30, the total is more than 100 percent. Nonparticipants also say that about 67 percent of their wall insulation retrofits in the last two years were R-13 or greater.

We can also see that each group is shifting toward insulation with higher R-values. For example, there was a 25 percent increase in the percentage of R-19 attic insulation retrofits before and since September 2000 for participants compared to 18 percent for partial participants and 13 percent for nonparticipants. A similar pattern is evident for R-30 or greater insulation retrofits as well as R-13 or greater wall insulation retrofits.

Table 5-89 What Percent of Your Insulation Installations Are:

	Nonparticipants			***Partial participants***			***Participants***		
	Before 1999	***Sept 2000***	***Ä***	***Before 1999***	***Sept 2000***	***Ä***	***Before 1999***	***Sept 2000***	***Ä***
R-19 attic insulation	39	52	13	20	38	18	23	48	25
	9.47	11.35		9.22	8.53		5.76	5.54	
	13	12		6	6		14	14	
R-30 or greater attic insulation	43	66	23	30	48	18	25	34	9
	8.41	8.97		6.32	8.33		5.36	6.39	
	13	12		6	6		14	14	
R-13 or greater wall insulation	43	67	24	20	23	3	18	22	4
	8.82	8.80		2.58	4.22		3.56	3.90	
	13	12		6	6		12	13	

The three values in the cells are the average, the standard error, and the number of cases.

Respondents were asked if they made any changes in the way they actually install insulation in attics and walls. Only one of the 14 participants said "yes," all six of the partial participants said "no," and 32 percent of the 19 nonparticipants said "yes." When asked what those changes were, one nonparticipant cited the use of foam backing in installations, and another nonparticipant cited using more insulation than had been used before. A reason given by yet another nonparticipant was that of using better quality materials. Still another nonparticipant cited installing a layer of R-19 attic insulation and then placing a layer of R-30 attic insulation over it.

Respondents were then asked why these changes were made. Customers being more aware is the most common reason for all three groups. Forty percent of participants also cited the energy crisis as a reason.

When respondents who did not cite RCP training were asked if the changes were due to the RCP program, two-thirds of participants and three-fourths of partial participants said "yes" compared to only 14 percent of nonparticipants. When asked if these changes would be continued if the RCP program were discontinued, 100 percent of partial participants said "yes" but only 56 percent of participants and 57 percent of nonparticipants said "yes."

5.5.10 Market Potential for Insulation Installation

Respondents were asked what percentage of homes in their area could still upgrade their attic and wall insulation and achieve a reasonable payback (Table 5-90). Participants and partial participants believe that almost two-thirds of homes could

upgrade their attic or wall insulation compared to nonparticipants who believe that less than a quarter of homes could be upgraded.

Table 5-90. Average Percentage of Homes That Could Upgrade Their Insulation and Achieve a Reasonable Payback

	Nonparticipant	***Partial participant***	***Participant***	***Total***
Attic insulation	23 5.48 18	60 11.11 6	64 6.49 14	44 5.02 38
Wall insulation	21 5.97 14	61 11.44 6	65 5.56 14	46 5.28 34

The three values in the cells are the average, the standard error, and the number of cases.

Respondents were then asked in what percentage of these homes they think the owners are likely to upgrade in the absence of an incentive (Table 5-91). Overall, respondents in all three groups indicated that upgrades without incentives were likely in about a fifth of homes.

Table 5-91. Average Percentage of Homes That Are Likely to Have an Insulation Upgrade in the Absence of an Incentive

	Nonparticipants	***Partial participants***	***Participants***	***Total***
Attic insulation	25 6.91 15	21 4.62 6	23 3.13 14	24 3.25 35
Wall insulation	18 6.38 15	21 4.62 6	23 2.71 14	20 3.00 35

The three values in the cells are the average percent, the standard error, and the number of cases.

If we multiply the percentages in Table 5-90 by those in Table 5-91, we obtain the percentage of the market that is likely to be changed without an incentive. The attic insulation percentages for participants, partial participants, and nonparticipants are 15, 13, and six percent, respectively. The wall insulation percentages for participants, partial participants, and nonparticipants are 15, 13, and four percent, respectively. In other words, participants and partial participants are more optimistic about the size and likelihood that the market will upgrade without incentives than are nonparticipants. Even so, participants and partial participants believe that as much as 45 to 50 percent of the market may have to be incentivized in order to get home owners to upgrade.

Respondents were asked if these percentages had changed since 1999. Roughly half of the respondents in all three groups said "yes."

When asked why, the main reason cited by participating contractors is educating their customers, followed by news about the energy crisis, and then the RCP program. For partial participants and nonparticipants, the main reason was that customers want to save energy, followed by contractors educating their customers.

Table 5-92 Reasons Contractors Changed Their Perception That Customer Would Upgrade Their Insulation by Contractor Type

	Nonparticipant percent	***Partial participant percent***	***Participant percent***
Contractors educate and sell	50	67	86
Utilities educate them		33	
News about the energy crisis	30		71
RCP vouchers	20	33	43
Want to save energy costs	70	100	29
N	10	3	7

Respondents could provide more than one response. Percents are percent of cases.

If the respondents did not indicate that RCP was a factor, they were asked directly if the RCP program was an influence. When the respondents who volunteered RCP and the respondents who were asked directly are combined, 100 percent of the participants, 67 percent of the partial participants, and 20 percent of the nonparticipants said that RCP was a factor. In other words, RCP was a factor for participants and partial participants but not so much a factor for nonparticipants.

When asked if the homeowners would continue with this tendency without RCP vouchers, 71 percent of participants said they would, and both partial participants said they would. One nonparticipant said he would and the other nonparticipant said he would not.

5.5.11 Overall Influence of RCP on Market for Insulation

Respondents were asked, on a 1 to 5 scale where "1" is "no influence" and "5" is "a great deal of influence," what influence the RCP program has had on customer demand for R-19 and R-30 or greater insulation. Participants and partial participants rated RCP as having a good deal of influence (4.0) compared to nonparticipants who gave a much lower average rating of 2.4, which is somewhere between a little bit of influence and some influence on the influence scale. Participants and partial participants gave a somewhat higher rating of 4.3 for R-30 or greater attic insulation. Nonparticipants gave a somewhat higher rating as well (2.9) compared to that for R-19 attic insulation. However, they clearly rated the

influence as being less. For R-13 wall insulation, participants rate the RCP influence at 3.9, while partial participants rated it 3.5, and nonparticipants 2.5. Thus, participants and partial participants rated the influence as somewhere between some influence and quite a bit of influence. The bottom line is that participants and partial participants think that RCP has had some influence on the insulation market while nonparticipants are less inclined to think so.

Table 5-93 Influence of RCP on Use of Various Types of Insulation by Contractor Status

	Nonparticipants	***Partial participants***	***Participants***
R-19 attic insulation	2.4 .43 14	4.0 .26 6	3.9 .22 14
R-30 attic insulation	2.9 .46 14	4.3 .33 6	3.5 .43 14
R-13 wall insulation	2.5 .44 14	3.5 .43 6	2.5 .44 15

5.5.12 Market Barriers

Respondents were asked if they have had or would have any trouble expanding their services if they were to experience a high demand for high performance windows. All of the participants and partial participants said "no" and only two of the 19 nonparticipants said "yes." When asked if they have had or would have trouble finding qualified labor, almost 80 percent or more of all three groups said "no."

5.5.13 Summary and Conclusions for Insulation Contractors

Insulation contractors have been in business an average of 16 years. Participant and partial participant firms serve more customers, an average of 661 and 629 homes per year, respectively, than nonparticipants who serve an average of 543 homes. Nonparticipants have fewer licenses but when we examine the range of services they offer, they tend to be less specialized.

Eighty percent of all contractors say that they are aware of the program. Because participants and partial participants have to be aware, lack of awareness is concentrated among nonparticipants. Forty-two percent of nonparticipant contractors are unaware of the RCP program. When we ask contractors to rate their customers' awareness on a 1 to 5 scale, participants gave their customers an average awareness rating of 3.6, while partial participants gave theirs a rating of 3.2, and nonparticipants gave their customers a rating of 1.9. Thus, there is an issue

of nonparticipating contractors being aware of the program and they rate their customers' level of awareness as being "not very aware."

Compared to participants and partial participants, nonparticipants thought their customers were more aware than in the past. When asked why this was the case, participants and partial participants cited the RCP program as a factor in customer awareness. To some extent nonparticipants cited the RCP program as a factor in their customers being aware but they cited other reasons, especially the energy crisis, as well.

Respondents were asked if their customers are more willing to install attic insulation now than they were two years ago. Eighty-four percent of nonparticipants said "yes" compared to 50 percent of participants and partial participants who said "yes." One hundred percent of participants, 67 percent of partial participants, and 25 percent of nonparticipants thought that RCP vouchers are a factor in customers being willing to install insulation. It appears that the RCP program is a factor in the willingness to install insulation for participants and partial participants but less so for nonparticipants.

All three contractor groups believe that R-30 insulation is more cost-effective than R-19 insulation. For R-19 attic insulation, respondents currently (2001) believe the average cost effectiveness score is 3.54 on a five-point scale. For R-30 attic insulation, the average cost effectiveness score was greater than 4.1. Thus, contractors believe R-30 attic insulation to be quite or very cost effective, and they believe R-19 insulation is cost effective as well. Similarly, they perceive that their customers believe R-30 attic insulation to be quite or very cost effective, and they believe R-19 insulation is cost effective as well.

Thirty-six percent of participants claim they have changed their recommendations for both attic and wall insulation in the last two years. Twenty-six percent of nonparticipants claim to have made changes to their recommendations about attic insulation and 16 percent claim to have made changes in their recommendations about wall insulation. None of the six partial participants claim to have made any changes to either wall or attic insulation recommendations. Most of the changes in recommendations had to do with the levels of insulation.

Nonparticipants say that about 66 percent of their attic insulation retrofits in the last two years were R-30 or greater. This compares with 48 percent for partial participants and 34 percent for nonparticipants. However, we note that if you combine the percentages for R-19 and R-30 for nonparticipants, the total is more than 100 percent. In this case, nonparticipants appear to have slightly exaggerated the percentage of homes they are insulating with R19 and R30 insulation.

Nonparticipants also say that about 67 percent of their wall insulation retrofits in the last two years were R-13 or greater.

Participants and partial participants believe that almost two-thirds of the homes in their areas could have their attic or wall insulation upgraded compared to nonparticipants who believe that less than a quarter of homes could be upgraded. Respondents in all three groups indicated that upgrades without incentives were likely in about a fifth of homes. Participants and partial participants are more optimistic about the size and likelihood that the market will upgrade without incentives than are nonparticipants. Even so, participants and partial participants believe that as much as 45 to 50 percent of the market may have to be incentivized in order to get home owners to upgrade.

Respondents were asked, on a 1 to 5 scale where "1" is "no influence" and "5" is "a great deal of influence," what influence the RCP program has had on customer demand for R-19, R-30, and R-13 wall insulation. Participants and partial participants rated the RCP program as having a good deal of influence (4.0) compared to nonparticipants who gave a much lower average rating of 2.4, which is somewhere between a little bit of influence and some influence on the influence scale. Participants and partial participants gave an even higher rating of 4.3 for R-30 attic insulation. Nonparticipants also gave a higher rating of 2.9 for R-30 attic insulation. However, nonparticipants clearly rated the influence of RCP as being less. For R-13 wall insulation, participants rate the RCP influence at 3.9 while partial participants rate it 3.5 and nonparticipants, 2.5. Thus, participants and partial participants rate the influence of the RCP program as somewhere between "some influence" and "quite a bit of influence." Nonparticipants rate the RCP program as having somewhere between a "little bit of influence" and "some influence."

Overall, we conclude contractors have increased the insulation levels in the homes on which they are working in the last two years. There is some indication that a higher percentage of nonparticipants than participants and partial participants may be increasing insulation levels. The RCP program has clearly influenced participant and partial participant insulation contractors. Participants and partial participants believe that the RCP program has also influenced their customers. All contractor groups, but especially participant and partial participant contractors, believe that there is a sizable market yet to be served. All types of contractors believe that a significant proportion of that market will require incentives to achieve high levels of penetration.

5.6 SUMMARY AND CONCLUSIONS FOR CONTRACTOR SURVEYS

For each of the contractor disciplines — HVAC, windows, and insulation — and contractor types — participants, partial participants, and nonparticipants — we briefly examined firmographics, including the length of time in business, the number of employees, the number of residences served annually, and the type and number of licenses. In addition, we explored:

- Awareness of the residential contractor program
- Perceptions of customer awareness of the RCP
- Changes in contractor or customer awareness of the RCP between 1999 and 2001
- Contractors' definitions and contractors' perceptions of customers' definitions of efficient equipment and products and the effects of the RCP on these
- How contractors' definitions of efficient equipment and products changed 1999 and 2001 and the influence of the RCP on these changes
- Contractor perceptions of the cost effectiveness of efficient equipment and products
- Contractor perceptions of customers' views of the cost effectiveness of efficient equipment and products
- Changes in contractor perceptions and contractors' perceptions of customers' views of cost effectiveness of efficient equipment and products between 1999 and 2001 and the effect of the RCP on these
- Recommendations to customers, changes in recommendations between 1999 and 2001 and the effect of the RCP on these
- Efficiency levels of products and equipment installed and changes in the levels of efficiency between 1999 and 2001 and the effect of the RCP on these
- The market potential for efficient equipment and products and the need for incentives to gain the adoption of efficient equipment and products
- Barriers to the market that reduce the potential for efficient equipment and products in the market

In general, we found that participating contractors have been in business longer, are larger firms, serve more residences, and have more licenses than nonparticipating firms.

About 40 percent of nonparticipating contractors are not aware of the program. Thus, there is still some room for increasing awareness within this group. One mechanism for accomplishing this might be to target information to single license contractors because nonparticipants are more likely to be single license contractors. However, for contractors as a whole, the percentage of contractors who are aware is in the range of 80 to 90 percent.

The definitions of what contractors consider high efficiency equipment have changed in the last two years. Among HVAC contractors, it is the nonparticipating contractors who have changed their definitions the most. On average, a 12 SEER air conditioning unit is now considered to be a high efficiency unit. For windows, the percentage of contractors changing their views is about equal across the three contractor types. Participants and partial participants clearly indicate that the RCP is a factor in their changing their views although there are other factors as well. Nonparticipants report other factors such as the energy crisis as influencing their views.

Contractors generally consider efficient equipment and products to be cost effective in their area although contractors gave HVAC equipment and windows higher average cost effectiveness ratings than insulation contractors gave to insulation.

More than half of all windows contractors indicated that they changed the recommendations they make to customer in the last two years. The most common change of recommendation for all types of participants was adopting low e-glass. A not inconsequential percentage of nonparticipants reported changing to two or three pane glass. Participants and partial participants reported changing to wood or vinyl framing systems. Participant and partial participants reported that RCP was a factor in changing their recommendations. Nonparticipants reported that the energy crisis was a factor.

Insulation contractors reported recommending more insulation to customers. Again for participants and partial participants, the RCP was a factor in the decision to change recommendations while nonparticipants changed for other reasons, most notably the energy crisis.

Overall, the penetration of efficient HVAC systems, windows, and insulation has increased in the market between 1999 and 2000. For instance, the average increase in the percent of air conditioners installed that are rated 13 SEER or higher has increased by three to seven percent across the three types of contractors. The average increase in the percentage of windows with a U-factor of 0.4 or less has increased between 16 and 28 percent across the three types of contractors. Thirty percent of the units now installed by participant HVAC contractors are 13 SEER or higher. Eighty percent of the windows installed by participating window contractors have a U-factor of less than 0.4. HVAC and windows participants and partial participants increase their use of efficient products more than nonparticipants. For insulation contractors, nonparticipants are reporting higher rates of installation of efficient products than participants and nonparticipants. However, there are some anomalies in the insulation data on this point so the finding with respect to insulation should be interpreted with caution. Participants and partial participants consistently cited RCP as a factor in choosing more

efficient products more often than nonparticipants. Nonparticipants are motivated by the energy crisis.

For all of the contractor disciplines, participants and partial participants believe that there is much more potential for customers to introduce efficient products into their homes than do nonparticipants. Further, participants and partial participants believe that higher percentages of customers will make changes without incentives than do nonparticipants. However, in absolute terms, participants and partial participants perceive a larger number of customers will need incentives to install efficient equipment than do nonparticipants.

Contractors were asked about barriers to the use of efficient products such as the lack of availability of efficient products or labor. Very small percentages reported barriers. The barrier mentioned most often was the availability of skilled labor, especially by HVAC contractors, but that appears to be less a problem related to efficient equipment than a general problem of finding skilled labor.

Our general conclusions are that the penetration of efficient products is increasing in the three contractor disciplines that we studied and among all types of contractors, participants, partial participants and nonparticipants. There is a range of factors that are influencing these increases: the RCP, the energy crisis, customer demand, and contractors selling the products to the customers. In general, participants and partial participants are adopting energy efficient technologies and products faster than nonparticipants. Participants and partial participants nearly always cite the RCP as a factor in these changes. Nonparticipants are more likely to cite the energy crisis or contractors selling the customers as reason for the change. They seldom cite the RCP as a factor. Based on this, we conclude that the RCP is influencing the market to be more efficient.

APPENDIX A: DATA COLLECTION PROCEDURES

This appendix discusses the methods used to collect the data needed for the analysis of savings for measures installed by RCP contractors and for the analysis of the diffusion of the measures among contractors.

A.1 UTILITY DATA

The gross savings impacts of measures installed under the RCP were determined using complementary analytical methodologies (e.g., econometric analysis and engineering analysis) and alternative types of data on energy use (e.g., billing data and engineering estimates). The short time schedule available for this project precluded extensive monitoring to collect data, although some monitoring was conducted for multifamily projects.

To begin implementation of the analysis, the following types of information were obtained from utility/RCP program staff: (1) program tracking information, (2) billing data on program participants, and (3) temperature data from their weather stations that were used to calculate cooling and heating degree hours.

The program tracking information provided by the utilities included the following items:

- Invoice Number
- Internal ID Tracking Number
- Applicant Name
- Utility billing account number for applicant
- Street Address
- City
- Zip Code
- Telephone Number
- Program
- Contractor
- Measure
- Install Date for measure
- Quantity of measure installed
- Unit Incentive for measure
- Total amount of incentive paid to applicant for measure
- Date Invoice Paid

Data from hard-copy program files were also used in some of the analysis (e.g., for case studies of multifamily projects).

For each program participant, utilities provided monthly billing data (for both electricity and natural gas) that covered periods of time before and after the installation of the RCP measure for the participant. In general, monthly billing data for the participants were provided for the period starting January 1, 1999 and going through July 31, 2001 (i.e., for 31 months). The billing data information included the following:

- premise or account number
- billing period consumption value (kWh or therms)
- indicator of whether the value was from an actual read or was an estimate
- meter read date or bill days
- usage code
- service address (i.e., street address, city, zip in order to ensure billing data matches back to the tracking system record)
- customer's weather station/weather region

Utilities also provided hourly temperature data that they have collected at their various weather stations, again covering the period from January 1, 1999 through July 31, 2001.

A.2 SURVEY FOR SF-RCP DATA

To facilitate the analysis of savings from SF-RCP measures, it was useful to have information on the characteristics of the houses where measures were installed under the RCP. Such information included square footage, year built, types of HVAC equipment and other energy-using appliances. Accordingly, a short mail survey was fielded to collect the needed information from a sample of households.

A sample of 2,500 households was selected for each of the three service areas (i.e., PG&E, SCE/SCG, and SDG&E). The total mail-out was therefore to 7,500 households. Out of the total mail-out of 7,500 questionnaires, 2,779 were returned (an overall response rate of 37.1 percent).

The survey questionnaire was a two-page sheet asking a homeowner to check off items indicating the square footage, year built, and HVAC characteristics. (A copy of this survey form is provided in Appendix B.)

A.3 DATA COLLECTION FOR MF-RCP ANALYSIS

Data were also collected that were used to estimate savings for the projects in the Multifamily RCP. A sample of MF-RCP sites was selected to visit on-site to

collect more detailed data with which to conduct the engineering analysis of the savings from the measures.

For selected sites where water heater controllers were installed, we installed monitoring equipment to determine whether the controllers perform as expected.

For outdoor lighting measures, we monitored sites to verify hours of use. At each site monitored, we used 3 to 5 time-of-use loggers at the site to measure lighting run times for various types of usage areas.

A.4 DATA COLLECTION FOR MEASURE DIFFUSION ANALYSIS

To provide the data for examining the diffusion of program-promoted measures, samples of both participating and non-participating contractors were surveyed by telephone to obtain relevant information. The surveys were used to gather information with which to determine why contractors chose to participate or not to participate in the program, as well as to determine from the participating contractors their opinion of the operation of the program and other evaluation issues.

The unit of analysis for this survey was the firm. The following data was used to draw the sample.

- List of the contractors firms and contacts from previous studies of the RCP;
- List of contractor firms who have had one or more employees complete the RCP training;
- List of contractor firms who have qualified for the RCP;
- List of contractors along with the number of RCP projects for which they have been reimbursed; and
- List of all HVAC, window, and insulation contractors.

Participant contractors were defined as those firms that have qualified to receive reimbursements from one of the participating utilities and who have received at least one reimbursement check. Review of the process analysis report for the RCP indicated that each of the utilities have a set of very active contractors as well as a group of less active contractors.

For the participant sample, a sample of 40 participating contractors was drawn from each utility service territory. The participant sub-sample for each utility was then distributed between the most active and least active contractors. A census was to be made of the most active contractors (as defined in the 2000 Process Evaluation), with a random sample selected from among the remaining participating contractors. Table A-1 shows the number of active contractors, the number of most active contractors as defined by the 2000 process evaluation, the remaining active

contractors, and the proposed sample sizes for the most and least active contractors.

Table A-1. Proposed Sample Design for Diffusion Examination

	SDG&E	***PG&E***	***SCE/SoCalGas***
Number of active contractors	73	134	156
Number of most active contractors	15	20	20
% of total funds committed to most active contractors	75	66	69
Number of remaining active contractors	58	114	136
Sample size for most active participating contractors	15	20	20
Sample size for remaining contractors	25	20	20
Total participant sample for utility	40	40	40

Two types of nonparticipants were defined:

- Those who have received training or qualified for the program but who have not participated in RCP and those who received training or qualified but elected not to qualify for whatever reason (partial nonparticipants)
- Those who have not received training or qualified for the program and who are therefore not participants in the program (true nonparticipants)

To identify the partial nonparticipants, training and/qualification records were compared with those who have received payments. Those firms that have received training but no reimbursements were be defined as partial nonparticipants. A sample of 20 partial nonparticipants was specified for each utility.

For the true nonparticipants, a random sample of firms was drawn from licensing board or other data. The size of the initial draw was made sufficiently large to account for firms that have gone out of business or can no longer be located. A sufficient sample was drawn to allow for 40 completions per utility.

The total sample of participants and nonparticipants was 300, comprised of 40 participants from each of the three utilities, 20 partial nonparticipants from each utility, and 40 nonparticipants from each utility.

One survey questionnaire was used for participants, and a parallel survey was used for nonparticipants. The main topic areas for the survey were:

- Windows
- Ducts
- HVAC efficiency
- Air conditioning and heat pump diagnostics
- Insulation

In addition, some questions were included to help understand how contractors have reacted to the changes in program design and whether the contractors who have had the training use different practices than those who have qualified for the program but have not had the training. The questionnaire also included an appropriate set of firmographic questions.

In-house personnel were used as the telephone survey staff. Training of the staff included training on the concepts and the language of the survey and practice in administering the survey. Interviews were be conducted from 7:00 AM to 5:00 PM PDT. As many as six attempts were made to reach each potential respondent.

APPENDIX B: DATA COLLECTION INSTRUMENTS

This appendix provides copies of the survey instruments used in the data collection. Provided are the following:

- Survey instrument for collecting data for engineering analysis. The form provided here has the first page used for the survey of participants in PG&E, SCE, and SoCalGas service territories. The first page used for the survey of SDG&E participants was different, but the same questions were asked.
- Survey instruments (for participant and nonparticipant contractors) for diffusion analysis survey. There are separate instruments for (1) HVAC contractors, (2) window contractors, and (3) insulation contractors.

Survey of Participants in Residential Contractors Program

Investor-owned utilities in California (including *Pacific Gas and Electric, Southern California Edison, and Southern California Gas*) in cooperation with the California Public Utilities Commission (CPUC) are sponsoring a study to determine how much electricity and/or natural gas have been saved from energy efficiency improvements installed in residences by contractors participating in the Residential Contractors Program (RCP). Our records show your residence had one or more energy efficiency improvements installed by a RCP contractor.

To aid us in our study to determine how much energy such improvements saved, we would appreciate if you answered the questions about your residence on the back side of this page and then returned this form in the enclosed envelope. Please be assured that your answers will only be used for statistical analysis and will not be used for any other purposes.

If you have any questions regarding this survey, please feel free to call Ms. Margie Barrett at ADM Associates, Inc., our contractor for this study. She may be reached at 1-800-556-2123

1. Which of the following best describes your residence?
   - ❒ Single story house
   - ❒ House with two or more stories
   - ❒ Duplex
   - ❒ Triplex
   - ❒ Quadplex
   - ❒ Townhouse
   - ❒ Apartment in one- or two-story building
   - ❒ Apartment in a building with three or more stories
   - ❒ Other (Describe) _____

2. What is the square footage of your residence?
   _____ Square feet

3. How many rooms does your residence have? (*Please include all bedrooms, family room, dining room, etc.)*
   _____ Number of rooms

4. When was your residence built?
   - ❒ Built before 1978
   - ❒ Built between 1979 – 1992
   - ❒ Built after 1992

5. How many people occupied your residence during the following two periods:
   - ____ Before energy efficiency improvements were made by RCP contractor
   - ____ After energy efficiency improvements were made by RCP contractor

6. What type of heating system does your residence have?
   - ❒ Natural gas wall heater
   - ❒ Natural gas furnace
   - ❒ Electric baseboard or furnace
   - ❒ Electric heat pump
   - ❒ Other (Describe) _____
   - ❒ Don't know

7. What type of air conditioning does your residence have?
   - ❒ Central air conditioner
   - ❒ Room air conditioners
   - ❒ Evaporative cooler
   - ❒ No air conditioning

HVAC Contractor Survey

Introduction

Hello, my name is _____ and I am calling on behalf of the California utilities. I am conducting research on their Residential Contractor Program *(If respondent is in SDG&E area, say the Residential Energy Efficiency Contractor Program).* The Residential Contractor Program (RCP) offers incentives to install energy efficiency measures to existing residences that are installed by approved contractors. May I please speak with _____.

Verification

V1. Before we get started, I'd like to ask you a few questions to make sure I'm talking to the appropriate person in your firm.

a) Are you a licensed HVAC contractor?
❑ Yes ❑ No → *Thank and terminate*

b) Do you provide services to the residential existing homes market?
❑ Yes ❑ No → *Thank and terminate*

c) Do you specialize in single-family homes?
❑ Yes ❑ No → *Thank and terminate*

Background

1a. Are you aware of the Residential Contractor Program *(If respondent is in the SDG&E area, say the Residential Energy Efficiency Contractor Program)?*
❑ No *(Go to Q2)* ❑ Yes

lb. Have you submitted any vouchers under the RCP program for HVAC services?
❑ No ❑ Yes

2. What contractor licenses does your company hold? (*Check all that apply. Do not read list unless to probe)*

   a. B1 General contracting
   b. C36 Plumbing
   c. C2 Insulation
   d. C17 Glazing
   e. C20 HVAC
   f. Cl0 Electrical
   g. C38 Refrigeration
   h. C43 Sheet Metal
   i. Mobile home
   j. HIC Home improvement
   k. D65 Weatherization
   l. Other_____

3. Which of the following services does your company provide?

   a. checking and correcting refrigerant charge and evaporator coil air flow on central air conditioners and heat pumps
   b. ❑ duct sealing
   c. ❑ duct testing
   d. ❑ installing Energy Star gas furnaces
   e. ❑ installing Energy Star central air conditioners and central heat pumps
   f. ❑ installing programmable thermostats
   g. ❑ installing attic and wall insulation
   h. ❑ installing high performance windows
   i. ❑ installing efficient gas water heaters
   j. ❑ installing pipe insulation
   k. ❑ installing water-saving showerheads
   l. ❑ installing hard-wired fluorescent fixtures
   m. ❑ installing screw-in compact fluorescent lights

4. How many years have you worked as a contractor?_____ years

5. How many of those years have you worked in California?_____ years

6. How many people work for your company?_____ (number of people)

7. Approximately how many single family existing homes, including mobile homes, did your company provide services to between September of 2000 and August 2001? _____ homes

High Efficiency Equipment

I'd like to ask you some questions about what in your opinion constitutes high efficiency HVAC equipment and services.

8a. For air conditioners, what SEER rating do you consider to be high efficiency? _____ SEER

b. Could I ask what you would have answered two years ago?_____

9a. For gas furnaces, what AFUE rating do you consider to be high efficiency? _____AFUE

b. What would you have said two years ago?_____

10a. For heat pumps, what SEER and heating season performance factor (HSPF) do you consider to be high efficiency?

_____ SEER _____ HSPF

b. What would you have said two years ago?_____ SEER _____ HSPF

11. *(Q8a and Q8b or, Q9a and Q9b, or Q10a or Q10b differ else skip to Q13)* Based on your responses it appears that you have changed your view about what is high efficiency since two years ago. Can you tell me what may have helped to change your mind? *(Do not read list. Listen to response and record. Then check all of the options to which that response applies.)*

a. ❑ have more experience with the products
b. ❑ customers are asking for it more
c. ❑ changed in response to the energy crisis
c. ❑ learned about this from the RCP program
d. ❑ learned about this from trade magazines or trade shows
e. ❑ other_____

12. *(If Q11a or Q11b or Q11c or Q11e talks about RCP, else Q13)* Do you think customers are asking for it more due to the RCP program?

❑ No ❑ Yes

13. On a scale of 1 to 5, where 1 represents not at all cost effective and 5 represents very cost effective, how cost effective do you think the following types of equipment are for your region? How about a:

a.	Central air conditioning with a SEER 12 rating or above	1	2	3	4	5	11
b.	Gas furnaces with an AFUE rating of 90 or above	1	2	3	4	5	11
c.	High efficiency heat pumps	1	2	3	4	5	11

14. Would you have answered differently for any of these a year ago?
❑ No (*Go to 17*) ❑ Yes (*If yes, probe to find out which ones)*

a. ❑ No ❑ Yes Central air conditioning with a SEER 12 rating or above
b. ❑ No ❑ Yes Gas furnaces with an AFUE rating of 90 or above
c. ❑ No ❑ Yes High efficiency heat pumps

15. *(If Q14a or Q14b or Q14c = Yes else go to Q17)* Why would you have answered it differently? *(Do not read list. Listen to response and record. Check all that apply.)*

a. ❑ have more experience with this product because customers are asking for it more
b. ❑ because of the energy crisis
c. ❑ learned about this from training required for the RCP program
d. ❑ learned about this from trade magazines or trade shows
e. ❑ other_____

16. (*If Q15a or Q15b or Q15d or Q15e mentrions RCP, else go to Q17)* Do you think customers are asking for it more due to the RCP program?
❑ No ❑ Yes

17. On a scale of 1 to 5, where 1 represents not at all cost effective and 5 represents very cost effective, how cost effective is duct testing and sealing in existing homes in your region?

a.	duct testing and sealing	1	2	3	4	5	11

18. Would you have given a different answer a year ago?
❑ No (*Go to Q21*) ❑ Yes (*Go to 19*)

19. *(If Q18 = Yes)* Why would you have answered it differently? *(Do not read list. Listen to response and record. Check all that apply.)*

    a. ❑ have more experience with this product because customers are asking for it more
    b. ❑ because of the energy crisis
    c. ❑ learned about this from training required for the RCP program
    d. ❑ learned about this from trade magazines or trade shows
    e. ❑ other_____

20. (*If Q19a or Q19b or Q19d or Q19f mentions RCP, else go to Q21)* Do you think customers are asking for it more due to the RCP program?
    ❑ No ❑ Yes

21. On a scale of 1 to 5, where 1 represents not at all cost effective and 5 represents very cost effective, how cost effective do you think your customers consider the folloowing?

a.	Central air conditioning with a SEER 12 rating or above	1	2	3	4	5	11
b.	Gas furnaces with an AFUE rating of 90 or above	1	2	3	4	5	11
c.	High efficiency heat pumps	1	2	3	4	5	11
d.	Duct testing and sealing	1	2	3	4	5	11

22. For any of the following items, would you have answered differently a year ago?

a.	❑ No	❑ Yes	Central air conditioning with a SEER 12 rating
b.	❑ No	❑ Yes	Gas furnaces with an AFUE rating of 90
c.	❑ No	❑ Yes	High efficiency heat pumps
c.	❑ No	❑ Yes	Duct sealing

23. *(If Q22a, Q22b, Q22c, and Q22d are No go to Q26)* Why would you have answered it differently? *(Do not read list. Listen to response and record. Then check all of the options to which that response applies.)*

    a. ❑ customers are more informed now because we are promoting it more
    b. ❑ customers are more informed because of the summer programs
    c. ❑ customers are more informed because of the energy crisis
    d. ❑ customers are more informed now due to the RCP program
    e. ❑ customers are more informed now from information they get from the utilities or

other organizations

f. ❑ RCP vouchers
g. ❑ Other: _____

24. *(If Q23a, else go to Q25)* Are you promoting it more now because of the RCP program?
❑ No ❑ Yes

25. *(If Q24a or Q23b or Q24c or Q24e or if Q24g mentions RCP, else go to Q26)* Is some of this information coming from the RCP program?
❑ No ❑ Yes

Retrofits

26. Since September 2000, roughly what percent of your total business is from performing residential HVAC retrofits?_____
❑ Don't do retrofits *(code 0 go to Q32)*

27. Thinking back two to three years prior to September 1999, roughly what percent of your total business was from performing residential HVAC retrofits?_____

28. *(If Q26 is > than Q27 else go to Q31)* What do you think is the primary reason for the increase? *(Do not read list. Listen to response and record. Check all responses that apply?)*

a. ❑ customers are more aware/receptive of the benefits of retrofits
b. ❑ our company is promoting retrofits more
c. ❑ the energy crisis caused people to be interested
d. ❑ RCP vouchers
e. ❑ our reputation as a contractor
f. ❑ business, in general, is increasing
g. ❑ other_____

29. *(If Q28a or Q28b or Q28c or Q28e or Q28f)* Is this due to the RCP program?
❑ No (*Go to Q32*) ❑ Yes

30. *If answered Yes to Q29, or Q28d, or Q28g mentions RCP, else go to Q32)* Do you anticipate that this level of jobs will continue if the RCP program is discontinued?
❑ No ❑ Yes

31. (*If Q27 is greater than Q26, else go to Q32*) What do you think is the primary reason it has decreased? *(Do not read list. Listen to response and record. Check all that apply.)*

    a. ❑ mild weather
    b. ❑ it's too expensive or not cost effective
    c. ❑ other_____

32. During the past two years, have you changed what you **recommend** to your customers with respect to…

    a. ❑ No ❑ Yes central air conditioners and heat pumps in existing homes?
    b. ❑ No ❑ Yes gas furnaces

    33. *(If yes to Q32a or Q32b else go to Q37)* What are those changes? *(Do not read list. Listen to response and record. Check all that apply).*

        a. ❑ recommending higher efficiency equipment
        b. ❑ recommending a different refrigerant
        c. ❑ evaluating air flow (or air distribution, or duct leakage)
        d. ❑ other_____

    34. Why did you change your recommendations? (*Do not read list. Listen to response and record. Check all that apply*).

        a. ❑ because the competition does it
        b. ❑ learned new techniques from the RCP program
        c. ❑ customers are more aware/receptive
        d. ❑ it's more profitable
        e. ❑ the energy crisis is causing customers to ask about it
        f. ❑ other_____

    35. *(If Q34a or Q34c or Q34d or Q34e else go to Q36)* Is this due to the RCP program?
        ❑ No ❑ Yes

    36. If *Q35 is yes or Q 34B or Q34f mentions RCP else go to 37)* Will you continue these changes even if the RCP program is discontinued?
        ❑ No ❑ Yes

37. During the last two years, have you changed your **recommendations** to customers for duct testing and duct sealing? (*Be sure respondent understands that these are recommendations not actions*)

❑ No *(Go to Q42)* ❑ Yes

38. What are those changes? *(Do not read list. Listen to response and record. Check all that apply).*

a. ❑ we didn't recommend duct testing and/or sealing before and we do now
b. ❑ we recommend to test and/or seal the ducts differently than we did before
c. ❑ we recommend to test and/or seal the ducts more often now than before
d. ❑ other_____

39. Why did you make these changes in your recommendations? (*Do not read list. Listen to response and record. Check all that apply*).

a. ❑ to keep up with the competition
b. ❑ learned about it through training for the RCP program
c. ❑ customers are more aware/receptive
d. ❑ to help customers in response to the energy crisis
e. ❑ it's more profitable
f. ❑ other_____

40. *(If Q39a or Q39c or Q39d or Q39e else go the Q41)* Is this due to the RCP program?
❑ No ❑ Yes

41. *(If answered Yes to Q40 or if answered Q39b or if response to Q39f includes RCP program, ask Q41, else skip to Q42)* Will you continue these changes even if the RCP program is discontinued?
❑ No ❑ Yes

We just asked about what you recommend to customers. Now, I would like to ask you what you actually install.

42. About how many air conditioners and heat pumps do you install annually?_____

43. About how many furnaces (not heat pumps) do you install annually?_____

44. Currently, approximately what percentage of the central air conditioners or heat pumps that you install are 13 SEER or higher?_____

45. What about 12 SEER only?_____

46. Two years ago, what percentage of central air conditioners or heat pumps did you install that were 13 SEER or higher?_____

47. And what about 12 SEER only?_____

48. Currently, approximately what percentage of furnace installations are 90 AFUE or higher?_____

49. How about two years ago?_____

50. On what percentage of homes do you do combustion appliance safety testing?_____

    ❑ Don't do testing *(code 0 skip to Q50)*

51. (*If "don' t do testing" skip to 50)* Roughly what percentage did you do two years ago?_____

52. *(If Q44 > than Q46 or if Q48 > Q49 or Q50 >Q51)* Based on your responses you seem to indicate that you are installing more efficient equipment and/or you are now doing more combustion safety testing. Can you tell me what encouraged you to make the change? *(Do not read list. Listen to response and record. Then check all that apply.)*

    a. ❑ our competition does it
    b. ❑ learned about it from training required for RCP program
    c. ❑ customers are more aware/receptive
    d. ❑ started doing it in response to the energy crisis to meet customer demands
    e. ❑ it's more profitable
    f. ❑ other_____

53 *(If Q52a or Q52c or Q52d or Q52e else go to Q54)* Is any of this due to the RCP Program?
❑ No ❑ Yes

54. *(If Q53 is yes or Q52b or Q52f mentions RCP)* Will you continue these changes even if the RCP program is discontinued?
❑ No ❑ Yes

6. Duct Testing and Sealing

55. For what percentage of homes do you do duct sealing or testing?_____

❑ Don't do testing or sealing *(code 0 then go to Q56)*

56. *(If Q55 = 0 else go to Q57)* Why don't you do duct testing and sealing? *(Do not read list. Listen to response and record. Check all of the options that apply.)*

a ❑ cost of equipment
b ❑ lack of customers asking for this service
c. ❑ waiting to take classes or get equipment
d. ❑ don't have the training
e. ❑ other_____

57. (*If Q55 is "don' t do testing" skip to Q70)* Roughly what percentage did you do two years ago?_____

58. (*If Q55 > 0 and Q57 is 0, else go to Q60*) Why did you decide to begin offering duct testing services? *(Do not read list. Listen to response and record. Then check all of the options that response apply)*

a. ❑ it's a good selling tool
b. ❑ customers heard about it and started asking for it specifically
c. ❑ customers heard about it because of the energy crisis and started asking
d. ❑ the energy crisis made it a good opportunity to increase business
e. ❑ started as part of the RCP program
f. ❑ other_____

59. (*If Q58a or Q58b or Q58C or Q58D else go to Q60)* Is this due to RCP vouchers?
❑ Yes ❑ No

60. *(If Q59 = Yes or Q58e or Q58f mentions RCP, else go to Q61.)* Will you continue to offer these services even if the RCP is discontinued?

❑ Yes ❑ No

61. Does your company own duct testing equipment such as a duct blaster?

❑ Yes ❑ No

62. (*If Q55 > Q57, else go to Q65*) Why has it increased? (*Do not read list. Listen to response and record. Then check all of the options to which that response applies*.)

a. ❑ we're marketing it more
b. ❑ we are pushing it as a solution to the energy crisis
c. ❑ customers are asking for it
d. ❑ customers are asking for it because of the energy crisis
e. ❑ RCP vouchers are creating interest
f. ❑ other_____

63. (*If Q62a or Q62b or Q62c or Q625d else go to 64)* Is this due to RCP vouchers?

❑ Yes ❑ No

64. (*If Q62e or Q63 is Yes or Q62f mentions RCP, else skip to Q57*) Will you continue to offer this service even if the RCP is discontinued?

❑ Yes ❑ No

65. (*If Q55 >0 and Q57 > 0, else go to Q70*) Over the past two years, has there been any change in the way you perform duct sealing?

❑ No *(Go to Q70)* ❑ Yes *(Go to Q66)*

66. What are those changes? *(Do not read list. Listen to response. Check all that apply.)*

a. ❑ we didn't offer duct sealing before and we do now
b. ❑ we use different methods or products to seal the ducts than we did before
c. ❑ we use different equipment to test the ducts now
d. ❑ we offer a more comprehensive service
e. ❑ other_____

67. Why did you make these changes? *(Do not read list. Listen to response and record. Check all that apply.)*

    a. ❑ our competition does it
    b. ❑ learned about it from training required for the RCP program
    c. ❑ customers are more aware/receptive
    d. ❑ started doing it in response to energy crisis to meet customer demands
    e. ❑ it's more profitable
    f. ❑ other_____

68. *(If answered Q67a, Q67c, or Q67d Q67e, else go to Q69)* Is this due to the RCP Program?
    ❑ No ❑ Yes

69. *(If Q67b or Q68 is Yes or Q67f mentions RCP else skip to Q70)* Will you continue these changes even if the RCP program is discontinued?
    ❑ No ❑ Yes

70. Have you or other employees at your company taken the training offered by RCP in duct sealing?
    ❑ No *(Go to 72)* ❑ Yes *(Go to Q71)*

    71. *(If Q45 = Yes)* How many employees have taken the training?_____

72. *(If respondent is not in the SCE/SoCal area, ask)* Have you taken the training offered for the RCP in combustion appliance safety testing?
    ❑ Yes ❑ No

Diagnostics-AC Maintenance

73. Currently, approximately what percent of your total business is providing diagnostic service for AC maintenance where you check and correct the refrigerant charge and evaporator coil air flow?_____

    ❑ Don't do testing *(code 0 then go to Q87)*

74. Thinking back to two years ago, roughly what percent of your total business was providing diagnostic service for AC maintenance?_____

75. (*If Q74 is 0 and Q73 > 0 else go to Q78)* Why did you decide to begin offering AC maintenance? *(Do not read list. Listen to response and record. Then check all that apply)*

a. ❑ it's a good selling tool
b. ❑ customers heard about it and started asking for it specifically
c. ❑ customers heard about it because of the energy crisis and started asking
d. ❑ the energy crisis made it a good opportunity to increase business
e. ❑ started as part of the RCP program
f. ❑ other_____

76. (*If Q75a or Q75b or Q75c or Q75d else go to Q77)* Is this due to RCP vouchers?
❑ Yes ❑ No → *(Skip to 78*)

77. (*If 75e or Q76 is Yes* or Q75f mentions RCP *else skip to 78*) Will you continue to offer this service even if the RCP is discontinued?
❑ Yes ❑ No

78. (If Q73 > Q74 else go to Q81) Why has it increased? (Do not read list. Listen to response and record. Then check all of the options that response applies to.)

a. ❑ we're marketing it more
b. ❑ we are pushing it as a solution to the energy crisis
c. ❑ customers are asking for it because they heard about it
d. ❑ customers are asking for it because of the energy crisis
e. ❑ RCP vouchers are creating interest
f. ❑ other_____

79. (*If Q78a or Q778b or Q78C or Q78D else go to 80)* Is this due to RCP vouchers?
❑ Yes ❑ No → *(Skip toQ80)*

80. *(If Q78e or Q79 = Yes or Q78f mentions RCP, else skip to Q81)* Will you continue to offer this service even if the RCP is discontinued?
❑ Yes ❑ No

81. (*If Q73 > 0 and Q74 > 0 else go to Q87*)Are you performing diagnostics for AC maintenance any differently than you did two years ago?
❑ No *(Skip to Q87)* ❑ Yes (*Go to Q82*)

82. Please describe what you are doing differently. *(Do not read list. Listen to response and record. Check all that apply.)*

    a. ❑ more in-depth or more accurate
    b. ❑ use better equipment
    c. ❑ other_____

83. Why did you start doing this differently? *(Do not read list. Listen to response and record. Check all that apply.)*

    a. ❑ able to charge more; it's more profitable
    b. ❑ RCP program
    c. ❑ because of the energy crisis
    d. ❑ customers asked for it
    e. ❑ other_____

84. *(Q83a or Q83c or Q83d else go to 85)* Is this due to the RCP program?
    ❑ Yes ❑ No

85. (*If Q84 = yes or Q83b or Q84e mentions RCP*) Will you continue to use these procedures even if the RCP program is discontinued?
    ❑ Yes ❑ No

    Why not?_____
    (Go to 86)

86. Do you anticipate that the number of diagnostic jobs will continue if the RCP program is discontinued?
    ❑ Yes ❑ No

87. *If respondent is in the SCE/SoCal area, ask*) Have you taken the training offered by the RCP in basic diagnostic AC tune-ups?
    ❑ Yes ❑ No

Whole-System Treatments

88. When making recommendations to your customers for heating and cooling systems, do you typically consider your customers' energy usage?
    Yes No

89. In addition to installing heating and cooling equipment, do you also consider changes to the distribution system that may affect the overall efficiency of the HVAC system?
    ❑ No ❑ Yes

    90. For what percent of systems do you do this?_____

    91 For what percent of systems did you do this two years ago?_____

    92. *(If Q90 >n Q91, else go to Q95)* Why has it increased? *(Do not read list. Listen to response and record. Check all that apply.)*

        a. ❑ we're marketing it more
        b. ❑ we offer more services now
        c. ❑ customers want it or are more receptive
        d. ❑ customers are asking for it because of the energy crisis
        e. ❑ RCP vouchers
        f. ❑ other_____

    93. *(If Q92a or Q92b or Q92c or Q92d)* Is this due to the RCP program?
        ❑ Yes ❑ No *(Go to Q94)*

    94. *(If Q93 = Yes or Q92e or Q92f mentions RCP, else go to 95)* Will you continue to offer these services even if the RCP is discontinued?
        ❑ Yes ❑ No

95. On a 1 to 5 scale where 1 is not at all aware and 5 is very aware, how aware do you think your customers are of the RCP program?

    a. aware of the RCP program 1 2 3 4 5 11

Market Potential

96. In your opinion, what percentage of the homes in your area could still upgrade their heating and cooling equipment for a reasonable cost?_____

97. Of these homes, in what percentage are the owners likely to have the work done in the absence of an incentive?_____

98. Have the percentages of customers likely to do the work changed over the past year?
❑ No (go to 101) ❑ Yes (Go to Q99)

99. (Why has it changed? *(Do not read list. Listen to response and record. Check all that apply.)*

a. ❑ contractors educate them and sell them on it
b. ❑ utilities have been educating them about it
c. ❑ RCP vouchers
d. ❑ the energy crisis
e. ❑ they want to save energy costs
f. ❑ other_____

100. *(If Q99a or Q99b or Q99d or Q99e)* Is this due to the RCP program?
❑ No ❑ Yes

101. In your opinion, what percentage of the homes in your area could reduce their duct leakage for a reasonable cost?_____

102. Of these homes, in what percentage are the owners likely to have the work done in the absence of an incentive?_____

103. In your opinion, what influence would you say the RCP program has had on the level of customer demand for the following measures? Please answer on a scale of 1 to 5 where 1 indicates no influence and 5 indicates very high influence.

a. High efficiency equipment	1	2	3	4	5	11
b. Duct sealing and testing	1	2	3	4	5	11
c. Air conditioning diagnostics	1	2	3	4	5	11

Product Availability

104. If you were to experience a high demand for HVAC retrofits, would you have any trouble expanding your services?
❑ Yes ❑ No

105. What about a high demand for diagnostic services for ac maintenance, would you have any trouble expanding those services?
❑ Yes ❑ No

106. And also what about a high demand for duct testing and sealing, would you have any trouble expanding those services?
❑ Yes ❑ No

107. Would you or have you had any trouble finding high efficiency air conditioning and heating units?
❑ Yes ❑ No

108. Would you or have you had trouble finding qualified labor?
❑ Yes ❑ No

109. Would you or have you had trouble acquiring diagnostic equipment?
❑ Yes ❑ No

Window Contractor Survey

Introduction

Hello, my name is _____ and I am calling on behalf of the California utilities. I am conducting research on their Residential Contractor Program *[If respondent is in SDG&E area, say the Residential Energy Efficiency Contractor Program].* The Residential Contractor Program (RCP) offers incentives to have energy efficiency measures installed by approved contractors in existing residences. May I please speak with_____.

Verification

V1. Before we get started, I'd like to ask you a few questions to make sure I'm talking to the appropriate person in your firm.

b) Are you a licensed window contractor?
❑ Yes ❑ No → *Thank and terminate*

d) Do you provide services to the residential existing homes market?
❑ Yes ❑ No → *Thank and terminate*

e) Do you specialize in single-family homes?
❑ Yes ❑ No → *Thank and terminate*

Background

1a. Are you aware of the Residential Contractor Program *(If respondent is in the SDG&E area, say the Residential Energy Efficiency Contractor Program)?*
❑ No (Go to Q2) ❑ Yes

lb. Have you submitted any vouchers under the RCP program for insulation services?
❑ No ❑ Yes

2. What contractor licenses does your company hold? *(Check all that apply do not read list unless to probe)*

   a. B1 General contracting
   b. C36 Plumbing
   c. C2 Insulation
   d. C17 Glazing
   e. C20 HVAC
   f. Cl0 Electrical
   g. C38 Refrigeration
   h. C43 Sheet Metal
   i. Mobile home
   j. HIC Home improvement
   k. D65 Weatherization
   l. Other_____

3. Which of the following services does your company provide?

   a. ❑ checking and correcting refrigerant charge and evaporator coil air flow on central air conditioners and heat pumps
   b. ❑ duct sealing
   c. ❑ duct testing
   d. ❑ installing Energy Star gas furnaces
   e. ❑ installing Energy Star central air conditioners and central heat pumps
   f. ❑ installing programmable thermostats
   g. ❑ installing attic and wall insulation
   h. ❑ installing high performance windows
   i. ❑ installing efficient gas water heaters
   j. ❑ installing pipe insulation
   k. ❑ installing water-saving showerheads
   l. ❑ installing hard-wired fluorescent fixtures
   m. ❑ installing screw-in compact fluorescent lights

4. How many years have you worked as a contractor?_____

5. How many of those years have you worked in California?_____

6. How many people work for your company?_____ (number of people)

7. For approximately how many single family **existing** homes, including mobile homes, did your company provide services between September of 2000 and August 2001?_____ homes

High Performance Windows

Now I'd like to ask you some questions about windows.

8. What U value of window do you consider to be energy efficient?_____

9. Would you have answered this question differently two years ago?
   ❑ No *(Go to Q12)* ❑ Yes (*Go to Q10)*

10. Why would you have answered it differently? *(Do not read list. Listen to response and record. Check all that apply.)*

    a. have more experience with this product because customers are asking for it more
    b. because of the energy crisis
    c. learned about this from training required for the RCP program
    d. learned about this from trade magazines or trade shows
    e. other_____

11. (*If Q10a or Q10b or Q10d or If Q10e does not mention RCP, else go to Q12)* Do you think customers are asking because of the RCP program?
    ❑ No ❑ Yes

12. On a scale of 1 to 5, where 1 represents not at all cost effective and 5 represents very cost effective, how cost effective do you think windows with a U-factor of 0.4 or less are in your region?

    a. Windows with U-value less than 0.4 1 2 3 4 5 11

13. Would you have answered differently for any of these two years ago?
    ❑ No (*Go to 16*) ❑ Yes *(Ggo to Q14)*

14. Why would you have answered it differently? *(Do not read list. Listen to response and record. Check all that apply.)*

    a. have more experience with this product because customers are asking for it more
    b. because of the energy crisis
    c. learned about this from training required for the RCP program
    d. learned about this from trade magazines or trade shows
    e. other_____

    15. (*If Q14a or Q14b or Q14d or Q14e does not mention RCP, else go to Q16)* Do you think customers are asking for it more due to the RCP program?
    ❑ No ❑ Yes

16. On a scale of 1 to 5, where 1 represents not at all cost effective and 5 represents very cost effective, how cost effective do you think your customers consider windows with a U-factor of 0.4 or less?

    a. Windows with u value less than 0.4 1 2 3 4 5 11

17. Would you have answered differently for any of these two years ago?
    ❑ No *(Go to 20)* ❑ Yes *(Go to 18))*

    18. Why would you have answered it differently? *(Do not read list. Listen to response and record. Check all that apply.)*

        a. customers are more informed now due to the internet
        b. customers are more informed now due to the RCP program
        c. customers are more informed now because contractors are promoting it more
        d. customers are more aware because of the energy crisis and all the discussion in the media
        e. customers are more informed now from information they get from the utilities or other organizations
        f. RCP vouchers
        g. other_____

19. (*If Q18a or Q18c or Q18d or Q18e or if 18 g does not mention RCP, else go to Q20)* Do you think customers are asking for it more due to the RCP program?
❑ No ❑ Yes

19a. Are you promoting it due to the RCP program?
❑ No ❑ Yes

Retrofits

20. Since September 2000, roughly what percent of your total business has been from installing windows in existing homes?_____

21. Thinking back two to three years, before September 1999, roughly what percent of your total business was from windows in existing homes?_____

22. *(If Q20 is > than Q21, else go to Q25)* What do you think is the primary reason for the increase? *(Do not read list. Listen to response and record. Check all responses that apply)*

a. ❑ customers are more aware/receptive of the benefits of retrofits
b. ❑ our company is promoting retrofits more
c. ❑ the energy crisis caused people to be interested
d. ❑ RCP vouchers
e. ❑ our reputation as a contractor
f. ❑ business, in general, is increasing
g. ❑ other_____

23. *(If Q22a or Q22b or Q22c or Q22e or Q22f)* Is this due to the RCP program?
❑ No *(Go to Q26)* ❑ Yes *(Go to Q24)*

24. Do you anticipate that this increase in the number of jobs will continue if the RCP program is discontinued?
❑ No ❑ Yes

25. *(If Q21 > Q20, else go to Q26)* What do you think is the primary reason it has decreased? *(Do not read list. Listen to response and record. Check all responses that apply?)*

a. ❑ mild weather
b. ❑ it's too expensive or not cost effective
c. ❑ other

26. In the last two years, have you made any changes to the **recommendations** you make to customers as to what to install?
❑ No *(Go to Q31)* ❑ Yes *(Go to Q27)*

27. What are those changes?

a. ❑ change from metal to wood or vinyl frames
b. ❑ use of dual pane glass
c. ❑ use of triple pane glass
d. ❑ use of inert gas fill such as argon
e. ❑ use of low e-coatings
f. ❑ other_____

28. Why did you make the changes in your recommendations? *(Do not read list. Listen to response and record. Check all responses that apply?)*

a. ❑ your competition does it
b. ❑ learned about it from training required for RCP program
c. ❑ customers are more aware/receptive
d. ❑ customers are aware because of the media attention to the energy crisis
e. ❑ it's more profitable
f. ❑ other_____

29. *(If Q28a or Q28c or Q28d or Q28e, else Q30)* Is this due to the RCP program?
❑ No ❑ Yes

30. (*If Q29 is Yes or Q28B or Q28f includes RCP, else Q31*) Will you continue these changes even if the RCP program is discontinued?
❑ No ❑ Yes

31. Now, I want to ask you about the windows you actually install. What percent of the windows that you install have a U-value of .4 or less?_____

32. What percent of the windows that you installed before September 1999 had a U-Value of 0.4 or less?_____

33. Did you make any of the following changes?

a. ❑ change from metal to wood or vinyl frames
b. ❑ change to dual pane glass
c. ❑ change to triple pane glass
d. ❑ began using inert gas fill such as argon
e. ❑ began using low e-coatings
f. ❑ change how you apply caulking to the window
g. ❑ change how you use flashing
h. ❑ change the material used for flashing
i. ❑ other_____

34. *(If Q31 > Q32 or Q33a through Q33h, else go to Q37)* Why did you make these changes? *(Do not read list. Listen to response and record. Check all responses that apply?)*

a. ❑ your competition does it
b. ❑ learned about it from training required for RCP program
c. ❑ customers are more aware/receptive
d. ❑ customers are aware because of the media attention to the energy crisis
e. ❑ it's more profitable
f. ❑ other_____

35. *(If Q34a or Q34c or Q34d or Q34e else Q37)* Is this due to the RCP program?
❑ No ❑ Yes

36. (*If Q35 = Yes or Q34B or Q34f includes RCP, else Q37* Will you continue these changes even if the RCP program is discontinued?
❑ No ❑ Yes

37. Have you or other employees at your company taken the training offered by RCP for installing windows?
❑ No (*Go to Q39*) ❑ Yes *(Go to Q38)*

38. How many employees have taken the training?_____

Perceptions of Customer Demand

39. Compared to two years ago, are your customers more aware of the benefits of installing high performance windows than they used to be?
❑ No *(Go to Q42)* ❑ Yes *(Go to Q40)*

40. Why do you think they are more aware? *(Do not read list. Listen to response and record. Check all that apply)*

a. ❑ Contractors educate them
b. ❑ Information from utilities
c. ❑ Other utility programs
d. ❑ Items in the news because of the energy crisis
e. ❑ RCP program
f. ❑ They learn from the internet or other media
g. ❑ Other_____

41. *(If Q41a or Q41b or Q41c or Q41d or Q41f or if Q43g does not mention RCP, else Q42)* Is this due to the RCP program?
❑ No ❑ Yes

42. In your opinion, compared to how customers responded two years ago, are your customers more willing to install high efficiency windows?
❑ No (*Go to Q45*) ❑ Yes *(Go to Q43)*

43. Why do you think they are more willing to install insulation or more insulation? *(Do not read list. Listen to response and record. Check all that apply)*

a. ❑ Contractors educate them and sell them
b. ❑ Utilities have been educating them
c. ❑ Utility programs other than RCP
d. ❑ They are convinced because of news about the energy crisis
e. ❑ RCP vouchers
f. ❑ they want to save energy costs
g. ❑ other_____

44. *(If Q43a or Q43b or Q43d or Q43f or Q43g does not mention RCP else Q45)* Is this due to the RCP program?
❑ No ❑ Yes

45. On a scale of 1 to 5 where 1 indicates they are unaware and 5 indicates they are very aware, how aware of the RCP program do you think customers are? (Circle the response or record exact number.)

1 2 3 4 5 11

7. Market Potential

49. In your opinion, what percentage of the homes in your area could upgrade their windows to high efficiency windows and achieve a reasonable payback?_____

50. Of these homes, what percentage of these owners are likely to have the work done in the absence of an incentive?_____

51. Have these percentages changed since 1999
❑ No (*Go to 55*) ❑ Yes (*Go to 52*)

52. Why has it changed?

a. ❑ Contractors educate them and sell them
b. ❑ Utilities have been educating them
c. ❑ Utility programs other than RCP
d. ❑ They are convinced because of news about the energy crisis
e. ❑ RCP vouchers
f. ❑ They want to save energy costs
g. ❑ Other_____

53. *(If Q52a or Q52b or Q52d or Q52f or if Q52g does not mention RCP)* Is this due to the RCP program?
❑ No ❑ Yes

54. *(If Q52c or Q53 = Yes or Q54g mentions RCP, else go to Q55)* In your opinion, will homeowners continue with this tendency even without RCP vouchers?
❑ No ❑ Yes

55. In your opinion, on a scale of 1 to 5 where 1 indicates no influence and 5 indicates a very high influence, what influence would you say that the RCP program has had on customer demand for high performance windows?

High performance windows	1	2	3	4	5	11

8. Product Availability

56. If you were to experience a high demand for high performance window retrofits, would you have or have you had any trouble expanding your services?
❑ No ❑ Yes

56. Have you had any problems obtaining high performance windows?
❑ No ❑ Yes

57. Would you have had or are you having trouble finding qualified labor?
❑ No ❑ Yes

Insulation Contractor Survey

Introduction

Hello, my name is _____ and I am calling on behalf of the California utilities. I am conducting research on their Residential Contractor Program *(If respondent is in the SDG&E area, say the Residential Energy Efficiency Contractor Program).* The Residential Contractor Program (RCP) offers incentives to have energy efficiency measures installed by approved contractors in existing residences. May I please speak with _____.

Verification

V1. Before we get started, I'd like to ask you a few questions to make sure I'm talking to the appropriate person in your firm.

c) Are you a licensed insulation contractor?
❑ Yes ❑ No → *Thank and terminate*

f) Do you provide services to the residential existing homes market?
❑ Yes ❑ No → *Thank and terminate*

g) Do you specialize in single-family homes?
❑ Yes ❑ No → *Thank and terminate*

Background

1a. Are you aware of the Residential Contractor Program *(If respondent is in the SDG&E area, say the Residential Energy Efficiency Contractor Program)?*
❑ No (Go to Q2) ❑ Yes

lb. Have you submitted any vouchers under the RCP program for insulation services?
❑ No ❑ Yes

2. What contractor licenses does your company hold? *(Check all that apply. Do not read list unless to probe)*

   a. ❑ B1 General contracting
   b. ❑ C36 Plumbing
   c. ❑ C2 Insulation
   d. ❑ C17 Glazing
   e. ❑ C20 HVAC
   f. ❑ Cl0 Electrical
   g. ❑ C38 Refrigeration
   h. ❑ C43 Sheet Metal
   i. ❑ Mobile home
   j. ❑ HIC Home improvement
   k. ❑ D65 Weatherization
   l. ❑ Other_____

3. Which of the following services does your company provide?

   a. ❑ checking and correcting refrigerant charge and evaporator coil air flow on central air conditioners and heat pumps
   b. ❑ duct sealing
   c. ❑ duct testing
   d. ❑ installing Energy Star gas furnaces
   e. ❑ installing Energy Star central air conditioners and central heat pumps
   f. ❑ installing programmable thermostats
   g. ❑ installing attic and wall insulation
   h. ❑ installing high performance windows
   i. ❑ installing efficient gas water heaters
   j. ❑ installing pipe insulation
   k. ❑ installing water-saving showerheads
   l. ❑ installing hard-wired fluorescent fixtures
   m. ❑ installing screw-in compact fluorescent lights

4. How many years have you worked as a contractor?_____

5. How many of those years have you worked in California?_____

6. How many people work for your company?_____ (number of people)

7. For approximately how many single family existing homes, including mobile homes, did your company provide services between September of 2000 and August 2001?_____ homes

8. On a scale of 1 to 5, where 1 represents not at all cost effective and 5 represents very cost effective, how cost effective do you think the following levels of insulation are for existing homes in your region? How about:

a. R-19 attic insulation	1	2	3	4	5	11
b. R-30 attic insulation	1	2	3	4	5	11
c. R-13 wall insulation	1	2	3	4	5	11

9. Would you have answered differently for any of these measures two years ago?

❑ No (*Go to 12*) ❑ Yes *(If Yes, continue)*

a. ❑ No ❑ Yes R-19 attic insulation
b. ❑ No ❑ Yes R-30 attic insulation
c. ❑ No ❑ Yes R-13 wall insulation

10. *(If any of Q9a or Q9b or Q9c = Yes, else go to Q12)* Why would you have answered it differently? *(Do not read list. Listen to response and record. Check all that apply.)*

a. have more experience with this product because customers are asking for it more
b. because of the energy crisis
c. learned about this from training required for the RCP program
d. learned about this from trade magazines or trade shows
e. other_____

11. (*If Q10a or Q10b or Q10d or Q10e does not mention RCP, else go to Q12)* Do you think customers are asking for it more due to the RCP program?
❑ No ❑ Yes

12. On a scale of 1 to *5*, how cost effective do you think your customers consider these measures?

a. R-19 attic insulation	1	2	3	4	5	11
b. R-30 attic insulation	1	2	3	4	5	11
c. R-13 attic insulation	1	2	3	4	5	11

13. Would you have answered differently for any of these measures two years ago?
❑ No (*Go to Q18*) ❑ Yes *(If Yes, continue)*

a. ❑ No ❑ Yes R-19 attic insulation
b. ❑ No ❑ Yes R-30 attic insulation
c. ❑ No ❑ Yes R-13 wall insulation

14. *(If any of Q13a or Q13b or Q13c = Yes, else go to Q18)* Why would you have answered it differently? *(Do not read list. Listen to response and record. Check all that apply.)*

a. ❑ customers are more informed now due to the internet
b. ❑ customers are more informed now due to the RCP program
c. ❑ customers are more informed now because contractors are promoting more
d. ❑ customers are more informed now because of the information they get from the utilities or other organizations
e. ❑ customers are more informed because of the energy crisis and media coverage
f. ❑ other_____

15. *(If Q14a or Q14c or Q14d or Q14e go to Q18)* Do you think customers are asking for it more due to the RCP program?
❑ No ❑ Yes

16. *(If Q15 = Yes or Q14b or Q14f mentions RCP, else go to Q18)* Are you promoting it more now because of the RCP program?
❑ No ❑ Yes

Retrofits

17. Since September 2000, roughly what percent of your total business has been from performing residential insulation retrofits?_____

18. Thinking back two or three years to the period before September 1999, roughly what percent of your total business was from performing residential insulation retrofits?_____

(*If Q18 = 0 go to Q23*)

19. *(If Q17 > Q18, else go to Q22)* Your answers suggest that you have seen an increase in insulation retrofits, what do you think the primary reason for the increase is? *(Do not read list. Listen to response and record. Check all responses that apply?)*

a. ❑ customers are more aware/receptive of the benefits of retrofits
b. ❑ our company is promoting retrofits more
c. ❑ the energy crisis caused people to be interested
d. ❑ RCP vouchers
e. ❑ our reputation as a contractor
f. ❑ business, in general, is increasing
g. ❑ other_____

20. *(If Q19a or Q19b orQ190c orQ19e orQ19f, else Q23)* Is this due to the RCP program?
❑ No ❑ Yes

21. *(If Q20 = Yes or Q19d or Q19g mentions RCP, else go to Q23)* Do you anticipate that this level of jobs will continue if the RCP program is discontinued?
❑ No ❑ Yes

22. *(If Q18 > Q17, else go to Q23)* What do you think is the primary reason it has decreased? *(Do not read list. Listen to response and record. Check all that apply.)*

a. ❑ mild weather
b. ❑ it's too expensive or not cost effective
c. ❑ other_____

23. Over the past year, has there been any change in your **recommendations** to your customers for installing:
    a. ❑ No ❑ Yes attic insulation?
    b. ❑ No ❑ Yes wall insulation

24. *(If Yes to Q23a or Q24b, else go to Q28)* What are those changes? *(Do not read list. Listen to response and record. Check all that apply).*

    a. ❑ recommending higher R levels than before
    b. ❑ other_____

25. Why did you change your recommendations? *(Do not read list. Listen to response and record. Check all that apply.)*

    a. ❑ because of the competition does it
    b. ❑ learned new techniques from the RCP program
    c. ❑ customers are more aware/receptive
    d. ❑ it's more profitable
    e. ❑ the energy crisis is causing customers to ask about it
    f. ❑ other_____

26. *(If Q25a or Q25c or Q25d or Q25e)* Is this due to the RCP program?
    ❑ No ❑ Yes

27. If *Q26 is yes or Q 25b or Q25f mentions RCP else go to Q28)* Will you continue these changes even if the RCP program is discontinued?
    ❑ No ❑ Yes

28. Now, I want to ask you about actually installing these measures in the last two years. In what percentage of these homes did you install R-19 to R-29attic insulation?_____

29. And in about what percentage did you install R-30 or greater attic insulation?_____

30. And in about what percentage of these homes did you install R-13 or greater wall insulation?_____

31. Thinking back to the period before September 1999, in about what percent of homes would you have installed R-19 to R-29 attic insulation?_____

32. And again thinking back to the period before September 1999, in about what percent of home would you have installed R-30 or greater attic insulation?_____

33. And thinking back to the period before September 1999, in about what percent of homes would you have installed R-13 or greater wall insulation?_____

34. Since September of 1999, have you made any changes in the way you actually install insulation in attics or walls?
❑ No ❑ Yes

a. Could you tell me what the changes are?_____
_____

35. (*If Q28 > Q31 or Q29 > Q32 or Q30 > Q337 or Q34 = Yes, else go to Q38*) Why did you make these changes?

a. ❑ our competition does it
b. ❑ learned about it from training required for RCP program
c. ❑ customers are more aware/receptive
d. ❑ the energy crisis has made people more aware/receptive
e. ❑ it's more profitable
f. ❑ other_____

36 *(If Q35a or Q35c or Q35d or Q35f, else Q37)* Are any of these changes attributable to RCP?
❑ No ❑ Yes

37. *(If Q35b or Q36 = Yes or Q35f mentions RCP)* Will you continue these changes if the RCP program is discontinued?
❑ No ❑ Yes

9. Perceptions of Customer Demand

38. In your opinion, are your customers more **aware** of the benefits of installing:

a. ❑ No ❑ Yes attic insulation than in the past
b. ❑ No ❑ Yes wall insulation than in the past

40. *(If Q38a = Yes or Q38b = Yes, else go to Q42)* Why do you think they more aware? *(Do not read list. Listen to response and record. Check all that apply)*

    a. ❑ Contractors educate them
    b. ❑ Information from utilities
    c. ❑ Other utility programs
    d. ❑ Items in the news because of the energy crisis
    e. ❑ RCP program
    f. ❑ they learn from the internet or other media
    g. ❑ Other_____

41. *(If Q40a or Q40b or Q40c or Q40d or Q40f or Q40g does not mention RCP, else Q42)* Is this due to the RCP program?
    ❑ No ❑ Yes

42. In your opinion compared to how customers responded two years ago, are your customers more willing to install:
    a. ❑ No ❑ Yes attic insulation
    b. ❑ No ❑ Yes wall insulation

44. Why do you think they are more willing to install insulation or more insulation? *(Do not read list. Listen to response and record. Check all that apply)*

    a. ❑ Contractors educate them and sell them
    b. ❑ Utilities have been educating them
    c. ❑ Utility programs other than RCP
    d. ❑ They are convinced because of news about the energy crisis
    e. ❑ RCP vouchers
    f. ❑ they want to save energy costs
    g. ❑ other_____

44. *(If Q446a or Q44b or Q44c or Q44d or Q44f or 44g does not mention RCP, else Q45)* Is this due to the RCP program?
    ❑ No ❑ Yes

45. On a scale of 1 to 5 where 1 indicates they are unaware and 5 indicates they are very aware, how aware of the RCP program do you think customers are? *(Circle the response or record the exact number?)*

1 2 3 4 5 11

10. Market Potential

46. In your opinion, what percentage of the homes in your area could ugrade their attic insulation and achieve a reasonable payback?_____

47. Of these homes, what percentage of these owners are likely to have the work done in the absence of an incentive?_____

48. In your opinion, what percentage of the homes in your area could upgrade their wall insulation with a reasonable payback?_____

49. Of these homes, what percentage of the owners are likely to have the work done in the absence of an incentive?_____

50. Have these percentages changed since 1999
❑ No ❑ Yes

51. *(If Q50 = Yes, else Q54)* Why has it changed?

a. ❑ Contractors educate them and sell them
b. ❑ Utilities have been educating them
c. ❑ Utility programs other than RCP
d. ❑ They are convinced because of news about the energy crisis
e. ❑ RCP vouchers
f. ❑ they want to save energy costs
g. ❑ other_____

52. *(If Q51a or Q51b or Q51d or Q51f for Q51g doe not mention RCP)* Is this due to the RCP program?
❑ No ❑ Yes

53. *(If Q51e or Q52 = Yes or Q51g mentions RCP, else Q57)* In your opinion, will homeowners continue with this tendency even without RCP vouchers?
❑ No ❑ Yes

54. In your opinion, on a scale of 1 to 5 where 1 indicates no influence and 5 indicates a very high influence, what influence would you say that the RCP program has had on customer demand for:

a.	R-19 attic insulation	1	2	3	4	5	11
b.	R-30 or greater attic insulation	1	2	3	4	5	11
c.	R-13 or greater wall insulation	1	2	3	4	5	11

11. Product Availability

55. If you were to experience a high demand for insulation retrofits, would you have or have you had any trouble expanding your services?
❑ No ❑ Yes

56. Would you have had or are you having trouble finding qualified labor?
❑ No ❑ Yes

APPENDIX C: COMPARISONS OF ENGINEERING AND ECONOMETRIC ESTIMATES OF KWH AND THERM SAVINGS FOR SINGLE-FAMILY RCP MEASURES

Estimates of savings for single-family RCP measures were developed through engineering analysis and econometric analysis. Moreover, Robert Mowris and Associates (RMA) had also developed *ex ante* engineering estimates of savings for such measures. Comparisons were presented in Chapter ?? between this study's *ex post* econometric estimates of savings and the *ex ante* engineering estimates of savings prepared by RMA.

This appendix provides two additional sets of comparisons between savings estimates.

- A first set of comparisons is between the engineering estimates of savings and the econometric estimates of savings that were developed in this study. These comparisons are provided in Section C.1.
- A second set of comparisons is between this study's engineering estimates of savings and RMA's *ex ante* engineering estimates.

All of the comparisons are presented by the climate zones defined for Title 24 purposes by the California Energy Commission. There are 16 climate zones, as shown in Figure C-1.

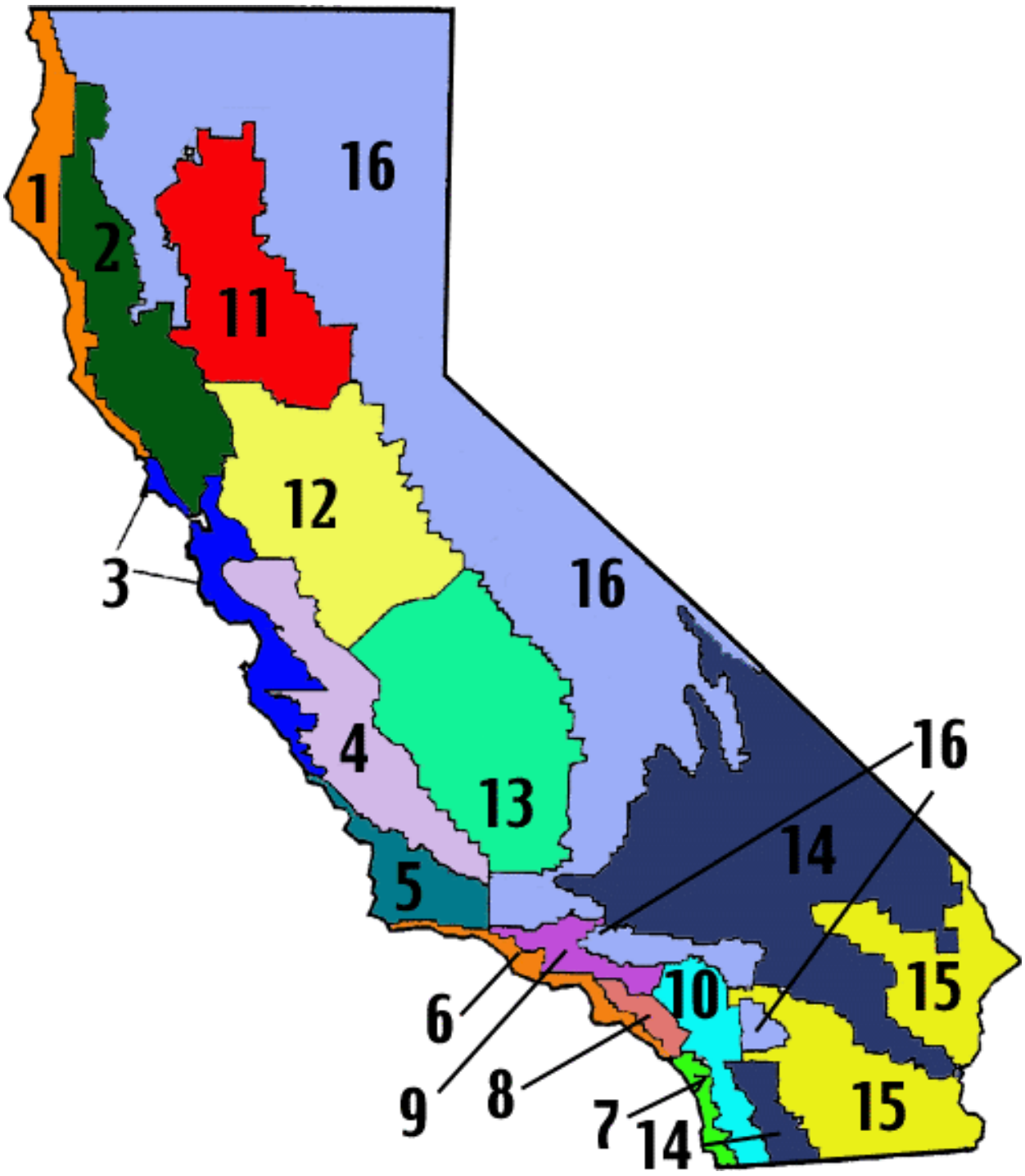

Figure C-1. Title 24 Climate Zones for California

C.1 COMPARISON OF THIS STUDY'S ENGINEERING ESTIMATES OF SAVINGS TO THE ECONOMETRIC ESTIMATES OF SAVINGS

This section provides a series of figures that compare the estimates of kWh and therm savings for single-family RCP measures that were developed through engineering analysis and through econometric analysis. Savings estimates are presented in each figure for the 16 Title 24 climate zones in California.

Comparisons are presented for the following single-family RCP measures:

- High performance windows;
- HVAC diagnostics (kWh savings only);
- Duct testing and sealing;
- Attic and wall insulation package;
- Programmable thermostats; and
- Energy Star central air conditioners (kWh savings only).

C.1.1 Comparison of Econometric and Engineering kWh Savings Estimates

This section provides a comparison of the econometric and engineering estimates of kWh savings for single-family RCP measures that were developed during this study.

- Table C-1 reports the econometric kWh savings estimates for the measures by Title 24 climate zones and weather stations within zones.
- Table C-2 reports the engineering estimates of kWh savings.

The figures then compare the econometric and engineering estimates for each measure for each climate zone.

Table C-1. Econometric Estimates of kWh Savings for Single-Family RCP Measures

CEC T24 Climate Zone	***Weather Station***	***Estimated Annual kWh Savings for Single-Family RCP Measures***					
		High Performance Windows	***HVAC Diagnostics***	***Duct Sealing***	***Insulation Package***	***Programmable Thermostats***	***Energy Star Central AC***
1	Eureka	204	137	2	-31	-204	162
2	Ukiah	585	92	21	103	-162	487
2	San Rafael	287	90	12	45	-148	218
2	Santa Rosa	352	85	15	65	-143	271
3	Oakland	205	52	10	48	-90	108
3	Colma	193	105	3	-18	-157	98
3	Potrero	178	57	7	25	-92	67
3	Belmont	227	44	13	69	-81	129
3	Santa Cruz	195	97	7	12	-152	137
3	Salinas	182	90	6	6	-139	110
4	Milpitas	231	43	13	72	-80	135
4	Paso Robles	589	100	21	103	-175	510
4	Cupertino	293	31	18	102	-68	187
11	Chico	728	28	31	188	-81	553
11	Marysville	617	50	26	149	-107	477
11	Red Bluff	826	29	33	199	-86	633
11	Auburn	556	99	21	104	-173	485
12	Concord	417	48	19	107	-96	301
12	San Ramon	363	64	16	82	-115	267
12	Sacramento	585	33	26	153	-82	431
12	Angels Camp	725	58	27	155	-120	572
12	Stockton	538	20	26	162	-64	388
13	Bakersfield	1,048	-18	42	277	-29	782
13	Fresno	953	-11	39	256	-35	706
6	Ventura	135	26	13	75	-55	60
6	Goleta	140	37	11	60	-68	61
6	El Segundo	118	3	12	79	-21	10
6	Long Beach	121	-5	20	130	-18	89
6	Westminster	121	0	19	120	-25	64
8	Santa Ana	121	-7	21	138	-18	101
9	San Dimas	135	-6	26	168	-26	282
9	Montebello	140	10	24	152	-47	253
9	Moorpark	153	46	16	89	-89	159
9	Valencia	160	22	28	172	-69	475
10	Romoland	163	22	29	181	-71	519
10	Rialto	141	-14	32	208	-21	454
13	Tulare	170	19	35	216	-73	659
14	Ridgecrest	174	-14	48	309	-41	999
14	Barstow	167	-10	43	278	-41	851
14	Lancaster	174	29	34	207	-86	629
14	Victorville	177	41	32	189	-101	587
14	Yucca Valley	174	26	35	218	-84	651
15	Cathedral City	146	-101	63	438	65	1,269
15	Blythe	155	-89	63		48	1,305
16	Mammoth Lakes	311	323	6	-72	-480	610
16	Rimforest	220	164	12	21	-256	340
16	Bishop	210	100	28	149	-184	683
7		486	22	17	98	-53	89
10		687	22	29	181	-71	519
14		924	-42	48	320	-1	896

Table C-2. Engineering Estimates of kWh Savings for RCP Measures by CEC Climate Zone

CEC Climate Zone	***Estimated Annual kWh Savings (kWh per house)***					
	High Performance Windows	***Advanced HVAC Diagnostics***	***Duct Sealing***	***Attic/Wall Insulation Package***	***Programmable Thermostat***	***Energy Star Central A/C***
1				1,049	701	
2	222	88	110		259	
3	178		28	518	77	
4	255			339		
5	236	192	60	603	275	300
6	467	428	337			305
7	318	104	101	738	374	288
8	210	199	160	711	343	
9	278	439	219	746	378	355
10	461	228	193		393	354
11	239	219	178	470	350	258
12	490	312	226		483	339
13	123	372	221	278	344	
14		785	444		352	
15	44					
16						

C.1.1.1 Econometric vs. Engineering kWh Savings Estimates for High Performance Windows

Figure C-2 compares the econometric and engineering estimates of kWh savings for high performance windows. The two sets of savings estimates for high performance windows are relatively similar for climate zones 1 through 10 and 15 and 16. For climate zones 11, 12, 13, and 14, the econometric savings estimates are generally higher than the engineering estimates .

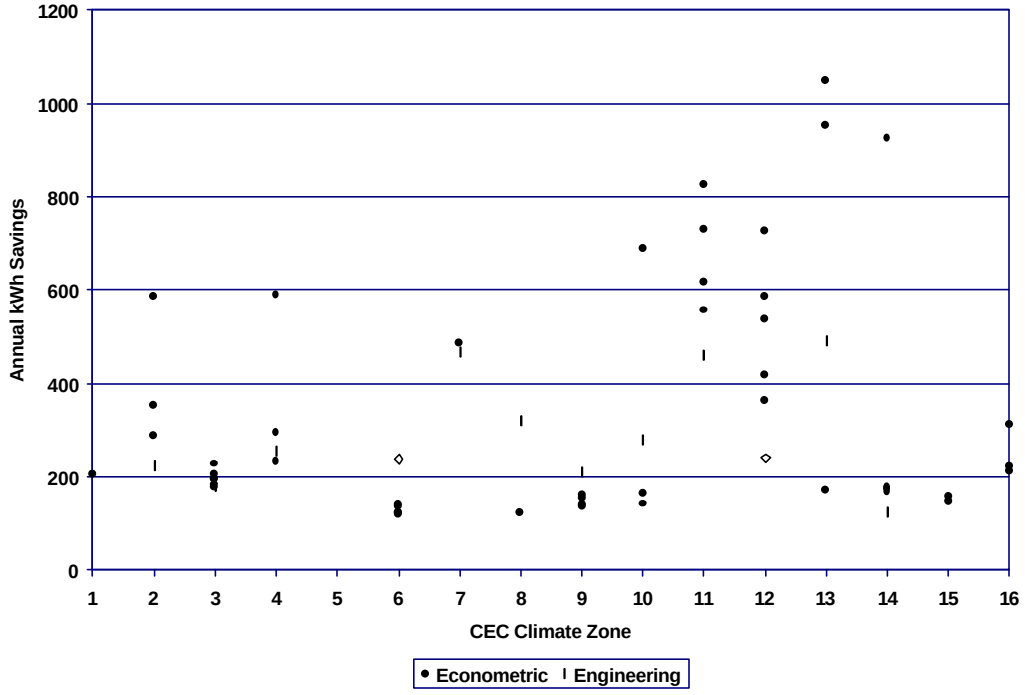

Figure C-2. Econometric versus Engineering kWh Savings Estimates for High Performance Windows

C.1.1.2 Econometric vs. Engineering kWh Savings Estimates for HVAC Diagnostics

Figure C-3 compares the econometric and engineering estimates of kWh savings for HVAC diagnostics. The two sets of savings estimates for HVAC diagnostics are relatively similar for climate zones 1 through 4. For climate zones 6 through 16, the econometric savings estimates are generally lower than the engineering estimates.

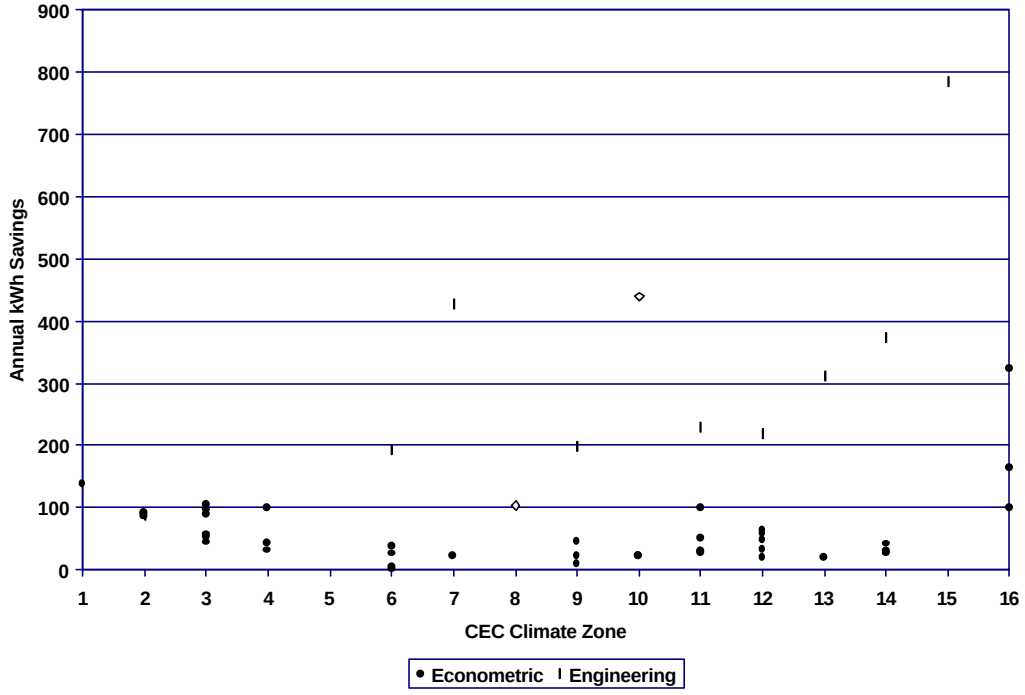

Figure C-3. Econometric versus Engineering kWh Savings Estimates for HVAC Diagnostics

C.1.1.3 Econometric vs. Engineering kWh Savings Estimates for Duct Testing and Sealing

Figure C-4 compares the econometric and engineering estimates of kWh savings for duct testing and sealing. The two sets of savings estimates for HVAC duct testing and sealing are relatively similar for climate zones 2 and 3. For climate zones 1 and 6 through 16, the econometric savings estimates are generally lower than the engineering estimates.

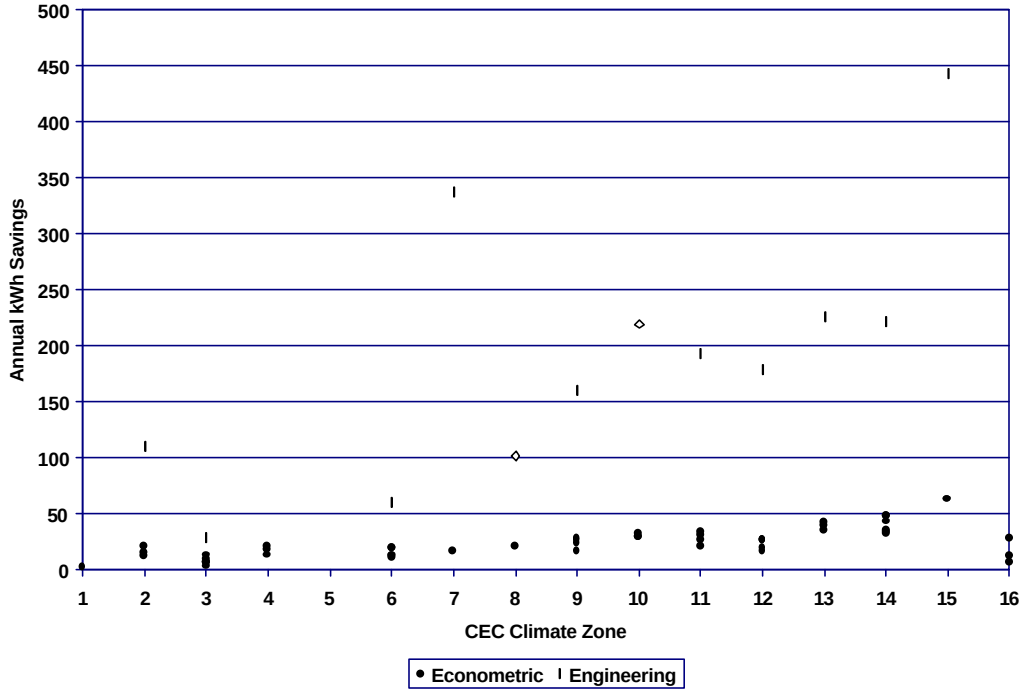

Figure C-4. Econometric versus Engineering kWh Savings Estimates for Duct Testing and Sealing

C.1.1.4 Econometric vs. Engineering kWh Savings Estimates for Attic and Wall Insulation Package

Figure C-5 compares the econometric and engineering estimates of kWh savings for attic and wall insulation package. For most climate zones, the econometric savings estimates are generally lower than the engineering estimates (except climate zone 14).

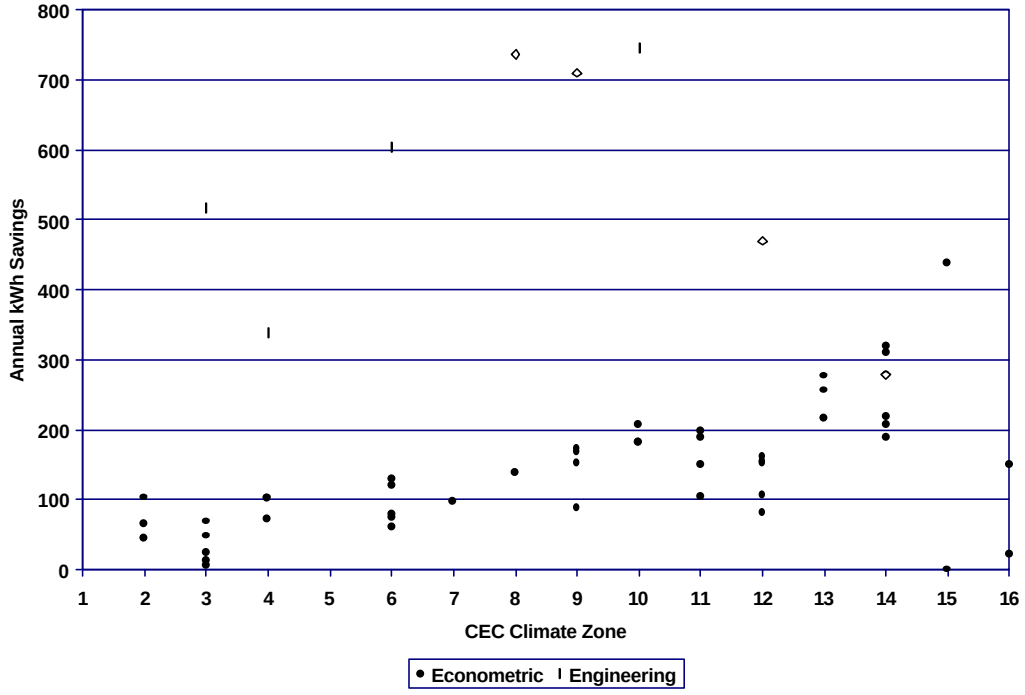

Figure C-5. Econometric versus Engineering kWh Savings Estimates for Attic and Wall Insulation Package

C.1.1.5 Econometric vs. Engineering kWh Savings Estimates for Programmable Thermostats

Figure C-6 compares the econometric and engineering estimates of kWh savings for programmable thermostats. The econometric analysis showed no kWh savings for programmable thermostats.

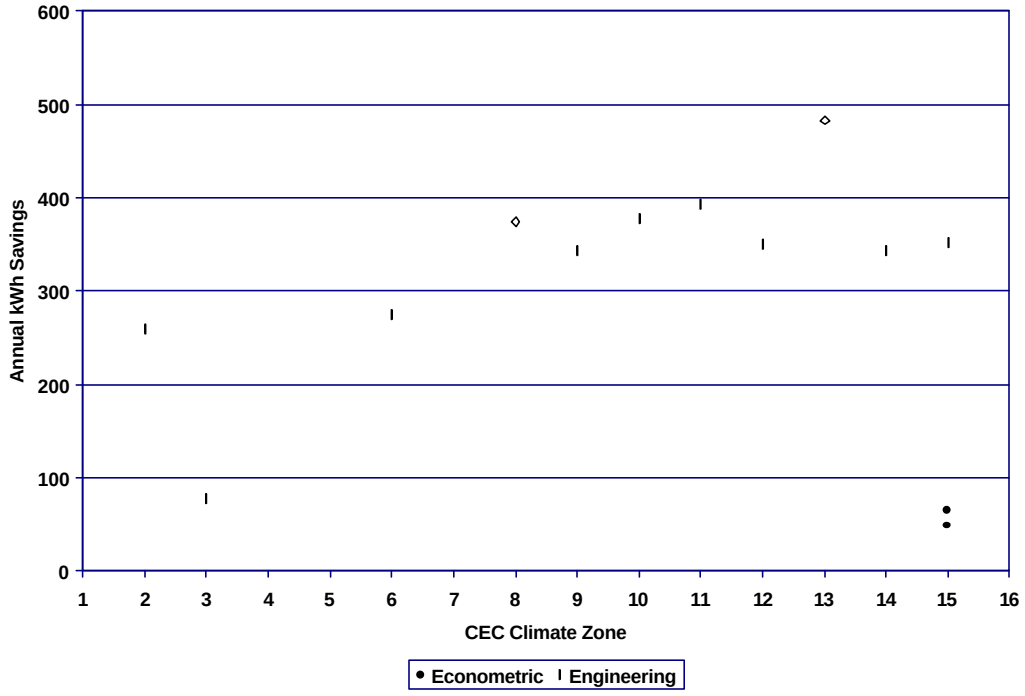

Figure C-6. Econometric versus Engineering kWh Savings Estimates for Programmable Thermostats

C.1.1.6 Econometric vs. Engineering kWh Savings Estimates for Energy Star Central Air Conditioners

Figure C-7 compares the econometric and engineering estimates of kWh savings for Energy Star central air conditioners. For climate zones 6, 7, and 8, the econometric savings estimates are generally lower than the engineering estimates. For climate zones 10, 11, and 12, the econometric savings estimates are generally higher than the engineering estimates.

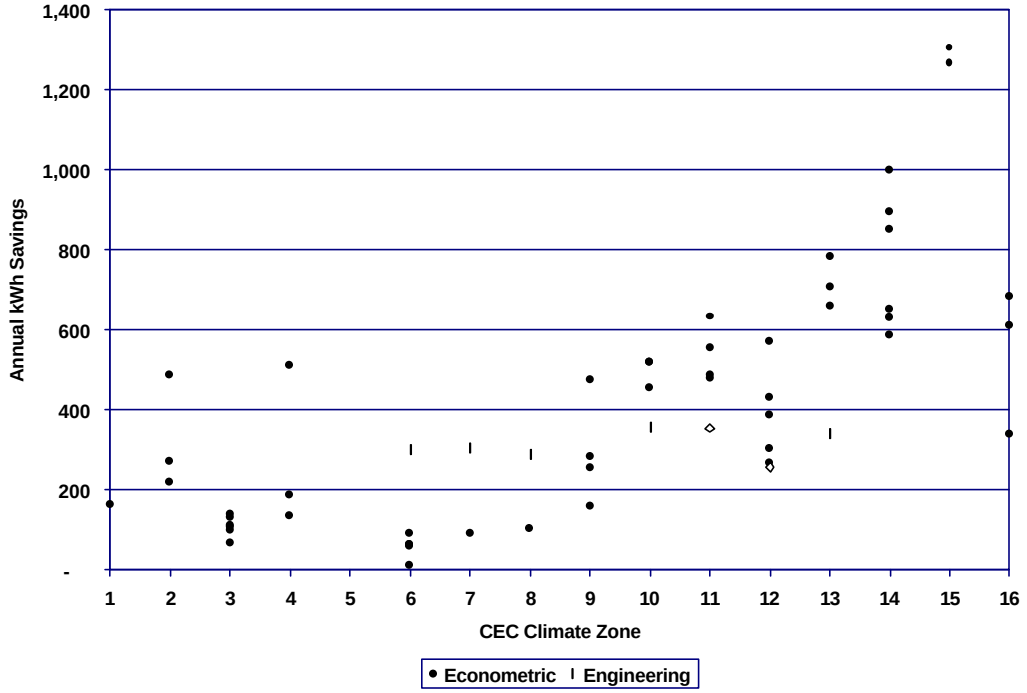

Figure C-7. Econometric versus Engineering kWh Savings Estimates for Energy Star Central Air Conditioners

C.1.2 Comparison of Econometric and Engineering Therm Savings Estimates

This section provides a comparison of the econometric and engineering estimates of therm savings for single-family RCP measures that were developed during this study.

- Table C-3 reports the econometric therm savings estimates for the measures by Title 24 climate zones and weather stations within zones.
- Table C-2 reports the engineering estimates of therm savings.

The figures then compare the econometric and engineering estimates of therm savings for each measure for each climate zone.

Table C-3. Econometric Estimates of Therm Savings for Single-Family RCP Measures

CEC T24 Climate Zone	***Weather Station***	***Estimated Annual Therm Savings for Single-Family RCP Measure (Therms per house)s***			
		High Performance Windows	***Duct Sealing***	***Insulation Package***	***Programmable Thermostats***
1	Eureka	77	62	197	0
2	Ukiah	63	57	193	17
2	San Rafael	59	53	173	6
2	Santa Rosa	58	53	174	9
3	Oakland	38	44	145	4
3	Colma	59	56	179	1
3	Potrero	38	45	147	2
3	Belmont	36	43	140	5
3	Santa Cruz	60	53	171	2
3	Salinas	54	52	166	1
4	Milpitas	36	43	140	6
4	Paso Robles	68	58	198	17
4	Cupertino	32	41	137	9
11	Chico	35	46	164	25
11	Marysville	45	49	170	20
11	Red Bluff	36	48	171	28
11	Auburn	68	58	195	16
12	Concord	41	46	156	13
12	San Ramon	48	48	161	10
12	Sacramento	36	46	158	19
12	Angels Camp	48	52	182	23
12	Stockton	30	42	147	19
13	Bakersfield	15	42	157	37
13	Fresno	18	42	155	34
6	Ventura	44	37	121	3
6	Goleta	50	39	127	2
6	El Segundo	25	32	102	1
6	Long Beach	28	31	103	7
6	Westminster	32	31	102	5
8	Santa Ana	29	31	103	8
9	San Dimas	32	35	123	16
9	Montebello	45	37	126	13
9	Moorpark	65	43	141	7
9	Valencia	54	44	155	22
10	Romoland	54	45	158	23
10	Rialto	28	37	133	24
13	Tulare	57	46	167	30
14	Ridgecrest	38	47	178	46
14	Barstow	38	45	169	40
14	Lancaster	65	48	170	28
14	Victorville	73	49	172	26
14	Yucca Valley	64	47	170	30
15	Cathedral City	-22	36	153	62
15	Blythe	-13	39	164	63
16	Mammoth Lakes	283	95	307	1
16	Rimforest	159	65	210	4
16	Bishop	119	60	208	24
7		43	36	120	5
10		64	45	158	23
14		43	40	155	44

Table C-4. Engineering Estimates of Therm Savings for Single-Family RCP Measures by CEC Climate Zone

CEC Climate Zone	***Estimated Annual Therm Savings (Therms per house)***			
	High Performance Windows	***Duct Sealing***	***Attic/Wall Insulation Package***	***Programmable Thermostat***
1			354	199
2	-81	70		149
3	-58		180	
4	-68	42	317	
5	-65	29	153	113
6	-77	36		
7	-88	22	150	97
8	-48	31	161	107
9	-66	58	212	104
10	-113	63		139
11	-70	71	377	163
12	-84	57		156
13		44	560	235
14		77		240
15				
16				

C.1.2.1 Econometric vs. Engineering Therm Savings Estimates for High Performance Windows

Figure C-8 shows the econometric estimates of therm savings for high performance windows. The engineering analysis showed no therm savings for high performance windows.

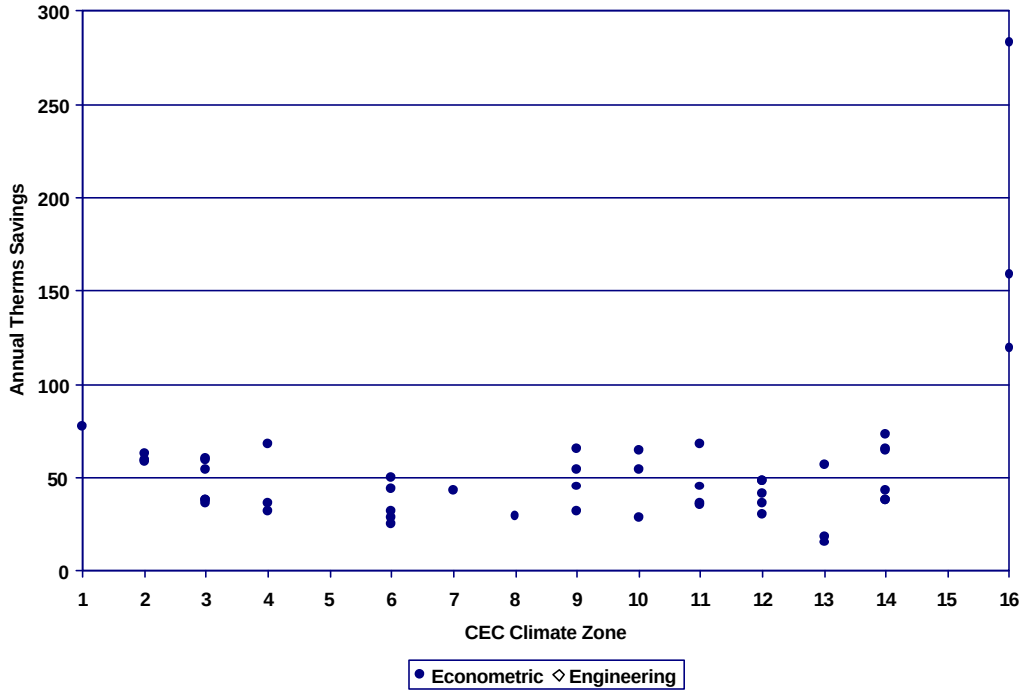

Figure C-8. Econometric versus Engineering Therm Savings Estimates for High Performance Windows

C.1.2.2 Econometric vs. Engineering Therm Savings Estimates for Duct Testing and Sealing

Figure C-9 shows the econometric and engineering estimates of therm savings for duct testing and sealing. The econometric and engineering estimates of therm savings for duct testing and sealing are similar for climate zones 4 and 14. The engineering savings estimates are generally higher than the econometric estimates for climate zones 2, 10, 11, 12, 13, and 15. The engineering savings estimates are generally lower than the econometric estimates for climate zones 6, 8, and 9.

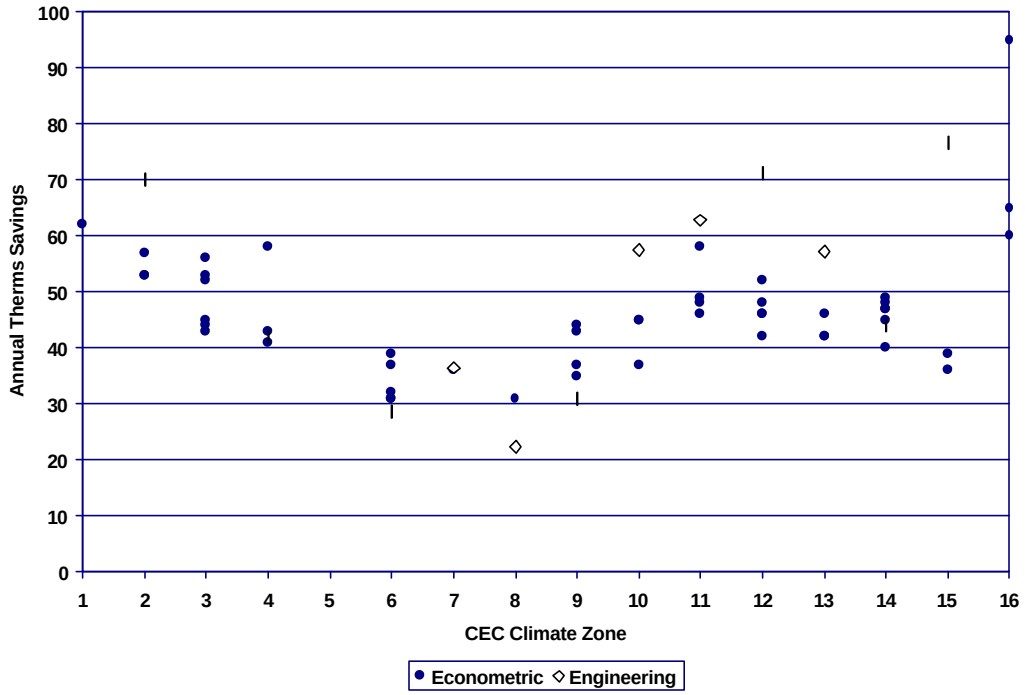

Figure C-9. Econometric versus Engineering Therm Savings Estimates for Duct Testing and Sealing

C.1.2.3 Econometric vs. Engineering Therm Savings Estimates for Attic and Wall Insulation Package

Figure C-10 shows the econometric and engineering estimates of therm savings for the attic and wall insulation package. The econometric and engineering estimates of therm savings for the attic and wall insulation package are similar for climate zones 3 and 9. The engineering savings estimates are generally higher than the econometric estimates for climate zones 1, 4, 6, 8, 10, 12, and 14.

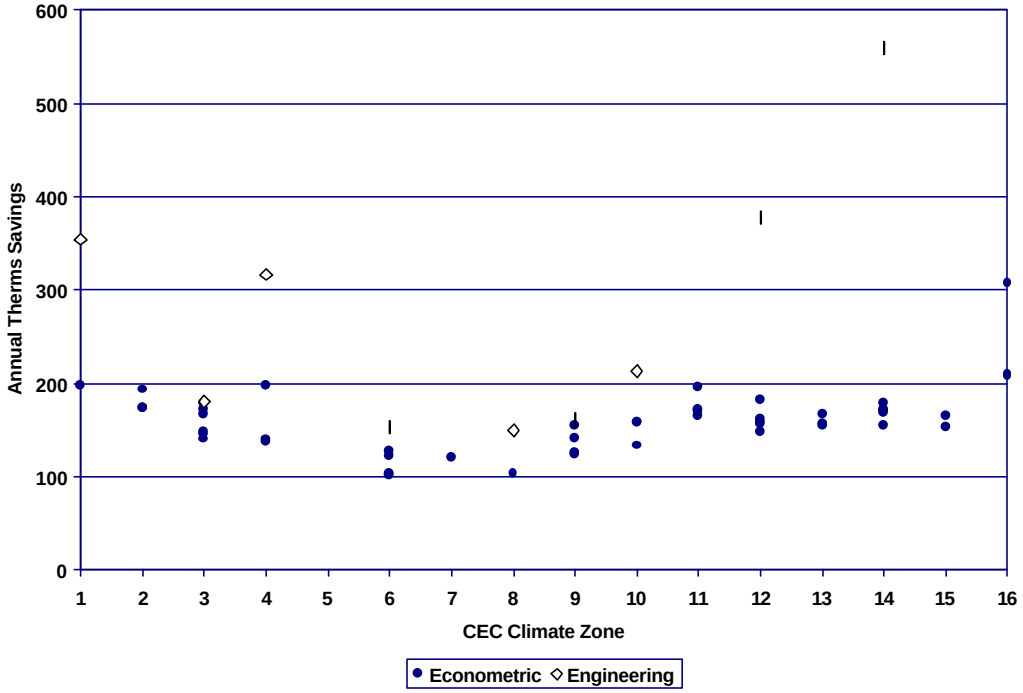

Figure C-10. Econometric versus Engineering Therm Savings Estimates for Attic and Wall Insulation Package

C.1.2.4 Econometric vs. Engineering Therm Savings Estimates for Programmable Thermostats

Figure C-11 shows the econometric and engineering estimates of therm savings for programmable thermostats. The engineering savings estimates are generally higher than the econometric estimates for all climate zones.

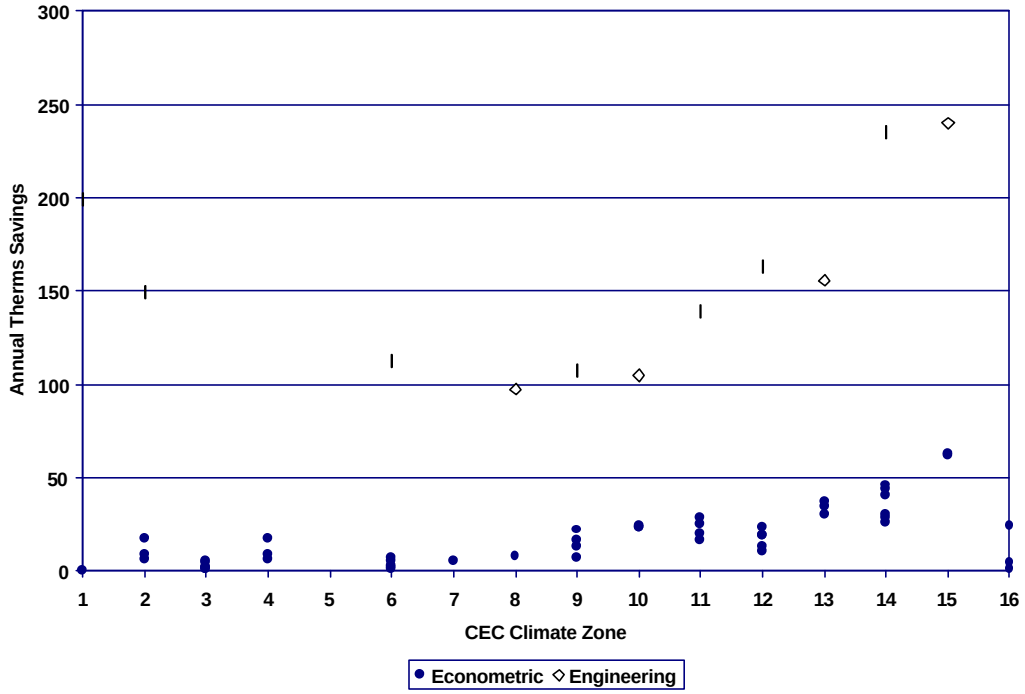

Figure C-11. Econometric versus Engineering Therm Savings Estimates for Programmable Thermostats

C.2 COMPARISON OF THIS STUDY'S ENGINEERING ESTIMATES OF SAVINGS TO RMA'S *EX ANTE* ENGINEERING ESTIMATES OF SAVINGS

This section provides a series of figures that compare the engineering estimates of kWh and therm savings for single-family RCP measures that were developed through engineering analysis in this study and in the study performed by Robert Mowris and Associates (RMA). Savings estimates are presented in each figure for the 16 Title 24 climate zones in California.

Comparisons are presented for the following single-family RCP measures:

- High performance windows;
- HVAC diagnostics (kWh savings only);
- Duct testing and sealing;
- Attic and wall insulation package;
- Programmable thermostats; and
- Energy Star central air conditioners (kWh savings only).

Engineering estimates developed in this study are denoted as ADM estimates; those estimates developed by Robert Mowris and Associates are denote as RMA estimates.

C.2.1 Comparison of ADM and RMA Engineering Estimates of kWh Savings Estimates

This section provides a comparison of the engineering estimates of kWh savings for single-family RCP measures that were developed during this study and those developed in an earlier study by Robert Mowris and Associates..

- Table C-5 reports this study's engineering kWh savings estimates for the measures by Title 24 climate zones and weather stations within zones. (These estimates are denoted as ADM estimates.)
- Table C-6 reports the engineering estimates of kWh savings developed by Robert Mowris and Associates. (These estimates are denoted as RMA estimates.)

The figures then compare the two sets of engineering estimates for each measure for each climate zone.

Table C-5. ADM Engineering Estimates of kWh Savings for RCP Measures by CEC Climate Zone

CEC Climate Zone	***Estimated Annual kWh Savings (kWh per house)***					
	High Performance Windows	***Advanced HVAC Diagnostics***	***Duct Sealing***	***Attic/Wall Insulation Package***	***Programmable Thermostat***	***Energy Star Central A/C***
1				1,049	701	
2	222	88	110		259	
3	178		28	518	77	
4	255			339		
5	236	192	60	603	275	300
6	467	428	337			305
7	318	104	101	738	374	288
8	210	199	160	711	343	
9	278	439	219	746	378	355
10	461	228	193		393	354
11	239	219	178	470	350	258
12	490	312	226		483	339
13	123	372	221	278	344	
14		785	444		352	
15	44					
16						

Table C-6. RMA Engineering Estimates of kWh Savings for RCP Measures by CEC Climate Zone

CEC Climate Zone	***Estimated Annual kWh Savings (kWh per house)***					
	High Performance Windows	***Advanced HVAC Diagnostics***	***Duct Sealing***	***Attic/Wall Insulation Package***	***Programmable Thermostat***	***Energy Star Central A/C***
1	11	187	4	-25	2	12
2	407	364	89	32	65	347
3	23	144	10	-26	5	29
4	358	266	63	-106	37	209
5	470	302	92	-116	45	263
6	93	273	106	-18	48	287
7	203	295	109	-61	56	322
8	255	333	143	98	62	378
9	320	536	251	136	96	608
10	707	557	244	598	107	650
11	1,153	1,146	464	99	212	1,276
12	860	667	224	34	121	695
13	1,205	1,174	470	209	240	1,393
14	770	844	331	470	153	920
15	1,590	2,295	1,144	2,165	475	2,937
16	84	441	54	13	42	216

C.2.1.1 ADM vs. RMA Engineering kWh Savings Estimates for High Performance Windows

Figure C-12 shows the engineering estimates of kWh savings for high performance windows developed by ADM and by RMA The engineering estimates of kWh savings for high performance windows developed by ADM are lower than those developed by RMA for climate zones 2, 3, 4, 9, 10, 11, 12, 13, and 14. The engineering estimates of kWh savings for high performance windows developed by ADM are higher than those developed by RMA for climate zones 6, 7, and 8.

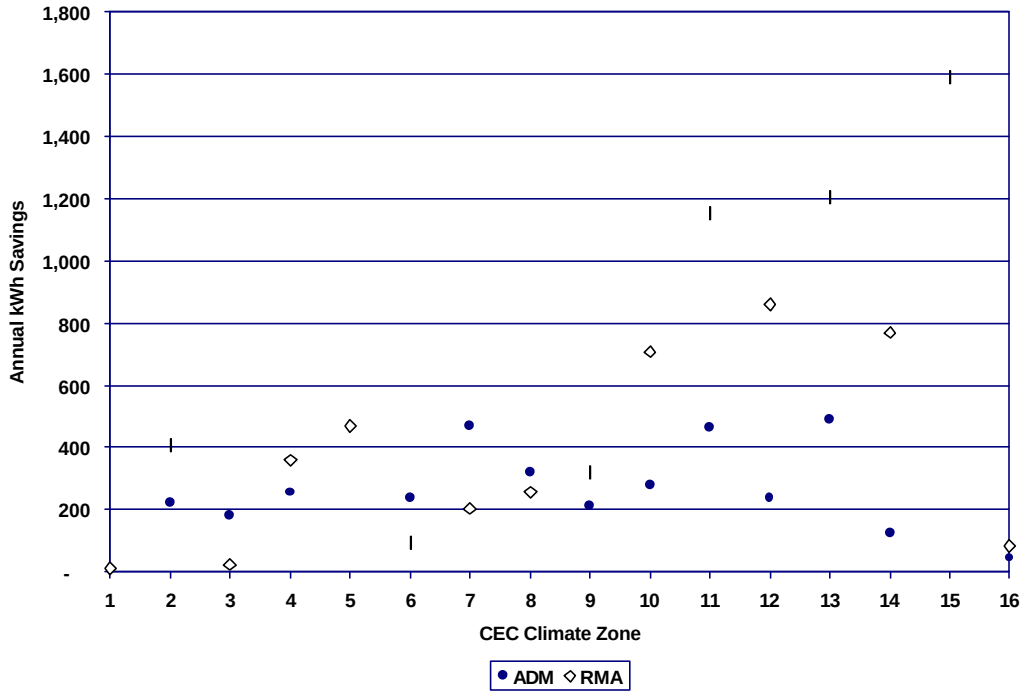

Figure C-12. ADM Engineering versus RMA Engineering kWh Savings Estimates for High Performance Windows

C.2.1.2 ADM vs. RMA Engineering kWh Savings Estimates for HVAC Diagnostics

Figure C-12 shows the engineering estimates of kWh savings for HVAC diagnostics developed by ADM and by RMA. For climate zones 1, 4, 9, and 14 the two different engineering estimates of kWh savings for HVAC diagnostics are similar. The engineering estimate of kWh savings for HVAC diagnostics developed by ADM for climate zone 6 is higher than that developed by RMA. The engineering estimates of kWh savings for HVAC diagnostics developed by ADM are lower than those developed by RMA for climate zones 7, 8, 10, 11, 12 and 13.

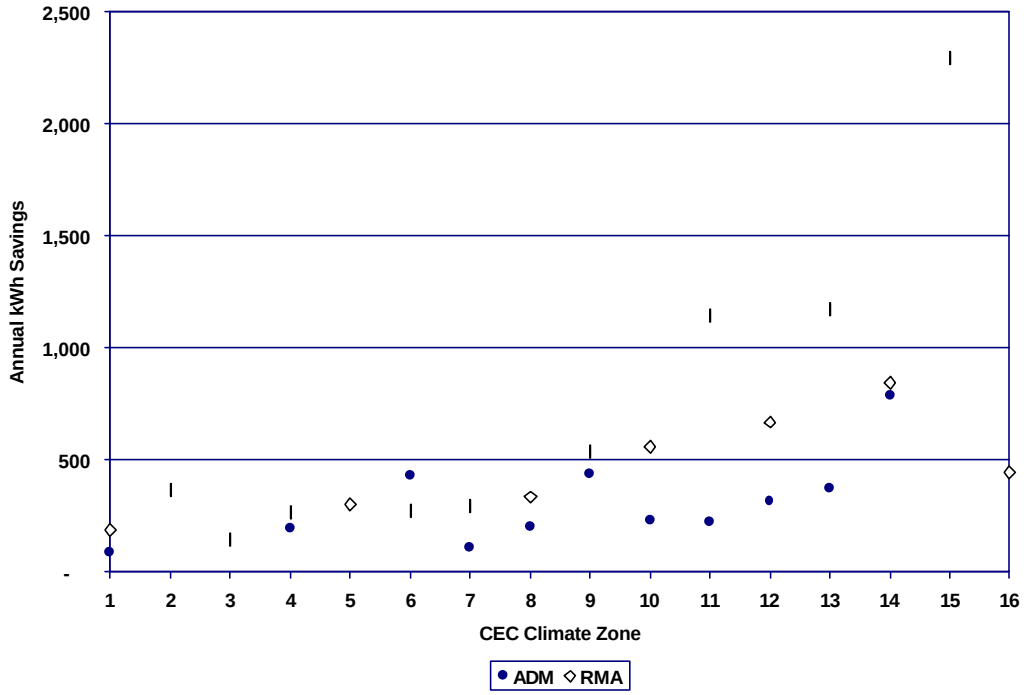

Figure C-13. ADM Engineering versus RMA Engineering kWh Savings Estimates for HVAC Diagnostics

C.2.1.3 ADM vs. RMA Engineering kWh Savings Estimates for Duct Testing and Sealing

Figure C-14 shows the engineering estimates of kWh savings for duct testing and sealing developed by ADM and by RMA. For climate zones 7, 8, 9, and 12 the two different engineering estimates of kWh savings for duct testing and sealing are similar. The engineering estimates of kWh savings for duct testing and sealing developed by ADM are higher than those developed by RMA for climate zones 6 and 14. The engineering estimates of kWh savings for duct testing and sealing developed by ADM are lower than those developed by RMA for climate zones 2, 10, 11, and 13.

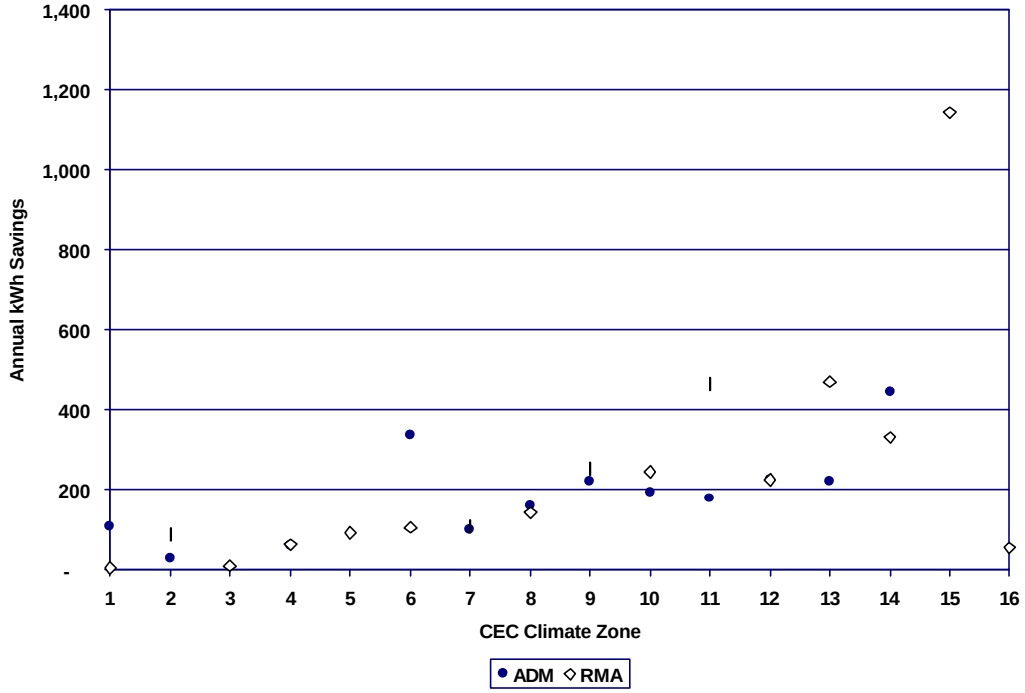

Figure C-14. ADM Engineering versus RMA Engineering kWh Savings Estimates for Duct Testing and Sealing

C.2.1.4 ADM vs. RMA Engineering kWh Savings Estimates for Attic and Wall Insulation Package

Figure C-15 shows the engineering estimates of kWh savings for the attic and wall insulation package developed by ADM and by RMA. The engineering estimates of kWh savings for the attic and wall insulation package developed by ADM are generally higher than those developed by RMA for all climate zones.

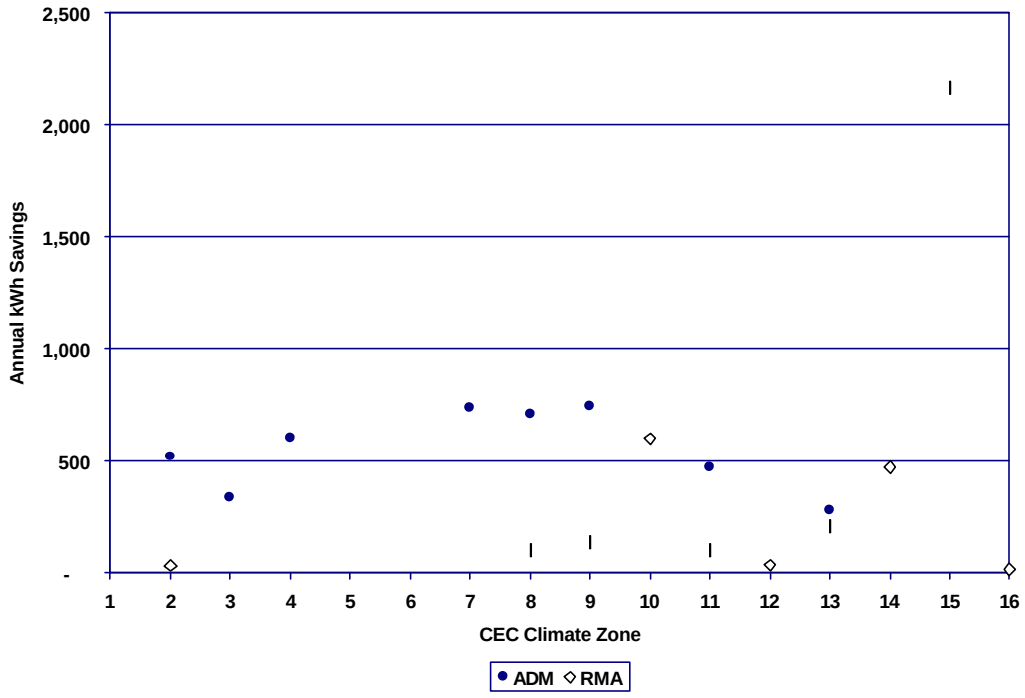

Figure C-15. ADM Engineering versus RMA Engineering kWh Savings Estimates for Attic and Wall Insulation Package

C.2.1.5 ADM vs. RMA Engineering kWh Savings Estimates for Programmable Thermostats

Figure C-16 shows the engineering estimates of kWh savings for programmable thermostats developed by ADM and by RMA. The engineering estimates of kWh savings for programmable thermostats developed by ADM are generally higher than those developed by RMA for all climate zones.

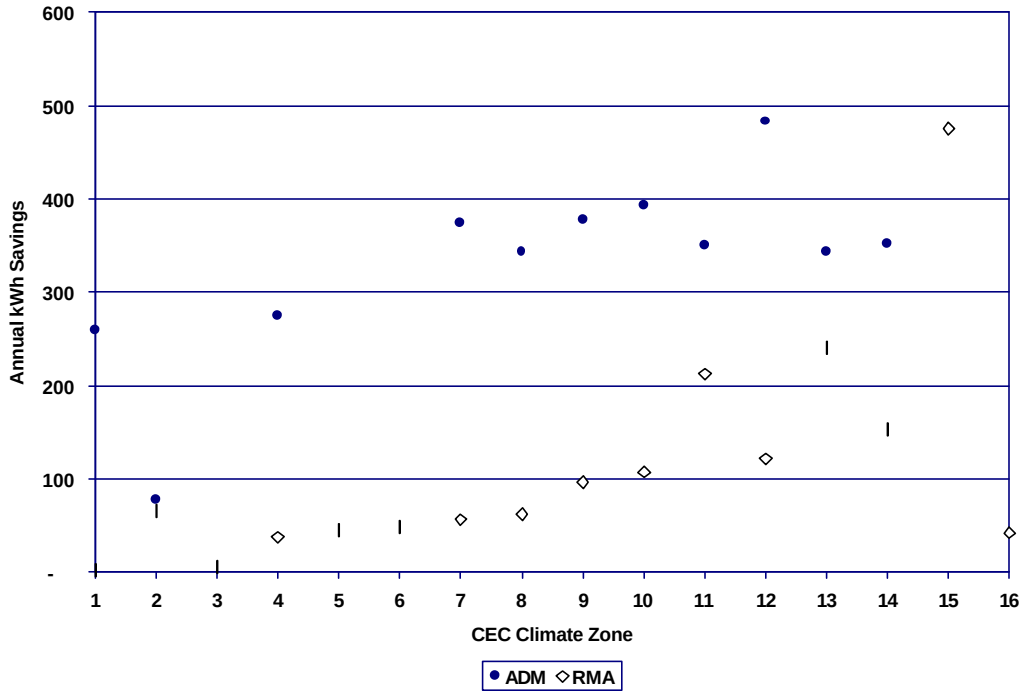

Figure C-16. ADM Engineering versus RMA Engineering kWh Savings Estimates for Programmable Thermostats

C.2.1.6 ADM vs. RMA Engineering kWh Savings Estimates for Energy Star Central Air Conditioners

Figure C-17 shows the engineering estimates of kWh savings for Energy Star central air conditioners developed by ADM and by RMA. The engineering estimates of kWh savings for Energy Star central air conditioners developed by ADM are similar to those developed by RMA for climate zones 4, 6, and 7. The engineering estimates of kWh savings for Energy Star central air conditioners developed by ADM are lower than those developed by RMA for climate zones 9, 10, 11, and 12.

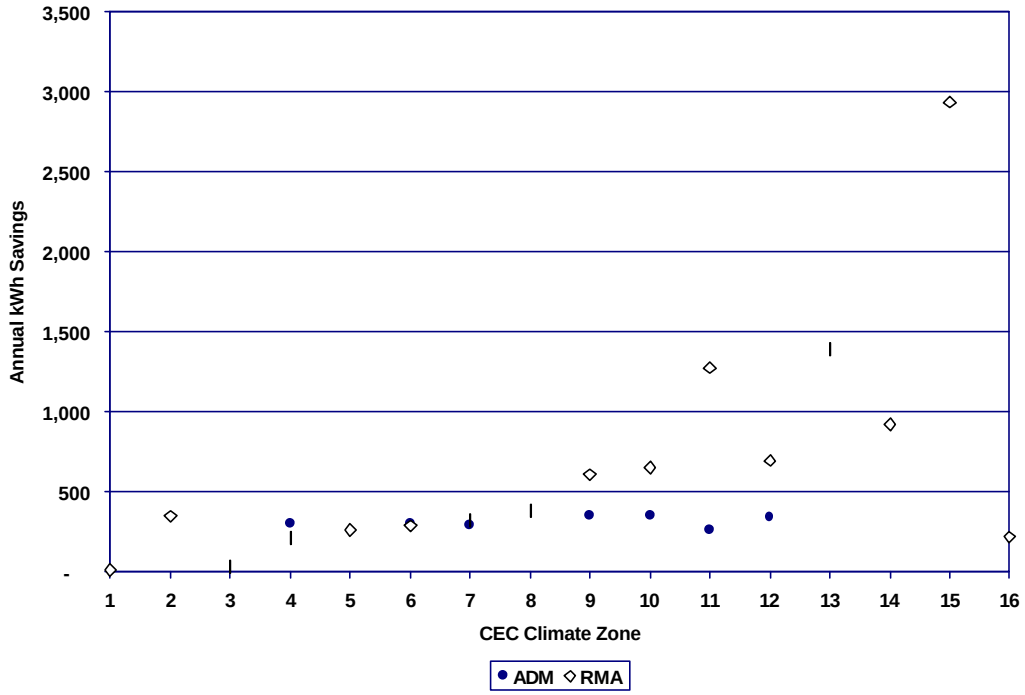

Figure C-17. ADM Engineering versus RMA Engineering kWh Savings Estimates for Energy Star Central Air Conditioners

C.2.2 Comparison of ADM and RMA Therm Savings Estimates

This section provides a comparison of the engineering estimates of therm savings for single-family RCP measures that were developed during this study and those developed in an earlier study by Robert Mowris and Associates..

- Table C-7 reports this study's engineering therm savings estimates for the measures by Title 24 climate zones and weather stations within zones. (These estimates are denoted as ADM estimates.)
- Table C-6 reports the engineering estimates of therm savings developed by Robert Mowris and Associates. (These estimates are denoted as RMA estimates.)

The figures then compare the two sets of engineering estimates of therm savings for each measure for each climate zone.

Table C-7. ADM Engineering Estimates of Therm Savings for RCP Measures by CEC Climate Zone

CEC Climate Zone	***Estimated Annual Therm Savings (therms per house)***			
	High Performance Windows	***Duct Sealing***	***Attic/Wall Insulation Package***	***Programmable Thermostat***
1			354	199
2	-81	70		149
3	-58		180	
4	-68	42	317	
5	-65	29	153	113
6	-77	36		
7	-88	22	150	97
8	-48	31	161	107
9	-66	58	212	104
10	-113	63		139
11	-70	71	377	163
12	-84	57		156
13		44	560	235
14		77		240
15				
16				

Table C-8. RMA Engineering Estimates of Therm Savings for Single-Family RCP Measures by CEC Climate Zone

CEC Climate Zone	***Estimated Annual Therm Savings (therms per house)***			
	High Performance Windows	***Duct Sealing***	***Attic/Wall Insulation Package***	***Programmable Thermostat***
1	80	101	204	46
2	16	70	143	30
3	54	57	132	26
4	11	56	165	25
5	14	57	151	25
6	23	21	104	10
7	6	20	104	9
8	4	17	76	8
9	-5	27	130	11
10	-52	23	209	9
11	65	87	133	34
12	48	78	125	31
13	47	59	116	24
14	-37	77	220	29
15	-23	8	105	3
16	186	152	212	66

C.2.2.1 ADM vs. RMA Engineering Therm Savings Estimates for High Performance Windows

Figure C-18 shows the engineering estimates of therm savings for high performance windows developed by RMA. The engineering estimates developed by ADM showed no therm savings for high performance windows.

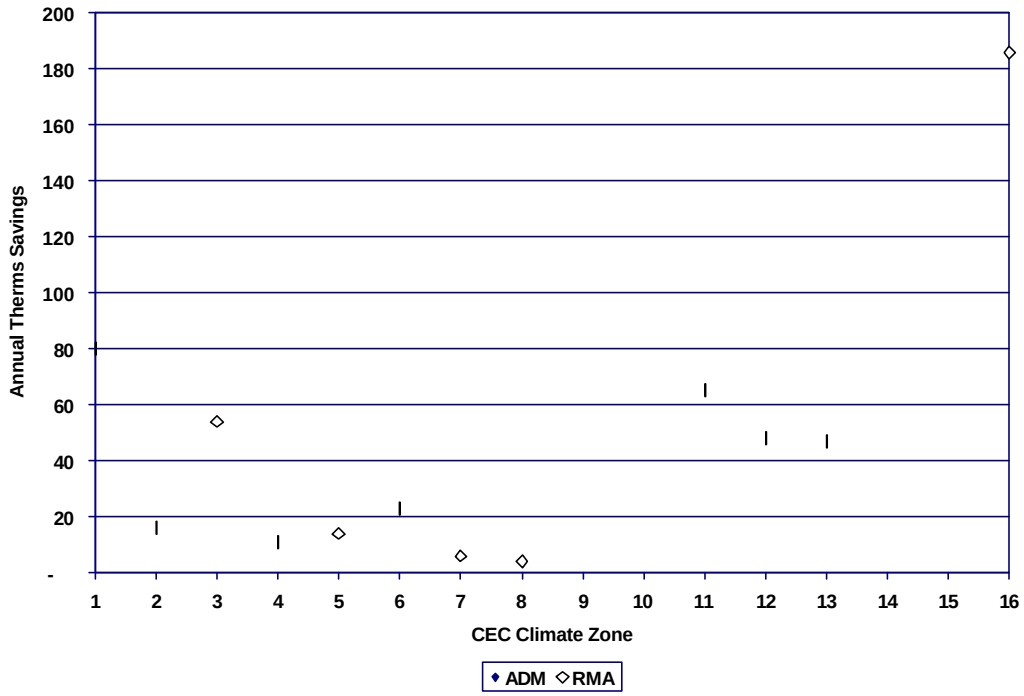

Figure C-18. ADM Engineering versus RMA Engineering Therm Savings Estimates for High Performance Windows

C.2.2.2 ADM vs. RMA Engineering Therm Savings Estimates for Duct Testing and Sealing

Figure C-19 shows the engineering estimates of therm savings for duct testing and sealing developed by ADM and by RMA. The engineering estimates of therm savings for duct testing and sealing developed by ADM are similar to those developed by RMA for climate zones 8, 9, 12, and 13. The engineering estimates of therm savings for duct testing and sealing developed by ADM are lower than those developed by RMA for climate zones 4, 11, and 14. The engineering estimates of therm savings for duct testing and sealing developed by ADM are higher than those developed by RMA for climate zones 6, 7, and 15.

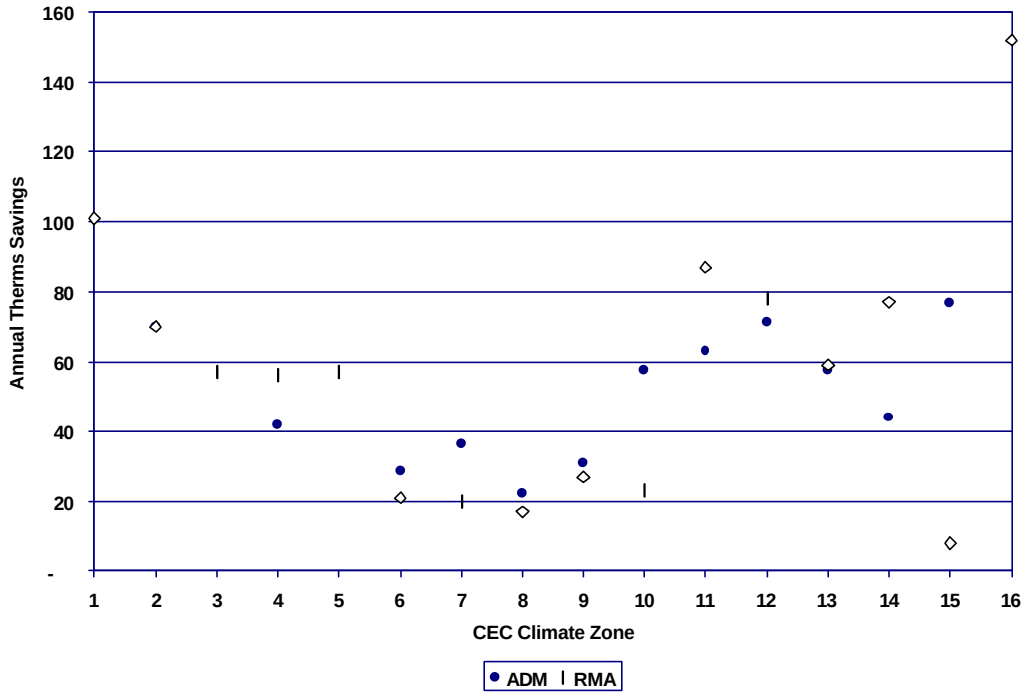

Figure C-19. ADM Engineering versus RMA Engineering Therm Savings Estimates for Duct Testing and Sealing

C.2.2.3 ADM vs. RMA Engineering Therm Savings Estimates for Attic and Wall Insulation Package

Figure C-20 shows the engineering estimates of therm savings for the attic and wall insulation package developed by ADM and by RMA. The engineering estimates of therm savings for the attic and wall insulation package developed by ADM for climate zone 10 is similar to that developed by RMA. The engineering estimates of therm savings for the attic and wall insulation package developed by ADM are higher than those developed by RMA for climate zones 3, 4, 6, 8, 9, 12, and 14.

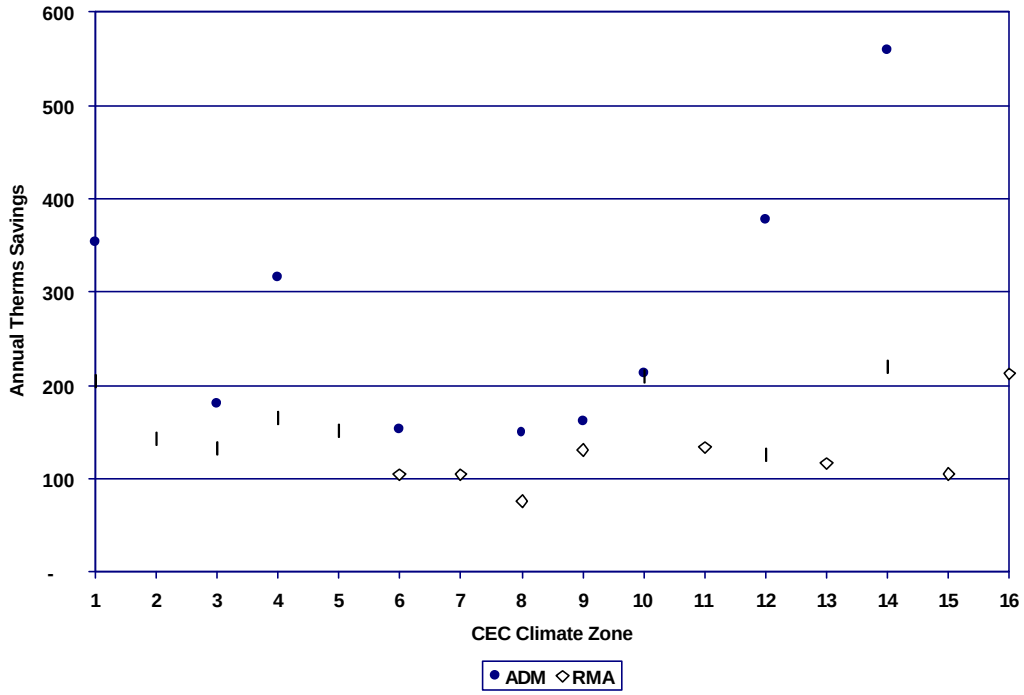

Figure C-20. ADM Engineering versus RMA Engineering Therm Savings Estimates for Attic and Wall Insulation Package

C.2.2.4 ADM vs. RMA Engineering Therm Savings Estimates for Programmable Thermostats

Figure C-21 shows the engineering estimates of therm savings for programmable thermostats developed by ADM and by RMA. The engineering estimates of therm savings for the attic and wall insulation package developed by ADM are higher than those developed by RMA for all climate zones.

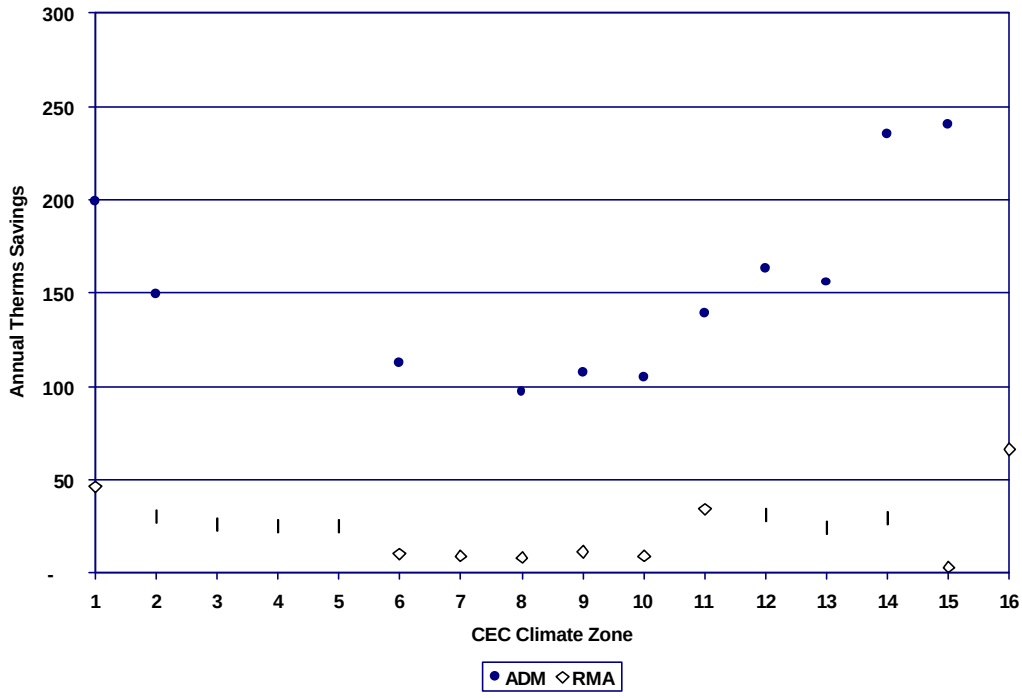

Figure C-21. ADM Engineering versus RMA Engineering Therm Savings Estimates for Programmable Thermostats

APPENDIX D: COMPARISON OF 2001 SURVEY RESULTS TO 1999 SURVEY RESULTS

This appendix provides tables with partial listings of indicators common to the 1999 and 2001 studies. Side-by-side comparison of the data for these indicators are provided so that readers may see how the indicators changed between the two years. Data are provided for three types of contractors: HVAC, window, and insulation. For each type of contractor, data are provided pertaining to non-participants (NP), partial participants (PP), and participants (P).

In a few cases the indicators are not quite equivalent. The 1999 version of the change questions asked for ratings of change in the last year while the 2001 study asked for the last two years. Where this occurs we have indicated that there were two options by inserting a (2 years).

Most of the questions in the 1999 study used 5 point scales but a few used a 10 point scale. We consistently used five point scales throughout the 2001 study. We did this to reduce the complexity for the respondents and to avoid potential problems with respondents being asked to respond on a 10 point scale but answering on a five point scale. Five or ten is always the high end of the scale, for example, a five would indicate the highest level of awareness.

Table D-1. Comparison of HVAC Indicators

Indicators	***1999***				***2001***		
	NP	***PP***	***P***		***NP***	***PP***	***P***
Central air conditioner SEER considered high efficiency	12.3 (0,17) n=49	12.5 (0.31) n=11	13.0 (0.17) n=23		12.1	12.7	12.9
Have changed opinion of what is high efficiency air conditioner in last year	2.6% (0.02) n=49	20% (0.02 n=11	1.0% (0.20) n=23		26% n=62	17% n=35	18% n=17
Change in opinion of efficiency levels is due to RCP	1.2% (0.05) n=7	14.8% (0.25) n=3	66.7 (0.47) n=2		23% n=13	16% n=6	100% n=16
Contractor ratings of cost effectiveness of SEER 12 air conditioners on a scale of 1 to 5	4.2 (0.17) n=48	4.9 (0.15) n=11	4.0 (0.27) n=23		4.09 0.16 n=69	4.15 0.15 n=34	4.05 0.11 n=62
Rating changed in the past year (2 years)	2.2% (0.02) n=48	17.5% (0.13) n=10	2.5% (0.03) n=23		19% (0.05) n=48	20% (0.05) n=10	21% (0.05) n=23
Contractor ratings of cost effectiveness of high efficiency heat pumps on a scale of 1 to 5	3.0 (0.96 n=4	2.8 (0.57) n=4	3.6 (0.22) n=10		3.29 0.19 n=68	3.64 0.25 n=28	3.14 0.20 n=56
Rating changed in the past year (2 years)	0.0% (0.00) n=10	8.9% (0.16) n=4	0.0% (0.05) n=4		19% n=7	17% n=7	15% n=7
Contractor ratings of cost effectiveness of AFUE 90 percent gas furnace on a scale of 1 to 5	3.6 (0.23) n=46	3.8 (0.48) n=11	3.2 (0.24) n=23		4.16 0.16 n=69	3.82 0.23 n=34	3.80 0.12 n=61
Ratings changed in the past year (2 years)	0.2% (0.01) n=45	17.5% (0.13) n=10	0.0 (0.00) n=23		19% n=	23% n=	18% n=
Change in opinion of cost effectiveness is due to RCP	8.3% (0.28) n=2	13.9% (0.35) n=2	36.0 (0.00) n=1		11% n=18	27% n=11	36% n=22
Contractor rating of cost effectiveness of duct services on a scale of 1 to 5	3.6 (0.19) n=46	4.3 (0.42) n=11	3.8 (0.31) n=23		4.03 0.24 n=69	3.65 0.25 n=34	4.17 0.20 n=61
Ratings changed in the past year (2 years)	22.0% (0.06) n=46	44.5% (0.17) n=10	43.9% (0.11) n=23		36% n=13	31% n=8	39% n=17
Changes in duct sealing procedures	23.9% (0.06) n=48	56.3% (0.16) n=11	56.1% (0.11) n=23		17% n=27	37% n=56	34% n=48
Changes are due to RCP training	0.0% (0.0) n=5	48.5% (0.22) n=6	84.6% (0.10) n=19		0% n=8	30% n=10	47% n=19
Contractor offers air conditioning maintenance services	98.6% (0.02) n=49	100% (0.0) n=11	100% (0. 0) n=23		83% n=72	74% n=35	69.0% n=61

Table D-1, continued. Comparison of HVAC Indicators

Indicators	***1999***				***2001***		
	NP	***PP***	***P***		***NP***	***PP***	***P***
Contractors consider changes in the distribution system that may effect the overall efficiency of the HVAC System	92.0% (0.04 n=49	100.0% (0.0) n=11	100.0% (0. 0) n=23		87% n=61	94% n=35	86% n=72
Contractors ratings of customer awareness of RCP on a 1 to 5 scale	3.45 (0.38) n=20	3.06 (0.77) n=9	3.26 (0.56) n=41		2.2 0.14 n=67	2.6 0.22 n=33	3.3 0.13 n=61
HVAC contractors' rating of RCP influence on customer demand for high efficiency equipment on a 1 to 5 scale	4.00 (0.62) n=22	3.29 (0.75) n=9	4.07 (0.61) n=19		3.1 0.11 n=71	3.4 0.24 n=34	3.9 0.11 n=61
Influence of RCP on customer demand for duct sealing on a 1 to 5 scale	3.50 (0.51) n=22	3.72 (0.85) n=9	4.44 (0.71 n=19		2.8 (0.19) n=68	2.9 (0.42) n=34	3.8 (0.31) n=61
Homes in the contractor's area that could still upgrade heating and cooling equipment for reasonable cost.	57.2% (2.80 n=49	82.4% (6.07) n=11	56.3% (4.38) n=23		39% 3.84 n=69	67% 4.18 n=34	66% 2.5 n=61
Owners likely to have the work done	24.2% (2.54 n=42	35.3% (7.50) n=11	38.5% (5.97) n=23		19% 2.48 n=67	32% 4.49 n=35	25% 2.10 n=58
Homes in the area that could still upgrade ducts for reasonable cost	57.2% (3.52 n=41	86.6% (5.31) n=10	56.3% (7.81) n=23		39% 3.84 n=69	67% 4.18 n=34	66% 2.5 n=61
Owners likely to have the work done	18.9% (2.26 n=39	24.6% (7.3) n=10	22.7% (5.5) n=23		18% 2.6 n=61	28% 3.6 n=28	23% 1.9 n=57
HVAC contractors would have trouble expanding service for HVAC retrofits	12.5% (0.05 n=39	16.4% (0.12) n=10	8.8% (0.06) n=23		14% n=73	14% n=35	10% n=10
HVAC contractors would have trouble expanding service for air conditioning maintenance	17.0% (0.05) n=48	13.6% (0.11) n=11	21.1% (0.09) n=23		15% n=72	9% n=35	10% n=61
HVAC contractors would have trouble expanding service for duct testing and sealing	6.8% (0.06) n=20	14.9% (0.13) n=9	9.1% (0.06) n=22		28% n=72	23% n=35	12% n=60
Would have trouble finding qualified labor	56.9% (0.07) n=49	59.8% (0.16) n=11	69.4% (0.10) n=23		46% n=72	50% n=34	44% n=61
Would have trouble finding high efficiency air conditioning and heating units	2.2% (0.02) n=49	0.0% (0.00) n=11	0.0% (0.00) n=23		8% n=72	3% n=34	5% n=61
Would have trouble acquiring diagnostic equipment	0.0% (0.00) n=20	0.00% (0.0) n=34	0.00% (0.0) n=22		7% n=72	0% n=34	5% n=61

Table D-2. Comparison of Window Indicators

Indicators	***1999***				***2001***		
	NP	***PP***	***P***		***NP***	***PP***	***P***
U-value considered energy efficiency by window contractors	0.62 (0.07) n=22	0.32 (0.02) n=6	0.34 (0.02) n=13		0.51 n=16	0.38 n=20	0.37 n=45
Have changed opinion of what U-value is considered energy efficient over past year (2 years)	40.9% (0.11) n=22	3.0% (0.8) n=6	13.3% (0.10) n=13		31% n=16	35% n=20	31% n=45
Cost effectiveness of windows with U-value of 0.4 or less on a 1 to 5 scale	3.7 (0.31) n=21	4.8 (0.21) n=6	2.9 (.42) n=13		4.5 (0.17) n=15	4.2 (0.14 n=20	4.0 (.14) n=43
Belief in cost effectiveness of windows with U-values of 0.4 or below changed in the past year (2 years)	27.4% (0.10) n=21	0.0% (0.00) n=6	16.9% (0.11) n=13		25% n=16	25% n=20	28% n=43
Above change due to RCP	0.0% (0.00) n=4	NA	78.4% (0.41) n=2		80% n=5	75% n=4	92% n=12
Customers more willing to install high performance windows	95.3% (0.03) n=44	91.9% (0.11) n=7	79.6% (0.11) n=15		25% n=16	25% n=20	28% n=43
Customers more willing to install high performance windows due to RCP	29.1% (0.07) n=41	86.3% (0.15) n=6	67.6% (0.14) n=12		77% n=15	79% n=14	77% n=17
Contractors' reports of customer beliefs of the cost effectiveness of windows with U-value of 0.4 or less on a 1 to 5 scale	2.6 (0.32) n=19	3.9 (0.13) n=6	3.3 (0.29) n=13		4.1 (0.16) n=16	4.2 (0.18) n=20	4.1 (0.16) n=45
Contractors' reports of that customer beliefs of the cost effectiveness of windows with U-value of 0.4 have changed	18.8% (0.09) n=19	9.5% (0.13) n=6	5.0% (0.06) n=13		31% n=16	30% n=20	24% n=45
Above change due to RCP	10.3% (0.22) n=3	0.0% (0.00) n=1	26.7% (0.44) n=2		60%	84%	89%
Window contractors' ratings of customer awareness of RCP on a 1 to 10 scale (1999) 1 to 5 (2001)	3.3 (0.45) n=24	4.5 (0.62) n=5	5.2 (0.65) n=15		3.1	3.3	3.4
Window contractors' ratings of RCP on customer demand 1 to 10 scale (1999) 1 to 5 (2001)	4.3 (0.57) n=24	2.9 (0.48) n=5	5.0 (0.36) n=15		3.1	3.5	3.8
Homes in the area could still upgrade for a reasonable cost	58.7% (2.64) n=42	54.3% (5.60) n=6	71.1% (5.09) n=15		41% (8.11) n=16	74% (3.38) n=20	72% (2.85) n=44
Owner likely to have window work done	27.5% (3.39) n=33	13.8% (3.28) n=6	48.1% (5.10) n=15		21% (5.04) n=16	30% (4.66) n=20	31% (2.86) n=43
Likelihood of having work done changed over the past year	72.3.3% (0.08) n=3	72.6% (0.20 n=1	85.3% (0.09) n=2		75% n= 16	75% n= 20	63% n= 45
Above changed in past year due to RCP	21.1% (0.007) n=3	8.0% (0.12) n=1	64.9% (0.13) n=2		45% n= 11	89% n= 15	80% n= 9

Table D-2, continued. Comparison of Window Indicators

Indicators	***1999***				***2001***		
	NP	***PP***	***P***		***NP***	***PP***	***P***
Contractor would have trouble expanding services	7.5% (0.04) n=47	0.0% (0.00) n=8	10.5% (0.08) n=15		13%	5%	4%
Contractor would have trouble obtaining high performance windows	0.4% (0.01) n=47	0.0% (0.00) n=15	0.0% (0.00) n=15		0%	6%	0%
Contractor would have trouble hiring qualified labor	40.6% (0. 07) n=47	77.8% (0.16) n=8	48.7% (0.13) n=15		19%	20%	38%

Table D-3. Comparison of Insulation Indicators

Indicators	***1999***				***2001***		
	NP	***PP***	***P***		***NP***	***PP***	***P***
Cost effectiveness of R-30 insulation in attics on 1 to 5 scale	4.08 (0.25) n=16	3.83 (0.39) n=7	4.70 (0.18) n=10		4.4 (0.23) n=17	3.8 (0.31) n=6	4.2 (0.19) n=14
Cost effectiveness of R-13 insulation in walls on a 1 to 5 scale	3.96 (0.34) n=16	4.09 (0.35 n=7	4.25 (0.20) n=10		4.1 (0.20) n=18	3.7 (0.42) n=6	3.4 (0.29) n=14
Contractors recommending more efficient insulation over the past year (two years) 2001 attic	33.1% (0. 12) n=16	23.8% (0.17) n=7	9.6% (0.10) n=10		26%	0%	36%
Contractors recommending more efficient insulation over the past year (two years) 2001 wall					16%	0%	36%
Contractors report that customer are more aware of the benefits of insulation with a higher R rating	45.7% (0.13) n=16	67.6% (0.19) n=7	88.2% (0.11) n=10		84% n=19	100% n=6	71% n=14
Contractors report increased customer awareness due to RCP	63.1% (0.15) n=11	0.0% (0.00) n=6	25.9% (0.20) n=6		37%	83%	100%
Contractors report customers are more willing to install attic insulation with higher R rating	87.3% (0.11) n=11	94.3% (0.10) n=6	81.8% (0.17) n=6		84%	50%	50%
Contractors report customers are more willing to install wall insulation with higher R rating					84%	33%	50%
Contractors perceptions of customers views of the cost effectiveness of R-30 insulation in attics on a scale of 1 to 5	3.25 (0.52) n=15	3.73 (0.48) n=5	4.09 (0.26) n=9		4.1 (0.44 n=18	4.7 (0.21) n=6	4.1 (0.25) n=14
Contractors perceptions of customers views of the cost effectiveness of R-30 insulation in walls on a scale of 1 to t	3.20 (0.51) n=15	3.68 (0.40) n=5	4.10 (0.22) n=9		2.3 (0.45) n=18	3.0 (0.45) n=6	3.0 (0.23) n=14
Insulation contractor influence of RCP on customer demand for attic insulation on R-3o attic insulation on a 1 to 10 scale 1999 and a 1 to 5 scale 2002	3.3 (0.98) n=11	1.1 (0.13) n=6	5.3 (0.98) n=10		2.9 (0.46) n=14	4.3 (0.33) n=6	3.5 (0.43) n=14
Insulation contractor influence of RCP on customer demand for attic insulation on R-3o attic insulation on a 1 to 10 scale 1999 and a 1 to 5 scale 2002	3.3 (1.03) n=10	1.0 (0.07) n=6	5.7 (1.03) n=10		2.5 (0.44) n=14	3.5 (0.43 n=6	2.5 (0.44) n=15
Contractors' reports of the percentage of homes in their area that could still upgrade attic insulation for a reasonable cost.	33.2% (7.03) n=14	40.6% (10.95) n=7	47.4% (5.68) n=10		23% 5.48 18	60% 11.11 6	64% 6.49 14
Contractors perceptions of the percentage of owners likely to have attic insulation upgraded	47.0% (7.06) n=13	67.8% (12.89) n=6	29.0% (5.43) n=10		21% 4.62 15	25% 6.91 6	23% 3.13 14
Homes in the area that could still upgrade wall insulation for a reasonable cost	38.6% (9.63) n=10	33.9% (11.73) n=7	56.3% (9.63) n=10		21% 5.97 14	61% 11.44 6	65% 5.56 14
Owners likely to have wall insulation upgraded	42.2% (7.96) n=14	62.5% (14.52 n=6	22.8% (3.85) n=14		18% (6.38) 15	21% (4.62) 6	23% (2,71) 14
Change due to RCP	0.00% (0.00) n=4	0.00% (0.00) n=1	68.2% (0.23) n=5		20%	67%	100%