

Customer Energy Efficiency Program
Measurement and Evaluation Program

1998 PG&E Comfort Home Program Market Baseline And Market Effects Study

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San Francisco, California

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As part of its Customer Energy Efficiency Programs, Pacific Gas and Electric Company (PG&E) has engaged consultants to conduct a series of studies designed to increase understanding of the efficacy of these energy efficiency programs. This report describes one of those studies. It represents the findings and views of the consultant employed to conduct the study and not of PG&E itself.

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Executive Summary

ES.1 Overview

This Executive Summary provides an overview of the PG&E Comfort Home (PCH) Program Market Baselines and Market Effects Study (PG&E Study ID #420) conducted by Regional Economic Research, Inc. The following sections present background on the PCH Program, enumerate the study objectives, discuss the data collection effort, summarize the study methodology, provide an overview of the residential new construction market, and summarize the results of the market baselines and market effects.

ES.2 Background and Objectives

The PCH Program is designed to increase energy efficiency in new homes through both midstream and downstream market transformation. Its midstream element consists of a variety of intervention strategies targeted at residential builders (i.e., advertising, training, education, and incentives), while its downstream component entails a comprehensive advertising campaign aimed at increasing homebuyer awareness of the importance of energy efficiency in new home purchase decisions. Two versions of the midstream element were offered in 1998. The Base Program, which was offered in the Central Valley, promotes the use of high efficiency air conditioning, tight duct sealing, natural gas cooking, gas dryer stubs, and high performance windows. The new PCH Plus Program, which is offered system-wide, encourages builders to exceed the Model Energy Code by 30%. Incentives cover the cost of the home energy rating required by the program.

The study was designed to achieve two central objectives:

- To characterize the residential new construction market in the PG&E service area, particularly as it relates to the market for energy efficiency, and
- To assess the near-term market effects of the 1998 PCH Program.

ES.3 Overview of Study Methodology

The methodology for this research consisted of a thorough literature review, the administration of a comprehensive set of surveys, interviews with key market actors, the development of market baselines, and the assessment of market effects. These elements of the analysis are described very briefly below.

Literature Review. A thorough literature review was conducted to support the market characterization, identify issues, assess methodologies, and collect evidence with respect to market transformation in general and the specific assessment of market transformation in the residential new construction (RNC) market. Data on market activity in the RNC market and suppliers' volumes and market shares were also obtained from trade association publications and other available sources to accommodate the analysis. Data on historical efficiency levels and shares of high efficiency equipment were obtained from a variety of sources, including shipments data, trade publications, PCH Program files, and the California Energy Commission's Post-Occupancy Residential Survey project.

Surveys and Interviews. The project team conducted telephone surveys of 760 residential customers split roughly equally among participants (residents of Comfort Homes), nonparticipants in PG&E's service area, and new home residents in a comparison area consisting of several service areas around the country. The team also conducted in-depth interviews of 31 builders in PG&E's service area and 51 builders in the comparison area. Finally, the team interviewed a wide variety of other market actors serving the PG&E service area, including window and HVAC manufacturers, distributors, contractors, Title 24 consultants, architects, lenders, sales agents, building inspectors, and government agency representatives.

Baseline Market Characterization. The baseline market characterization was based on a review of program materials, a review of literature relating to the market, surveys of customers, and interviews with market actors. The characterization includes a full description of the program, a comprehensive market characterization, a description of market barriers, a discussion of indicators that could be used to track market effects, and an analysis of program-related and efficiency-related attitudes and perceptions of key market actors.

Assessment of Market Effects. The assessment of market effects entailed testing a series of distinct hypotheses relating to the potential effects of specific program interventions to reduce key market barriers and the assessment of the sustainability of these effects. The tests of hypotheses relating to market effects are based on the analysis of the interviews and survey information collected from the market actors in the PG&E service area (with a fairly strong focus on the Central Valley). In addition, surveys of builders and consumers were conducted in a comparison area consisting of various regions of the country. These surveys were used to determine if the PCH Program has had a perceptible influence on builders' attitudes, perceptions, and behaviors relating to energy efficiency. Three kinds of evidence were used to test these hypotheses:

- **Self-Reported Impacts.** The review of program impacts self-reported by market actors in the PG&E service territory offered some evidence with respect to the market effects induced by the PCH Program. This included self-reported changes over time.
- **Simple Comparisons Across Groups.** As is traditional in market effects studies, comparisons across groups of market actors who were and were not exposed to the PCH Program helped to provide insights with respect to market effects attributable to the Program. In the case of customers (homebuyers), the analysis made use of comparisons of participants, nonparticipants in the PG&E service area, and customers in a comparison area consisting of 14 other service areas. For builder, attitudes and behaviors of builders in the PG&E service area were contrasted with those of builders in the comparison area.
- **Modeling Approach.** The simple comparison of responses of market actors inside and outside the PG&E service area is a traditional approach for the assessment of market effects. However, such comparisons could be distorted by other differences between the PG&E service area and the comparison area. As a result, an econometric modeling approach was used to control for these other differences between the PCH Program area and the regions of the comparison area. This allowed us to infer the net impacts of the PCH Program on key aspects of consumers' and builders' attitudes, perceptions and behaviors.

ES.4 Data

A substantial amount of information was collected from market actors to support a baseline market characterization and to discern market effects from the PCH Program. Both surveys and in-depth interviews were used to collect primary data on actions and perceptions of key market actors.

- First, open-ended telephone interviews were conducted with manufacturers, distributors, contractors, architects, Title 24 consultants, builders and developers, building inspectors, and government staff.
- Second, a more structured quantitative survey was used for sales agents, lenders, and consumers.

The sample design for the data collection effort targeted 795 telephone surveys and 145 in-depth interviews. The consumer surveys and the builder interviews were conducted within PG&E's service area and in the national comparison area.¹ The use of a national comparison area is a key feature of the analysis. The national comparison area was constructed by

¹ While some of the other interviews could also be performed in the comparison area, it is our judgment that the primary benefits of cross-area comparisons can be extracted by focusing on consumers and builders, the two market actors whose behavior is most central to the success of market transformation programs in the new construction market.

selecting 14 regions outside of California.² These regions were based on utility service territories and were used to stratify the sample of builders and nonparticipant consumers. The sample design required a completed sample of at least three builders and 15 consumers from each region, and a total completed sample of 50 nonparticipant builders and 255 nonparticipant consumers.

Table ES-1 presents the number of targeted, contacted, and completed surveys and interviews by market actor. As shown, RER completed 942 surveys and interviews (790 telephone surveys and 152 in-depth interviews). All targets were either met or exceeded, except for participant consumers. Table ES-1 also presents a summary of the response rate by market actor. The response rates for in-depth surveys vary from 17% to 88% with an overall rate of 34%. The response rates for the telephone surveys vary from 31% for nonparticipant consumers in the control area to 59% for sales agents. The overall response rate for the telephone surveys was 37%.

² These areas were in Arizona, Colorado, Florida, Georgia, Nevada, New York, North Carolina and Texas.

Table ES-1: Summary of Survey and Interview Response Rates by Market Actor

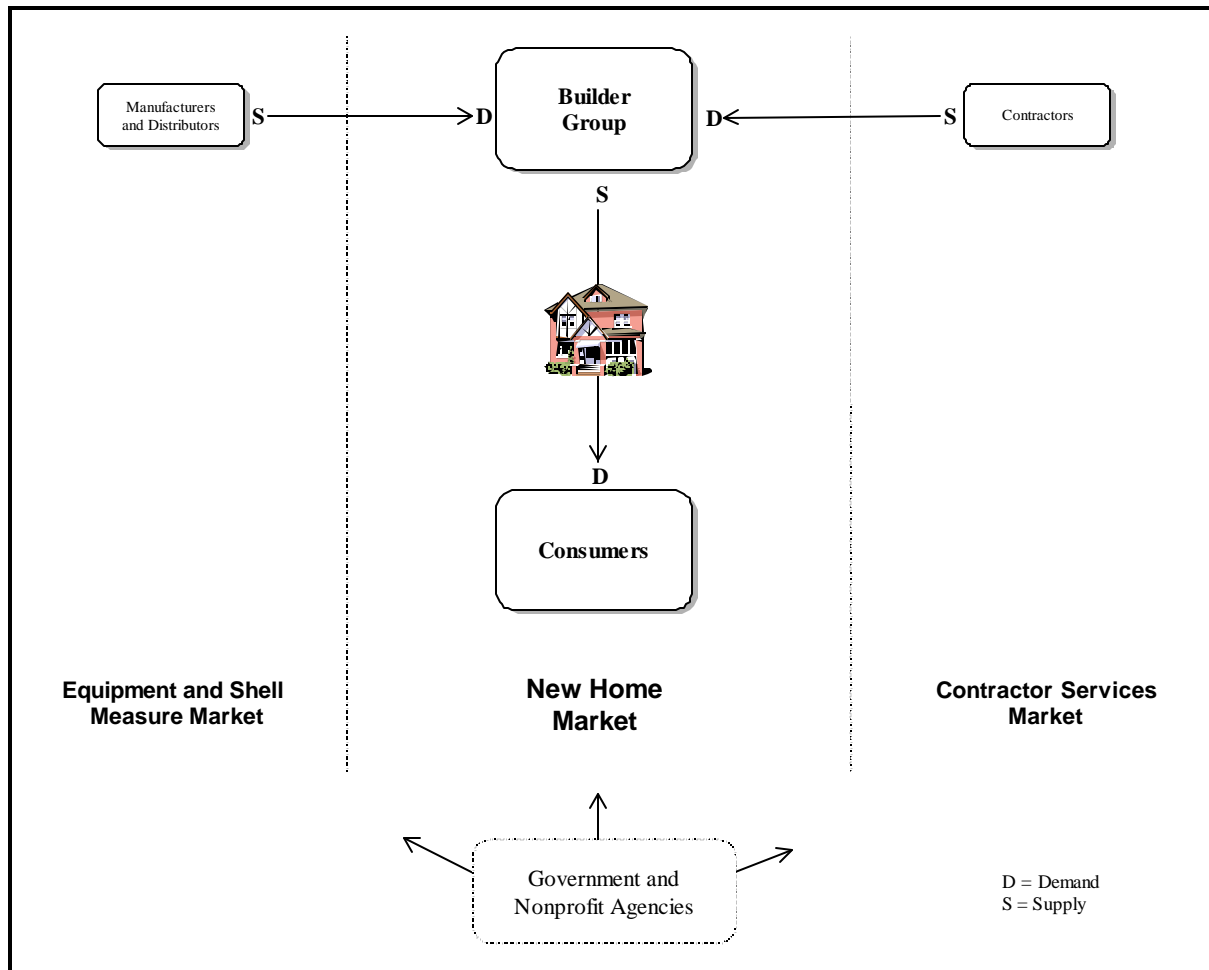
Market Actor	Target Interviews	Contacted	Completed Interviews	Response Rate
HVAC Manufacturers	5	8	5	63%
Window Manufacturers	5	12	6	50%
HVAC Distributors	5	11	5	45%
Window Distributors	5	13	5	38%
HVAC Contractors	5	30	5	17%
Window Contractors	5	10	5	50%
Architects	10	16	10	63%
Energy Consultants	5	8	7	88%
Builders in California	30	81	31	38%
Builders in Control Area	50	218	52	24%
Building Inspectors	10	14	10	71%
Government and Nonprofit Association Representatives	10	14	11	79%
<i>Total In-Depth Surveys</i>	<i>145</i>	<i>435</i>	<i>152</i>	<i>34%</i>
Sales Agents	20	34	20	59%
Lenders	10	23	10	43%
Participant Consumers	255	619	244	39%
Nonparticipant Consumers in California	255	633	256	40%
Nonparticipant Consumers in Control Area	255	828	260	31%
<i>Total Telephone Surveys</i>	<i>795</i>	<i>2,137</i>	<i>790</i>	<i>37%</i>

ES.5 The Market for Residential New Construction

Overview

Figure ES-1 provides an overview of the residential new construction market. As shown, the residential new construction market can be thought of as consisting of the new home market and two ancillary markets: the equipment and shell measure market and the contractor services market. Each of these ancillary markets consists of suppliers and demanders of the product, and each is affected by various government and non-profit agencies.

Figure ES-1 : The Market for Residential New Construction



The New Home Market. The new home market is the dominant sub-market in residential new construction, as the commodity bought and sold is the actual completed home. Builders and those directly involved in the design and construction of the new home (referred to here as the “builder group”) play the dominant supply side role and homebuyers play the demand-side role in the new home market. During the process of producing their product (a new house), builders rely on a number of transactions with other market actors, including contractors, distributors, architects, lenders, and Title 24 consultants.

The Market for Equipment and Shell Measures. The markets for HVAC equipment and windows are of particular relevance here, as these measures were covered by the 1998 PCH Program. In this market builders (or the builder group) are the primary demand-side actors in this market as they purchase the central air conditioning units, furnaces, and windows to be installed in the new homes. Manufacturers are the ultimate suppliers of these products, though the contractor and/or builder might purchase them through a distributor. Manufacturers also supply information to distributors, contractors, and builders. This

information concerning new product development, pricing, service, reliability, and efficiency mixes assists the demand-side actors in making informed decisions.

The Market for Contractor Services. Builders, or the builder group, play a demand-side role and contractors play a supply side role in the market for contractor services. Specifically, builders rely heavily on HVAC contractors to provide HVAC equipment, to install the HVAC system, and, in some cases, to perform diagnostics. Other contractors assisting in the building process include window contractors and Title 24 energy consultants, who work with the builder to ensure compliance with Title 24 and to prepare the required documentation.

Government and Nonprofit Agencies. Government and nonprofit agencies have a broad influence on all market actors. The government influences builders directly through the imposition of minimum energy efficiency standards, and compliance with these standards is recorded by building inspectors. Numerous government and nonprofit organizations exist to support and influence various other market actors by means of research and informational programs, professional associations, and consumer advocacy groups.

Market Actors

The following market actors play significant roles in the new construction and auxiliary markets:

- **Builders.** Builders have the ultimate responsibility for coordinating the other actors and making final decisions with respect to the specification and construction of new homes. Builders include both production builders and customer home builders. Production builders are typically larger corporations with various departments and managers sharing the decision-making responsibilities, while custom builders tend to be smaller companies or individual contractors.
- **Architects.** Builders employ architects to design the home and prepare the building plans for inspection. While most builders hire an outside architect or architectural firm, large national builders typically have an in-house architecture department.
- **Sales Agents.** Builders' sales agents facilitate the sale of the home and are responsible for all transactions between the consumer and the builder or developer.
- **Lenders.** Lenders can provide financing for both consumers and builders. Some lenders specialize in mortgages for new residential construction. These are usually mortgage companies specializing in new housing mortgages, a division of a mortgage company, or a mortgage company owned by a builder.
- **Consumers.** Consumers represent the demand-side of the market for residential new construction. However, as the final end users of these products, they are the ultimate beneficiaries of the utilization of these products.

- **HVAC Equipment Manufacturers.** HVAC equipment manufacturers produce a variety of heating and cooling equipment for the residential sector. They are also a source of information for purchasers of this equipment.
- **Window Manufacturers.** Firms in the industry vary in structure and product line. Many tend to be small firms that sell their product regionally, while the largest window manufacturers distribute their products internationally.
- **HVAC Equipment Distributors.** HVAC equipment distributors function as intermediaries between manufacturers and HVAC contractors.
- **Window Distributors.** Window distributors in the residential new construction industry function as intermediaries between manufacturers and contractors or builders – the link between the window supply and demand markets. Window distributors sell new construction products primarily to builders and contractors, and sell to retail and building supply outlets for replacements and retrofits.
- **HVAC Equipment Contractors.** HVAC contractors are employed by builders to design, select, purchase, and install all HVAC system materials and components.
- **Window Contractors.** Window contractors are typically retained by either builders or window manufacturers to install windows in new homes.
- **Title 24 Consultants.** Title 24 consultants work with builders, architects, and sometimes HVAC contractors to ensure compliance with California's Title 24 energy efficiency standards.
- **Building Inspectors.** Building inspectors are responsible for ensuring that all new residential buildings comply with both state and federal building codes.
- **Government and Nongovernment Agency Representatives.** Both government and nongovernment organizations influence the residential new construction market

Baseline Attitudes, Perceptions, and Market Barriers

The report provides considerable information on attitudes and perceptions of all of the key market actors in the residential new construction market. Further, most of the specific market barriers targeted through the PCH program were confirmed in the course of the analysis. These barriers include asymmetric information, performance uncertainties, organizational practices, access to financing, product unavailability, information search costs, hassle costs, and split incentives. Split incentives arguably constitute the primary barrier in residential new construction. However, all of these barriers can potentially hinder the adoption of energy efficiency in new construction.

ES.6 Market Effects Indicators

To support the assessment of market effects, it is useful to identify and measure a number of market effects indicators, including market shares of relevant high efficiency technologies and baseline attitudes and perceptions of key market actors.

Market Shares

Market share data for the technologies relevant to this study (energy efficient central air conditioners, high performance windows, and duct sealing) were collected and reviewed for their usefulness for constructing historic market shares. The development of measure baselines was only partly successful. General conclusions follow:

- Measure baselines for air conditioners are relatively good for the years prior to 1994, but nonexistent in more recent years.
- No recent data on window efficiencies are available. Data on frame type, number of panes and glazing type were transformed into U-values and SHGC for the years 1990 through 1994 using rules-of-thumb.
- We were unable to find any reliable data on duct leakage or duct sealing practices, other than from the in-depth surveys. We did however infer the share of new homes that have had duct testing.

The report also provides suggestions for filling gaps in the historical data and for tracking measure shares for use in the assessment of the PCH Program.

Other Market Effects Indicators

Other market effects indicators that could be tracked to assess the PCH Program were identified throughout the report. These market effect indicators are summarized below:

- **Builders.** Awareness of energy saving technologies, importance of various reasons for not exceeding code, changes in building practices, and perceptions of buyer demand.
- **Architects.** Awareness of energy saving technologies, awareness of Title 24, awareness of the program, changes in business practices, and proportion of homes designed that exceed Title 24.
- **Sales Agents.** Awareness of Title 24, proportion of homes sold that exceed Title 24, awareness of energy saving technologies, awareness of energy efficient mortgages, perceptions of consumer demand, and perceptions of marketability of energy efficiency.
- **Lenders.** Awareness of energy efficient mortgages, proportion of energy efficient mortgages written and changes in business practices.

- **Customers.** Awareness of energy efficiency options, awareness of ENERGY STAR[®] and energy efficient mortgages, the importance of energy efficiency, intentions to opt for energy efficient equipment and homes in the future, and (perhaps most important) willingness to pay for higher levels of efficiency.
- **HVAC Manufacturers.** Changes in efficiency level mixes, awareness of the program, changes in stocking and distribution practices, changes in research and development investments and changes in manufacturing processes.
- **HVAC Distributors.** Changes in efficiency level mixes of HVAC equipment sold, awareness of the program, and changes in the following. inventory and distribution practices, sales and marketing, and sources of information relating to efficiency standards and energy efficiency programs.
- **Window Manufacturers.** Changes in the relative distribution of performance indicators of windows sold including include U-factors, SHGC, and the number of panes in the window assembly; awareness of the program; changes in stocking and distribution practices, research and development investments, and manufacturing processes.
- **Window Distributors.** Changes in efficiency level mixes of windows sold, awareness of the program, and changes in the following. inventory and distribution practices, sales and marketing, and sources of information relating to efficiency standards and energy efficiency programs.
- **HVAC Contractors.** Participation in utility sponsored training, sources of information, awareness of the program and energy saving technologies, ranking of market barriers, estimated market shares of high efficiency air conditioners, and building practice changes.
- **Window Contractors.** Awareness of the latest available performance factors for windows, primary sources of information, perceived barriers to the installation of high performance windows in new homes, changes in the proportion of high performance windows installed by contractors, and awareness of the program.
- **Title 24 Consultants.** Awareness of energy saving technologies, sources of information, awareness of the program, and changes in business practices.

ES.7 Tests of Market Effects Hypotheses

The following results emerged from the tests of specific hypotheses relating to the potential short-term market effects of the PCH Program.

Effects on Builders

The analysis suggests the following:

- The PCH Program does seem to have increased builder awareness of duct testing. Moreover, the PCH Program and its predecessors have apparently diminished lack

of information and hassle costs to the point where these are no longer perceived as serious barriers.

- While builders appear to have changed construction and marketing practices as a result of the PCH Program, these changes are strongly dependent on the presence of the PCH Program (especially its incentives), and may not be sustained in the absence of the PCH Program. Moreover, only a minority of participants would continue with the PCH Program in the absence of incentives.
- While the PCH Program has offered marketing support for the promotion of Comfort Homes, it has not convinced builders that customers are willing to pay for energy efficiency. On average, PG&E builders estimate that home buyers are willing to pay for only 31% of the cost of improving efficiency in new homes. Changing this fact (whether it is reality or perception) is the key challenge of future programs.

Effects on Architects

The in-depth interviews with architects provided the following insights:

- There are no sustainable market effects in the form of increased awareness attributable to the program among architects. Architects tend to be aware of the latest technologies and obtain the majority of their technical information from resources other than program participation.
- There appears to be weak support for sustainable changes in business practices attributable to the program. This finding is based upon one interview respondent who reported basing plans on PCH program specifications. This respondent explained that homes built to PCH specifications were highly marketable and builders took advantage of this marketability, even without formal participation in the program.

Effects on Sales Agents

The telephone survey of builder's sales agents revealed the following:

- Sales agents with program experience are no more aware of energy-saving features or of energy efficient mortgages than are agents with no program experience. However, some evidence was found that agents with program experience are more aware of Title 24.
- Similarly, agents with program experience perceived no more demand for energy-saving features from consumers than did agents with no experience with the PCH Program. Likewise, program agents did not perceive energy efficiency as any more marketable as a new home feature than did non-program agents.

Effects on Lenders

Information from the telephone survey of lenders suggests the following.

- In general, lenders are typically unaware and inexperienced with mortgages for energy efficient homes. Specifically, none of the lenders interviewed are currently writing such mortgages and only one had done so in the past.
- The lenders that are aware of energy efficient mortgages know them as FHA upgrades, indicating their information source is something other than the PG&E or ENERGY STAR[®] programs.

Effects on Customers

The program has also targeted customers (new home buyers). Its effects on buyers are summarized below:

- The PCH Program (and others preceding it) seems to have had a modest impact on homebuyers' awareness of the benefits of energy efficiency, in principle.
- The PCH Program may have had an impact on customers' awareness of ENERGY STAR[®], but attribution of this effect is problematic and the general level of awareness is still quite low.
- PG&E new homebuyers are marginally more aware of the existence of energy efficient mortgages, but the level of awareness is still low.
- PG&E customers are marginally more likely to look for energy efficiency in their next home, but attribution of this tendency to the PCH Program is weak.
- While the PCH Program appears to have given participants positive experiences with energy efficient homes, it does not seem to have significantly changed the willingness of either participants or other homebuyers in the service area to pay premiums for higher levels of efficiency.

Effects on HVAC Manufacturers

The in-depth interviews with HVAC manufacturers revealed the following:

- There is evidence of evidence of market effects in the form of increases in the percentage of high efficiency HVAC units shipped to central and northern California. This evidence is fairly strong for central air conditioners, but weak for gas furnaces.
- Other changes in the HVAC equipment market include some changes in inventory and distribution practices. Though most manufacturers agreed that rebates strongly influence the percentage of high efficiency units that are shipped nationwide, these apparent market effects were not attributed specifically to the PCH program.
- There was consensus among manufacturers that demand for high efficiency equipment will decrease (from "slightly" to "dramatically") when programs promoting the units are discontinued. Thus, at this point, evidence from

manufacturers suggests that the sustainability of any detectable market effects will be weak at best.

Effects on HVAC Distributors

The analyses of information collected from HVAC distributors indicate the following:

- There is evidence of market effects in the form of increases in the percentage of high efficiency HVAC units sold by distributors in Central and Northern California. While interview respondents agreed that they sell a greater percentage of high efficiency HVAC units now than in the past, few could claim that energy efficiency program incited such changes.
- The strongest influences on efficiency mixes of HVAC equipment are energy efficiency standards, quality of the equipment, though one company did increase stock of high efficiency units to accommodate contractor orders under energy efficiency programs. Regardless of the cause, most distributors also agreed that the proportion of high efficiency equipment is likely remain stable or increase in the future.

Effects on Window Manufacturers

The in-depth interviews with window manufacturers revealed the following results:

- Evidence was found to support market effects in the form of increases in the proportion of high performance windows. However, these effects are not attributable to the PCH Program. Window manufacturers attributed these changes to state standards, technological advancement, demand for further sound reduction, and general recognition of and demand for energy efficiency.
- Efficiency programs – the ENERGY STAR[®] programs in particular – had some influence in manufacturers broadening product lines and changing product designs for program eligibility. Some manufacturers also instituted changes in inventory and manufacturing practices in efforts to decrease production and operating costs that were not facilitated by market intervention strategies. Because the changes identified are viewed as industry and technological advancement, window manufacturers anticipate that they will be sustained and continue in the future irrespective of energy efficiency program offerings.

Effects on Window Distributors

The results of the window distributors interview analyses suggest the following:

- There is no evidence of market effects relating to increased availability of high efficiency windows or changes in standard inventory, sales, or marketing practices of distributors. This could be due to the fact that two of the largest distributors in the sample sell exclusively for the same manufacturer, who produces only high efficiency units.

- Because only about 30% percent of windows installed in the residential new construction market in the study area are sold through distributors, it is not surprising that their business has not been affected by the PCH or energy efficiency programs, in general.

Effects on HVAC Contractors

The analyses of information collected from HVAC distributors indicate the following:

- PG&E-sponsored training sessions are well attended by HVAC contractors. Further, contractors indicate that the sessions provide a valuable source of information on high efficiency equipment and energy-efficiency standards and programs.
- It was also obvious from the interviews that lessons learned and materials provided by PG&E were utilized to improve duct-sealing methods. One contractor specifically cited PG&E's Duct Installation Standards Manual as an excellent resource that provides "*good pictures and useful information that is easy to disseminate.*"
- Most contractors mentioned that they have incorporated lessons learned from duct blaster testing into their procedures. In particular, all contractors indicated that even after discontinuance of the program they would continue using the sealing methods (excluding duct blaster testing) they had learned and incorporated as a result of PCH.
- The majority of HVAC contractors indicated that in the absence of the program, air conditioner efficiency levels would decrease back to the Title 24 minimum 10 SEER.

Effects on Window Contractors

The results of the window contractors interview analyses suggest the following:

- There appears to be no evidence of market effects relating to increase awareness of high performance technologies, lower information costs, and reduced performance uncertainties that can be attributed directly to the PCH Program. While contractors did report changes in the relative proportions of high performance windows installed in the past several years, these changes are primarily due to changes in the state energy efficiency standards and consumer demand for comfort.

Effects on Title 24 Consultants

The analyses of Title 24 consultants' in-depth interviews suggest the following:

- Title 24 consultants tend to be aware of the latest technologies. However, they obtain the majority of their technical information from resources other than through program participation.

- The only reported changes in business practices attributable to the program are directly tied to program requirements (mainly required paperwork and diagnostics). These practices are assumed to cease with the ending of the program. It is worth noting two reported permanent changes in business practices not attributable to the PCH Program. That is, the offering of an ENERGY STAR[®] turn key program and HVAC contractors offering Title 24 services for builders installing their equipment.

1

Introduction

1.1 Background

This report presents the results of an assessment of the PG&E Comfort Home (PCH) Program. The PCH Program is designed to increase energy efficiency in new homes through both midstream and downstream market transformation. Its midstream element consists of a variety of intervention strategies targeted at residential builders (advertising, training, education, and incentives), while its downstream component entails a comprehensive advertising campaign aimed at increasing homebuyer awareness of the importance of energy efficiency in new home purchase decisions. Two versions of the midstream element were offered in 1998. The PCH Base Program, which was offered in the Central Valley, promotes the use of high efficiency air conditioning, tight duct sealing, natural gas cooking, gas dryer stubs, and high performance windows. The new PCH Plus Program, which is offered system-wide, encourages builders to exceed the Model Energy Code by 30%. Incentives cover the cost of the home energy rating required by the program.

1.2 Research Objectives

The general purpose of the study was to support the analysis and refinement of the PCH Program. The study had two primary objectives:

- To characterize the residential new construction market in the PG&E service area, particularly as it relates to the market for energy efficiency, and
- To assess the near-term market effects of the 1998 PCH Program.

1.3 Methodology

The analysis consisted of a thorough literature review, a comprehensive set of surveys and interviews of market actors, the development of market baselines and the assessment of market effects. These elements of the analysis are summarized below.

Literature Review. A thorough literature review was conducted in order to support the market characterization, identify issues, assess methodologies, and collect evidence with

respect to market transformation in general and the specific assessment of market transformation in the residential new construction (RNC) market. Data on market activity in the new construction market and suppliers' volumes and market shares were also collected from trade association publications, and other available sources to accommodate the analysis. Data on historical efficiency levels and shares of high efficiency equipment were obtained from a variety of sources, including shipments data, trade publications, PCH Program files, and the California Energy Commission's Post-Occupancy Residential Survey project.

Surveys and Interviews. The project team conducted telephone surveys of 760 residential customers, roughly equally split among participants (residents of Comfort Homes), nonparticipants in PG&E's service area, and new home residents in a comparison area consisting of several service areas around the country. The team also conducted in-depth interviews of 31 builders in PG&E's service area and 51 builders in the comparison area. Finally, the team interviewed a wide range of other actors serving the PG&E service area, including window and HVAC manufacturers, distributors, contractors, Title 24 consultants, architects, lenders, sales agents, and government staff.

Baseline Characterization. The baseline characterization was based on a review of program materials, a review of literature relating to the market, surveys of customers, and interviews of market actors. The characterization includes a full description of the program, a comprehensive market characterization, a description of market barriers, a discussion of indicators that could be used to track market effects, and an analysis of program-related and efficiency-related attitudes and perceptions of key market actors.

The Assessment of Market Effects. The assessment of market effects entailed testing a series of distinct hypotheses relating to the potential effects of specific program interventions on key market barriers and the assessment of the sustainability of these effects. These tests were based primarily on the surveys and interviews, and consisted of several kinds of evidence: self reports relating to PCH Program effects by market actors; comparisons of participating and nonparticipating customers, comparisons of customers and builders in the PG&E service area with those sampled in the comparison area; and the application of a set of statistical models designed to control for other differences in market conditions and respondent features across areas.

1.4 Report Organization

The remainder of this report is organized as follows:

- Section 2 describes the PCH Program as well as other initiatives targeting energy efficiency in the residential new construction market.

- Section 3 discusses the design of the surveys used to collect information used in this study.
- Section 4 presents the baseline characterization of the market for energy efficiency in residential new construction.
- Section 5 presents the results of several tests of hypotheses relating to the near-term market effects of the PCH Program.
- Section 6 summarizes the results of the study and offers several conclusions.
- Appendix A presents a list of references.
- Appendix B presents trade associations and related organizations.
- Appendix C provides the survey instruments and interview guides.
- Appendix D includes results of builder and consumer regression analyses.

2

Residential New Construction in the PG&E Area: Programs, Market Size, and Standards

2.1 Introduction

This section provides some background information on the residential new construction market in the PG&E area. Some background and information on the PCH Program is presented in Section 2.2, along with information on single family residential new construction during the course of the program. Section 2.3 presents an overview of the EPA's ENERGY STAR[®] New Homes Program and home energy rating systems. Furthermore, information on the Title 24 energy code and the International Energy Conservation Code (formerly the Model Energy Code) is discussed in Section 2.4.

2.2 PG&E Comfort Home Program

The PG&E Comfort Home (PCH) Program was designed to encourage residential builders to construct homes exceeding state energy efficiency standards. In addition to the use of media advertising, education, and training seminars, financial incentives were offered to builders or owners who installed a set of energy efficient measures in new single family detached houses.

This program description starts with a brief background describing the evolution of the program from 1992 through 1998 and the residential new construction market in the PG&E service territory. Then, a discussion of the energy efficient products targeted by the 1998 PCH Program is presented, including a description of program qualifications and related incentives. Also provided is a description of the targeted customer market. As the program was designed to target certain market barriers, a discussion of these barriers and the strategies designed to mitigate them is included. Finally, a description of the implementation of the program and its resulting accomplishments is presented.

Background

The Comfort Home Program

The PCH Program started in 1992 and was marketed directly to builders across PG&E's entire service territory. The various measures targeted included the following:

- A decrease in base-case Title 24 cooling by at least 10%,
- Shell measure upgrades and evaporative coolers or whole house fans,
- Natural gas appliances for cooking, clothes drying, space heating and water heating exceeding Title 24 by at least 10%,
- High efficiency ducts (optional bonus),
- Reduced size of central air conditioner (optional bonus), and
- Enhanced case air conditioning unit of 12.5 or less and at least 15 SEER (optional bonus).

The program continued in 1993 in a similar fashion. The 1994 program was redesigned to target both builders and consumers, and the targeted market area was reduced to include only the Central Valley area. Builders received incentives, and homebuyers received coupons for energy efficient appliances. The targeted measures were refocused to include only air conditioning, high efficiency ducts, lighting, and natural gas appliances. In addition, the incentives included rebates that could be passed to the homebuyer.

In 1995, incentive levels were significantly reduced¹ in order to allocate a greater portion of the program budget to consumer related advertising. In 1997, an additional measure was added: fluorescent bathroom lighting. The program continued to be marketed primarily to the Central Valley region with little other changes.

In 1998, a two-tiered program was introduced. The original Base Program level was modified to include an energy efficient windows bonus component, while a second tier called the PCH Plus Program was marketed to a broader geographical base. This second tier offered additional builder incentives for complying with the EPA ENERGY STAR[®] New Homes Program.

Single Family Residential New Construction in the PG&E Service Area

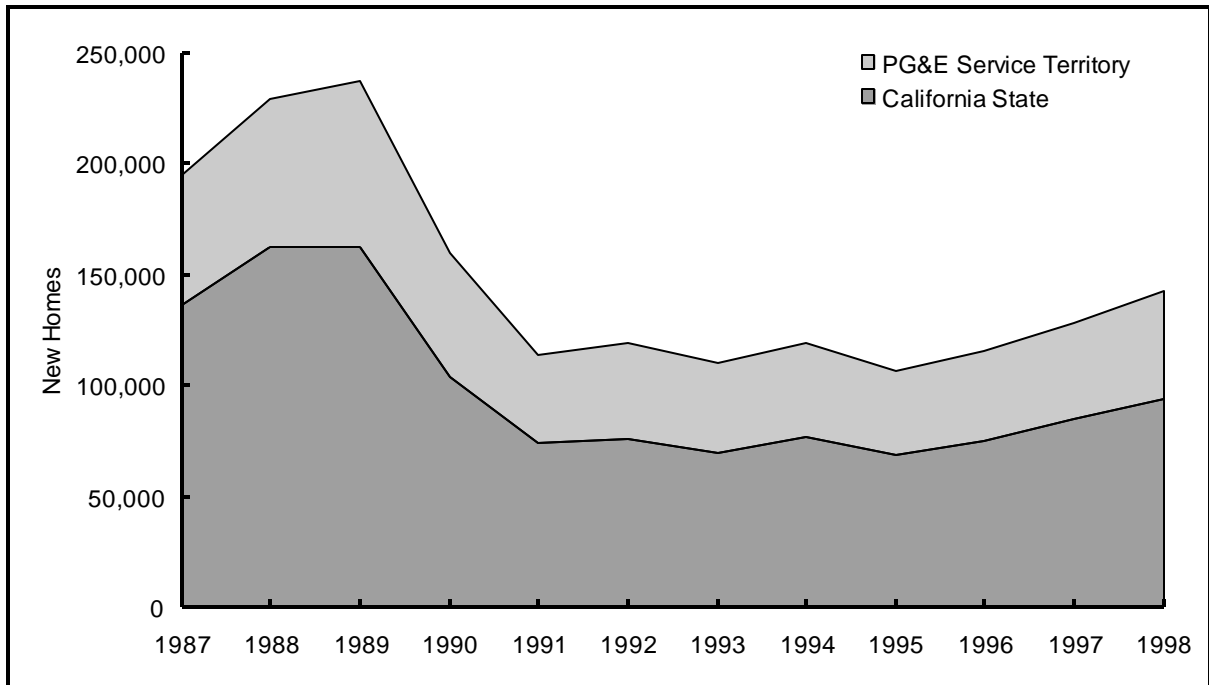
In assessing the impacts of the PCH Base and Plus Programs, it is useful to understand the recent history of residential new construction in the different areas. These trends could affect the willingness of developers to incorporate energy efficiency into their offerings, and

¹ According to a PG&E representative, incentive levels were approximately \$3,000 before 1995 and have since dropped to roughly \$400.

influence both baseline efficiency levels and the impacts of utility programs. This section reviews the volume of single family housing starts.

Figure 2-1 presents the total number of new single family housing starts for California and the PG&E service territory from 1987 to 1998.² As illustrated, the PG&E service territory accounts for approximately 43% of the 1987 total new single family housing construction market in California. By 1998, this rises to nearly 52%. Single family new housing starts statewide declined significantly in 1989 and 1991. The number of state permits issued in 1989 totaled around 162,650, compared to almost 73,810 permits issued in 1991. This represents an average annual decline of approximately 17,340 permits or almost 26.9%. Statewide, the average annual decline was 32.6%. Single family new construction was fairly stable between 1991 to 1995 and, according the last three years, looks to be on the upswing. All supporting values are presented in Table 2-1.

Figure 2-1: Total Single Family New Housing Units – California Comparison

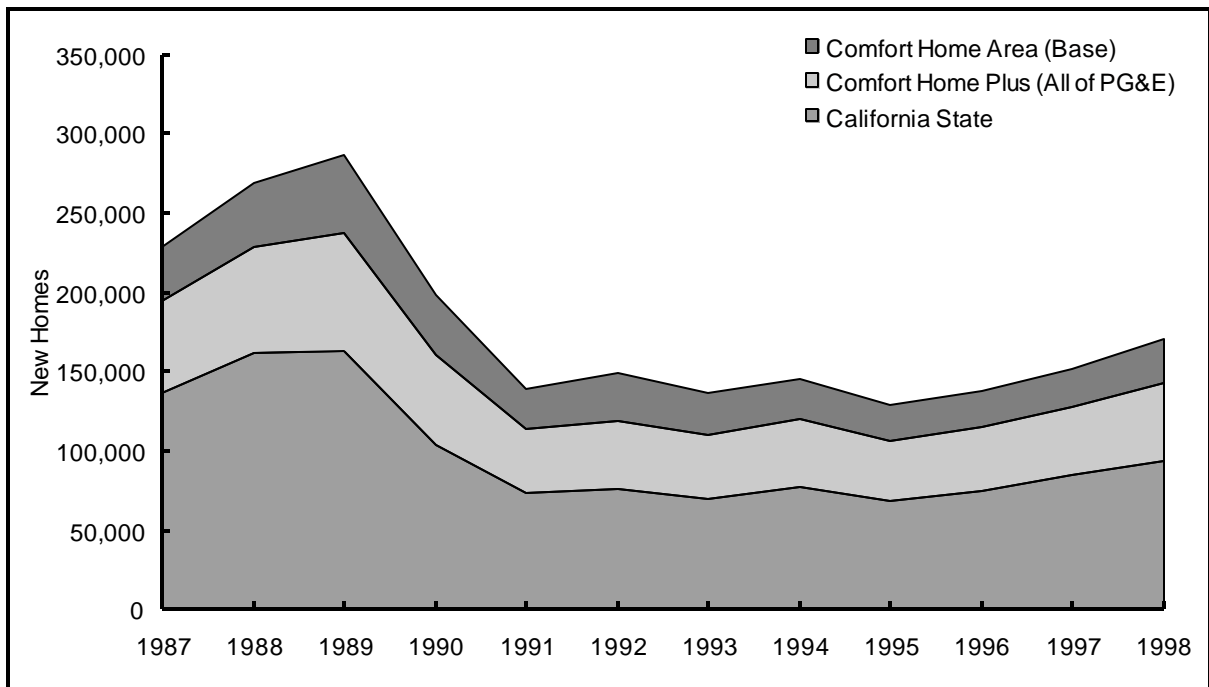


² New housing starts are developed from data on building permits issued by the Construction Industry Research Board, Burbank, CA.

The Base Program targeted the residential new construction market in the Central Valley region (CEC weather zones 11, 12, and 13).³ The Plus program was offered to all those in the PG&E service territory. Figure 2-2 illustrates the total single family new housing permits in the Base and Plus Program regions along with all of California.

In 1993, there were approximately 26,900 single family permits issued in the Central Valley region compared to the entire PG&E service territory of around 40,170 permits. When the Plus Program was introduced in 1998, there were nearly 28,390 permits issued in the Base Program area and over 48,600 in the entire service territory (the Plus Program region). Statewide, there were more than 93,960 single family permits issued in 1998.

Figure 2-2: Total New Single Family Housing Units – Program Comparison



³ California Climate Zone Descriptions for New Buildings Directory (P400-95-041), California Energy Commission, July 1995.

Table 2-1: Total Single Family Permits Summary

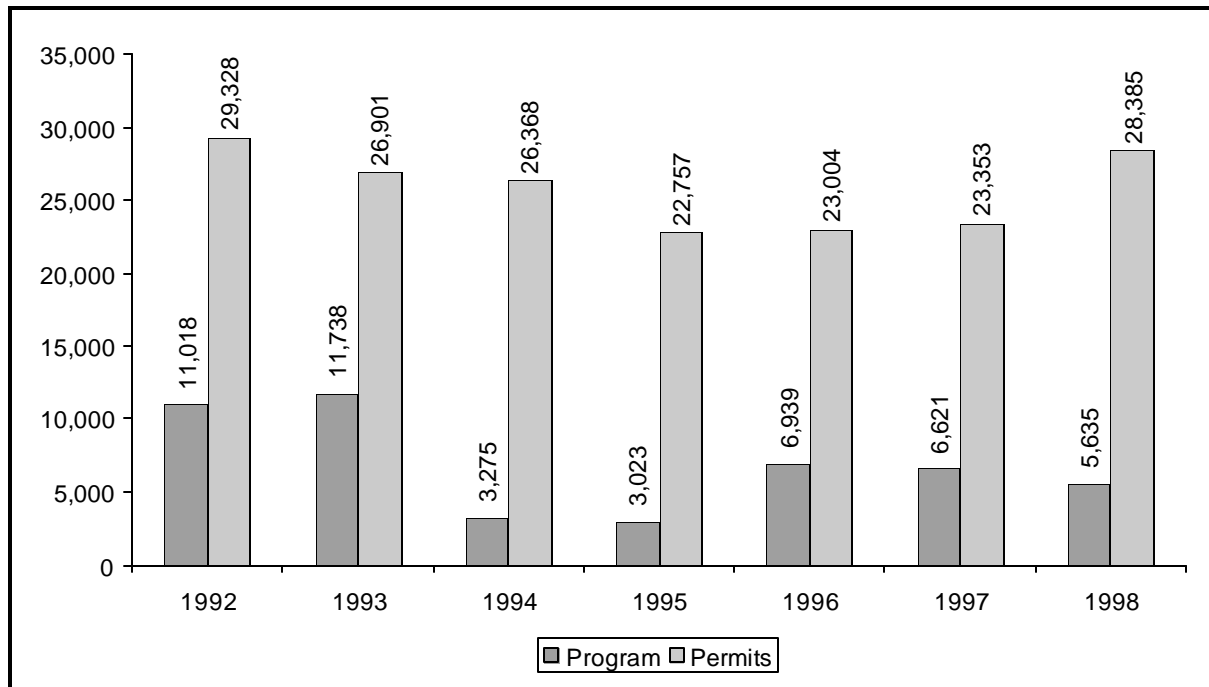
Year	California	PCH Base Program Region⁴	PCH Plus Program Region⁵	PCH Base Program Committed Units
1987	136,128	33,800	58,214	
1988	162,167	40,453	66,787	
1989	162,651	48,904	74,577	
1990	103,819	38,073	56,087	
1991	73,809	25,661	39,895	
1992	76,187	29,328	43,097	11,018
1993	69,901	26,901	40,170	11,738
1994	77,115	26,368	42,276	3,275
1995	68,689	22,757	37,445	3,023
1996	74,923	23,004	40,150	6,939
1997	84,780	23,353	43,069	6,621
1998	93,693	28,385	48,601	5,635

The number of homes built under the PCH Program varied across years. The last column in Table 2-1 presents the committed units for each of the Base Program years. These units represent accepted builder applications for homes to be built under the program. Figure 2-3 compares the committed program units with single family permits for the Base Program area.

⁴ The PCH Base Program region includes the Central Valley region (CEC weather zones 11, 12, and 13).

⁵ The PCH Plus Program region includes the entire PG&E service territory. The permits displayed in this column include the permits in the PCH Base Program region.

Figure 2-3: PCH Base Program Units and Single Family Permits



Targeted Products

Base Program

The 1998 PCH Base Program required the installation of a set of energy efficient measures, including the following:

- High efficiency air conditioning units,
- Enhanced HVAC ducts,
- Natural gas cooking equipment, and
- Natural gas dryer stubs.

The program required that all four measures be installed to qualify for the incentive.⁶ One incentive was paid for the set of measures which ranged from \$225 to \$400 depending on how much greater the SEER rating of the installed air conditioning unit was above Title 24 compliance.⁷ Table 2-2 lists the incentive levels and their relative SEER ratings.⁸

⁶ If the home existed in an area that did not receive gas from PG&E, a reduced incentive was available which did not require the installation of the cooking equipment or dryer stub.

⁷ Title 24 Compliance was required to be performance based.

⁸ PG&E. *Comfort Home 1998 Application Instructions*, June 1998.

Table 2-2: Incentives Paid for Equipment with Increased SEER Ratings

SEER Increase Above Title 24 Compliance	Incentive
3.0 or greater	\$400
2.0 – 2.9	\$325
1.5 – 1.9	\$225

Optionally, an additional bonus incentive of \$150 or \$200 was available for installing windows that meet the ENERGY STAR[®] performance requirements. As compliance with the Title 24 energy codes was required to be performance based for PCH homes, the amount of the paid incentive was based on the U-factors used for Title 24 compliance.

Table 2-3 lists the incentive levels and their relative Title 24 compliance ratings.

Table 2-3: Incentives Paid for Window Upgrades

Title 24 Compliance U-Factor	Incentive
0.50 – 0.64	\$150
0.65 or greater	\$200

The average incentive paid in the 1998 PCH Program was \$400. Each of the required measures is described in more detail below.

Central Air Conditioning (CAC). The program called for installation of conventional single-speed or two-speed air conditioners. In areas where natural gas is unavailable, air-to-air heat pumps were allowed. Each installed CAC unit needed to be properly sized for the home and exceed the rating used in the Title 24 compliance document by a Seasonal Energy Efficiency Ratio (SEER) of at least 1.5. Incentives were paid for only one unit per home; if multiple units were installed, the incentive was based on the one with the lowest SEER rating.

Enhanced HVAC Ducts. Duct systems were required to meet PG&E High Efficiency Duct Standards. These standards involve installation and material specifications, and a description was provided to builders upon acceptance into the program. In addition to compliance with local building codes, 1998 *PG&E Duct Installation Standards*, and the 1997 *Uniform Mechanical Code*,⁹ a number of general guidelines were required to be followed. These were supplied to participants in *Comfort Home High Efficiency Duct Guidelines* –

⁹ Specifically, within the *Uniform Mechanical Code*, refer to Chapter 6, Duct Systems, and Appendix A, UMC Standard No. 6-3.

Specifications for 1998 Program Installations and in Comfort Home High Efficiency Duct Guidelines – Recommended Duct System Installation Guidelines. To qualify for the incentive payment, a duct blaster test was required to be passed, and a completed form was required to be submitted verifying total duct leakage within program limits.

Natural Gas Cooking Equipment. A natural gas cooktop or range was required in areas where PG&E distributed natural gas to the home. Homes not supplied with PG&E distributed natural gas were not required to install this equipment, and they were eligible for a reduced incentive (\$50 less). For production home projects (two or more single family detached homes), 75% of the homes built were required to have natural gas cooking.

Gas Clothes Dryers. A natural gas dryer stub was required in areas where PG&E supplied natural gas to the home. Homes not supplied with PG&E distributed natural gas were not required to install this measure, but were eligible for the reduced incentive.

Energy Efficient Windows. A bonus incentive of up to \$200 was available for homes with windows meeting the ENERGY STAR® Performance Requirements. To qualify for this bonus incentive, installed windows needed to meet the Southern Region ENERGY STAR® Performance Requirements for Solar Heat Gain Coefficient (SHGC) and the Central Region ENERGY STAR® Criteria for U-factor. The requirements applied to all fenestration in the house including windows, fixed glass, glass doors, and skylights. Specifically, these requirements were as follows:

- An SHGC of 0.4 or less,
- A U-factor of 0.4 or less for all fenestration except skylights,
- A U-factor of 0.45 or less for skylights, and
- Certification by the National Fenestration Rating Council in accordance with NFRC 100, 200, 300 and 301.

Production homes were required to meet these levels on all homes within the same development. The bonus incentive was variable and was based on the Title 24 compliance U-factor. The program required Title 24 compliance using a U-factor of 0.5 or greater, a shading coefficient of 0.87 or greater, and a SHGC of 0.68 or greater.

Plus Program

The 1998 PCH Plus Program offered \$150 incentive for each new home for meeting the Home Energy Rating requirements of the EPA ENERGY STAR® New Homes Program.¹⁰ While this program tier did not target any specific products, it was designed to serve as a

¹⁰ In order to receive the ENERGY STAR® New Home designation, a new home must exceed the Model Energy Code (MEC) by 30% and maintain or exceed indoor air quality (ASHRAE) guidelines.

bridge to the ENERGY STAR[®] Program and to be used as a channel for new energy efficient products and services. An additional benefit to homebuyers who qualify or qualified for the ENERGY STAR[®] Program is that they are then eligible for an energy efficient mortgage (EEM).¹¹

Compliance with the ENERGY STAR[®] New Homes Program is certified by a score of 86 or higher as measured by a Home Energy Rating System (HERS). The PCH Plus incentive was meant to offset the cost of obtaining the HERS rating which can be obtained only from a certified HERS rater. The HERS rating results in a score ranging from 1 to 100, indicating the estimated annual energy use of a rated house relative to a reference house built to the Model Energy Code (MEC) that has been assigned a score of 80. A rated home with identical annual energy use would also receive a score of 80. For every 5% reduction in energy use (compared to the reference house) the score increases by one point. Thus, with a minimum of 30% more energy efficient, an ENERGY STAR[®] house has a HERS rating of 86 at minimum.

In the PG&E service area, California Home Energy Efficiency Rating System (CHEERS) provides the ratings. Their on-site inspection includes evaluation of the insulation, HVAC equipment and ducting, windows, water heaters, hard-wired lighting fixtures, weather-stripping and caulking, and pool and spa covers. The resulting report includes a cost and benefit analysis of the recommended energy efficiency improvements, along with a list of participating contractors and lenders. PG&E worked with CHEERS to develop a rating system based on a Title 24 compliant house.¹²

Targeted Markets

The 1998 PCH Base Program targeted the single family detached residential new construction market in the climate zones 11, 12, and 13 of PG&E's service territory (Central Valley). This area represents the portion of PG&E's service area with the highest cooling loads. The 1998 PCH Plus Program was offered to the entire PG&E service area.¹³ Figure 2-4 depicts the targeted areas for both the Base and Plus Programs.

In order to participate in either program, all homes had to receive electric and/or gas distribution service from PG&E. Furthermore, the new home was required to be built under

¹¹ An EEM offers better qualifying ratios so that a homebuyer can afford a larger mortgage with no additional down payment.

¹² In general, Comfort Homes are approximately 25% more energy efficient than Title 24 code dictates. ENERGY STAR[®] New Homes are approximately 30% more energy efficient than the MEC. PG&E and CHEERS joined forces to develop an appropriate baseline for measuring Comfort Homes in relation to the MEC and Title 24.

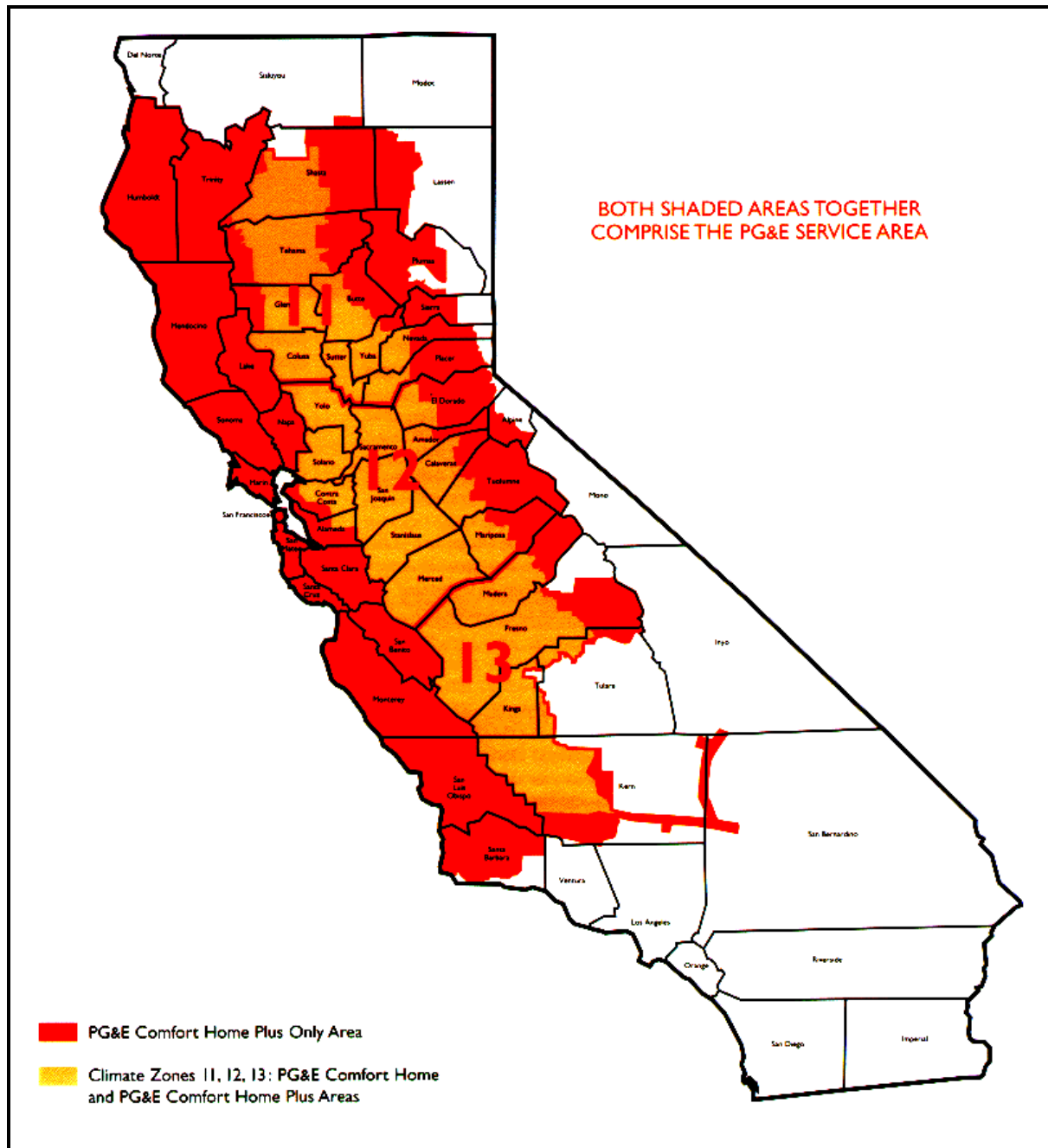
¹³ However, actual participants for the Plus program were all in the Central Valley area.

the current Title 24 residential energy efficiency standards for low-rise (three stories or less) buildings and must have complied with Title 24 using the performance method. Additionally, it must be intended as a full-time residence.

For production home projects,¹⁴ all homes within the development must be upgraded with all the required measures with the exception of gas cooking appliances, for which 75% of the homes in the development must be upgraded.

¹⁴ Consisting of two or more single family detached homes.

Figure 2-4: PG&E Service Area



Targeted Market Barriers

The PCH Program was designed as a delivery mechanism for marketing emerging new technologies. Specifically, in 1998 the PCH was designed to serve as a bridge from the existing Base Program to the EPA New Home Program ENERGY STAR[®] specifications. As such, it sought to influence relative market actors and market barriers. The specific market barriers targeted through the PCH Program are the following.¹⁵

- Asymmetric information,
- Product unavailability,
- Performance uncertainties,
- Access to financing,
- Split incentives, and
- Organizational practices.

The implementation strategy of the program was to offer incentives for Base Program measure installations with additional bonus incentives for emerging technologies¹⁶ and compliance with ENERGY STAR[®] Program requirements. A by-product of this strategy is the continued development of an emerging industry of builder assistance, such as service agencies providing HERS ratings, home diagnostic and design review, and other assistance in meeting EPA ENERGY STAR[®] requirements. As part of its advertising campaign, PG&E also provided educational and training services for market actors.¹⁷

Market actors targeted by the program include builders, contractors, architects, lenders, realtors, building inspectors, regulators, manufacturers, and customers. Program efforts targeted these actors in the following ways:

- Promoting the EPA ENERGY STAR[®] New Home Program,
- Providing incentives for builders to purchase and install more emerging technologies,
- Educating builders, realtors and lenders on selling energy efficiency,
- Training building inspectors on new technologies,
- Educating architects and contractors on energy efficient technologies and installation practices,
- Working with government agencies to incorporate new technologies into standards,

¹⁵ PG&E CPUC Application, October 1, 1997 filing.

¹⁶ For the 1998 PCH program, this consists of high performance windows.

¹⁷ For example, how to sell energy efficiency, what are Energy Efficient Mortgages, and how to install high performance HVAC ducts were some of the topics.

- Working with manufacturers to increase the supply of energy efficient products, and
- Increasing consumer awareness through advertising.

Implementation

Base Program

The 1998 PCH Program included an aggressive marketing campaign to consumers and builders. Features of the marketing campaign included the following:

- Direct response television advertising aimed at 11.5 million consumers,¹⁸
- The Smarter Energy Line, an 800 number provided for consumers to telephone for more information,
- Printed information packages along with an educational video mailed to potential homebuyers,
- Two bill inserts describing the benefits of PCH mailed to 13 million PG&E customers in April and August 1998,
- Magazine advertisements,¹⁹ and
- Merchandising units for display in builder sales offices.

Consumers who saw the television advertisement or received a bill insert and, as a result, called the 800 number were offered a consumer kit. Each kit included a consumer's guide to purchasing an energy efficient home, an information video on the PCH Program, directions to PCH developments, and money-saving certificates on home-related products and services. Approximately 15,000 packages were mailed in response to roughly 20,000 telephone calls received.

PG&E division representatives contacted builders through builder associations, cold calls, and leads received from HVAC contractors. At the beginning of the program year, a builder information meeting was held and attended by builders and their contractors. Additional marketing efforts aimed at builders included training in duct installation and testing for HVAC contractors and sales training for builders' sales agents. Furthermore, PG&E

¹⁸ Forty to fifty 60-second spots ran between April and October in Bakersfield, Chico, Fresno, Sacramento, and San Francisco.

¹⁹ Specifically, advertisements were placed in the following publications during the period April through July 1998. For builders – *BIA/Superior California Builder, Builder, Builder and Developer, Builder/Architect San Francisco, Builder Digest of Northern California, Daily Pacific Builder, Design Build Business, Home Builders Association News, Professional Builder, SAC Builder's Exchange, and Western Building Show Guide*. For consumers – *New Homes*.

supplemented its existing sales staff with specialists of the EPA ENERGY STAR[®] New Homes Program to add their expertise to the sales training.

Builders wishing to participate in the program were required to submit the following to their local PG&E representative to begin the application process:

- A complete PG&E Comfort Home application,
- The final Title 24 C-2R or P-2R form as approved for the building permit,
- A set of construction plans,
- A manufacturer's data sheet or a copy of the Air Conditioning and Refrigeration Institute (ARI) Directory listing of the mechanical equipment to be used,
- A copy of the home's load-sizing calculations, and
- A manufacturer's specification sheet listing the U-factors of the windows used to meet Title 24 compliance.

Most applications were received during the period of May through August 1998. After receiving approval from PG&E, builders were allowed 18 months to complete the requirements of the program. In addition to installing the required measures, they were required to plant a five-gallon deciduous tree within 20 feet of the house, ensure air-conditioner filters and coils were easily serviceable, and install the outside air-conditioning condenser in an unconfined space. To receive their incentive, they then provided PG&E with a completed form requesting inspection and payment, a copy of the Certificate of Insulation, and a completed form certifying compliance with duct installation requirements.

PG&E inspected 25% of the homes that completed the Base Program.²⁰ In the case of production homes with multiple models, a minimum of one house per model was inspected. All installed measures were examined; however, the major part of the inspection consisted of a duct blaster test. Duct leakage greater than 90 cfm at 25 Pa²¹ was not acceptable.

Plus Program

Builders participating in the PCH Plus Program were required to sign a Memorandum of Understanding with the EPA and to construct all homes within their development to meet EPA ENERGY STAR[®] New Homes Program requirements. A copy of the HERS rating

²⁰ Sampling was conducted randomly. A 25% sample of production homes and a 25% sample of custom homes were inspected.

²¹ For more detail, see *Comfort Home Efficiency Duct Guidelines: Specifications for 1998 Program Installations*.

summary was then submitted to PG&E with a completed form requesting inspection and payment.²²

Program Accomplishments

Base Program

The goal for the 1998 PCH Base Program was originally set for 5,000 committed homes, and later revised to 6,000. The actual number of homes accepted to the program were 5,635 committed. Of these, 99% are production homes, and only 50 represent custom built homes. Furthermore, 304 of the 5,635 committed units include the optional window bonus. Information on actual paid incentives is unavailable at this time due to the ongoing construction of most of these committed units. Historically, PG&E has experienced a 5% to 10% drop-out rate for the program. Table 2-4 presents the total units (houses) in the 1998 PCH Base Program.

Table 2-4: PCH Base Program Units

No. of Homes	With Window Option	Without Window Option	Total Units Committed	No. of Builders Represented
Custom	1	49	50	16
Production	303	5,282	5,585	66
Total	304	5,331	5,635	77
<i>No. of Builders Represented</i>	5	74	77	

Plus Program

The goal for the 1998 PCH Plus Program was 560 committed homes, and approximately 202 homes were actually committed. Five builders participated in the program; all five also participated in the Base Program. All but one of the committed units are production homes.

Benefits and Costs

The PCH was designed to deliver a number of benefits market-wide. The most important of these include the following:²³

- Energy savings of up to 30% for consumers of a PG&E Comfort Home,

²² PG&E. *Comfort Home Plus 1998 Application Instructions*, June 1998.

²³ In addition, builders claim increased marketability. A builder survey was implemented by Opinion Dynamics Corporation to determine if participating builders viewed the program as a marketing advantage in selling their homes. Seventy-six percent of builders interviewed agreed that it was.

- Improved awareness about energy efficient appliances and home building standards for residential consumers,
- Incentives for builders to include high efficiency appliances and building technologies, and
- Leveraged market transformation efforts.

For expected rebates, \$3,805,238 was encumbered based on committed units for the 1998 program. In addition, \$813,572 was budgeted for media advertising. Net savings reported are as follows:

- 11,540,311 kWh,
- 8,020 kW, and
- 328,308 Therms.

2.3 ENERGY STAR[®] New Homes Program

Overview

The ENERGY STAR[®] New Homes Program is part of the family of ENERGY STAR[®] programs funded by the U.S. Environmental Protection Agency (EPA) and designed to prevent pollution and save money. The program functions by partnering with builders and other “allies” who provide services related to building, certifying or selling the ENERGY STAR[®] home. As of March 1999, the program had 1,563 participating members, which included 937 builder/developers. Of these, 25 are in California.²⁴ While builders are not required to partner with the EPA to build ENERGY STAR[®] Homes, there are a number of benefits available for partners including free marketing materials, software and sales training. ICF Inc. administers the program for the EPA and publicizes the program through public service announcements, a web site, and a toll-free telephone number. In addition, they actively promote the program to builders and allies.²⁵

An ENERGY STAR[®] home is one that is built to be 30% more efficient than a similar house built to meet the current national Model Energy Code (MEC). In order to earn the ENERGY STAR[®] certification, the home is inspected and rated by an independent home energy rater. The home energy rating system (HERS) used in the rating process compares various features of the home with one built to the MEC standard and assigns a numerical rating from a scale of 1 to 100. The MEC standard house is assigned a rating of 80. To earn each additional point above 80, the rated house must be tested as 5% more efficient than the MEC house.

²⁴ The ENERGY STAR[®] New Homes web page:

<http://yosemite.epa.gov/appd/eshomes/eshomes.nsf/webdocslookup/FrameBody>

²⁵ Conversation with ICF associate, May 1999.

Therefore, an ENERGY STAR[®] home will have a rating of at least 86 on the HERS scale, and will be at least 30% more energy efficient than the reference MEC house.

Typical features in an ENERGY STAR[®] home tend to be the following:

- Tightly sealed and insulated ducts,
- Air leakage control,
- High performance windows, and
- High-efficiency heating and cooling equipment.

Energy Efficient Mortgages

One feature of the program is the ENERGY STAR[®] mortgage. An ENERGY STAR[®] mortgage is similar to an Energy Efficient Mortgage in that it starts with a 2% “stretch,” allowing the homebuyer to qualify for a larger mortgage amount. The ENERGY STAR[®] mortgage takes that a step further by either extending the stretch to up to 5% or offering cash back after closing. Chase Manhattan Mortgage Corporation, Countrywide, and PHH Mortgage Services are three national lenders that partner with the program.

Home Energy Rating Systems

To obtain the ENERGY STAR[®] New Home certification, a builder submits the home plans to a HERS rater for a review. Raters use information from the plan and software designed according to HERS guidelines to perform a computer simulation and estimate the annual energy use of the house design. Once the home is built, the HERS rater inspects the house and performs a blower door test and a duct blaster test. The results of these tests are added to the computer simulation program and a HERS rating for the house is produced.

Home Energy Rating System Council

The HERS guidelines were established by a nonprofit association, the HERS Council (HERSC), whose members represent a broad spectrum of roles in the housing industry, including appraisers, builders, raters, consumer groups, contractors, energy and environmental groups, government agencies, lenders, manufacturers, realtors and utilities. The Council was formed in 1992 to develop uniform national guidelines to promote energy efficiency through the availability of energy efficient mortgages. There are 17 guidelines that address equipment, minimum features, protocols for inspecting, and guidelines for rater training and accreditation.

California Home Energy Efficiency Rating System

In California, the primary HERS rating system in use is the California Home Energy Efficiency Rating System (CHEERS). CHEERS is a nonprofit organization formed in 1990

an headquartered in Chatsworth, California. They are funded by utility support and by fees charged for processing ratings. Their board of trustees is composed of utility representatives, the Natural Resources Defense Council (NRDC), and some private businesses and consultants. CHEERS currently has over 250 people certified by their training program. Forty of these are trained raters and use the CHEERS software (other levels of training include data collectors, diagnostic testers, and analysts). Of the 40, 10 are doing this full time; the others also work as HVAC contractors, general contractors, appraisers and Title-24 Consultants. Most of the raters are in northern California, due to the weather and more support for them in that area.²⁶

CHEERS is has been predominantly focusing on existing housing. In this capacity, they provide the homeowner with a detailed report listing recommended improvements to the house along with estimated energy savings and cost of upgrades. When the upgrades are complete, the home is tested and a certificate of the level of energy efficiency of the house is provided for use with energy efficient mortgages.

2.4 Energy Standards

This section discusses appliance and building efficiency standards and their relevance to the PCH Program. Appliance standards cover efficiencies for equipment such as air conditioning units, furnaces, heat pumps, refrigerators, water heaters, and lighting. Building standards address building shell, HVAC air distribution system, and other constructions that affect energy use. Both state and national standards are discussed.

Title 24 Energy Efficiency Standards

California is one of the leaders in promoting energy efficiency through the Title 24 energy efficiency standards. All new buildings in California must meet the energy efficiency standards contained in Title 24, Part 6, of the California Code of Regulations. Title 24 building efficiency standards are typically more stringent than the national Model Energy Code (MEC). Regarding appliance efficiencies, California has primarily adopted the national appliance standards.

One unique feature of Title 24 is the use of sixteen climate zones. Because energy use is directly related to weather conditions, distinct climate zones were established to reflect the many microclimates that exist throughout California. Each zone has a different set of standards to reflect this diversity.

²⁶ Conversation with CHEERS executive director, May 1999.

Title 24 Compliance

Title 24 standards encompass the envelope, mechanical, and lighting components of a building. The parameters for Title 24 compliance are based on the date a building permit application is filed. The responsibility for compliance rests with the architect and the builder, who must provide Title 24 compliance forms and documentation with the architectural blueprints. However, Title 24 compliance calculations and documentation are usually performed and supplied by an engineer or energy consultant.

Compliance can be achieved through either one of the following prescriptive or performance methods:

- **Prescriptive Method.** This approach is the simplest route to compliance. Compliance is achieved by installing components which have performance specifications equal to or better than the values given by one of several “packages” of specifications from the Standards. Minimum/maximum values are established for parameters such as window U-values and shading coefficients, wall and roof insulation R-values, etc. No trade-offs are allowed and requirements are included for envelope, mechanical, and lighting components of the building.
- **Computer Analysis Performance Method.** This analysis method is the most flexible compliance method. In general, for the performance approach a baseline “energy budget” (i.e. estimated energy use) is developed for a building configured with prescriptive measures relevant to the climate zone of interest. Compliance for the building to be certified is achieved by keeping the simulated energy use less than the baseline energy budget. This method is the most useful for measure trade-off studies and most accurately reflects the benefits of different conservation measures. However, it is also usually too complex to perform manually, hence the use of computer programs to perform this work. The CEC maintains a list of energy analysis computer programs approved for this service.
- **Point System Performance Method.** The point system is a simplified performance method. With this compliance approach, points are assigned to various types of conservation measures. Positive points are assigned for energy features or levels of performance that exceed levels used to develop the standard energy budget while negative points are assigned for measures below standard levels. Compliance is obtained with an overall score of 0 or greater.

Recent Title 24 Updates

The California Energy Commission (CEC) administers changes to the code in three-year cycles. Interested parties may submit proposals for changes to the code to the CEC at any time. These proposals are then reviewed by CEC staff, discussed in a public hearing, and voted on by the commissioners. Typically, the hearings are attended by interested parties in the building industry such as manufacturers and professional associations for builders, contractors, and Title 24 Consultants.

First established in 1977-78, Title 24 standards are updated every three years to allow new energy efficiency technologies to be considered. The most recent update goes into effect July 1, 1999. Key changes to the standards include:

- New credits for improved HVAC air distribution systems, and the addition of testing to receive maximum credit.
- New specifications and control of tapes and mastics used for sealing ducts.
- The Solar Heat Gain Coefficient (SHGC) replaces the Shading Coefficient (SC) in both specifications and labeling requirements.
- Incorporation of a home energy rating system (HERS) into the certification process.

National Energy Efficiency Standards

The Energy Policy and Conservation Act of 1975 (EPCA) established an energy conservation program that related to major household appliances and required the U.S. Department of Energy (DOE) to set testing procedures and standards for major appliances. The National Appliance Energy Conservation Act (NAECA) of 1987, an amendment to the EPCA, set national efficiency standards for appliances and established a schedule for regular updates. The Energy Policy Act of 1992 (the Act) expanded the coverage of the EPCA to include HVAC equipment, water heaters, and other devices. The Act also provided for voluntary testing and consumer information programs for certain electrical devices, windows, and some plumbing equipment.

National Appliance Energy Efficiency Standards

In 1987, Congress passed the National Appliance Energy Conservation Act (NAECA). The act sets federal efficiency standards for thirteen classes of consumer products including gas water heaters and furnaces. These standards are aimed at manufacturers. NAECA sets forth an administrative rulemaking schedule for each product category. Under the act, at least two administrative reviews are scheduled through 2007. Standards are only revised or tightened if analysis indicates that changes are economically justified and are technically feasible. Table 2-5 illustrates the energy conservation standards timeline from 1988 to 1997 for gas water heaters and furnaces.

Table 2-5: Effective Dates and Review Dates for NAECA Standards

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
CAC/HP Split System			☆														
CAC/HP Single Package				☆													
Furnaces			☆														⊛
Gas Water Heaters	☆											⊛					

☆ Standard's effective dates

⊛ Scheduled for review

The Code of Federal Regulations (CFR) Title 10, Part 430, documents the Department of Energy's (DOE) official laboratory test procedures for measures of energy consumption. Gas water heaters are covered under Appendix E and furnaces are under Appendix N.

Central Air Conditioners (CAC) and Heat Pump Units. There are two basic types of central air conditioning units used for residential applications; single package and split system. Split systems, which are the most typical in single family home applications, the condenser and compressor are located outside the residence away from the heat exchanger, fan, and/or furnace components. CAC systems can be heat pumps or they can be combined with a furnace. Single package systems are units in which all components (heating equipment, compressor, condenser, heat exchanger, fans, etc.) are combined in one package.

NAECA requires that single package central air conditioning (CAC) units manufactured after January 1, 1993 have a minimum 10 SEER (Seasonal Energy Efficiency Ratio) rating, and in addition, a CAC/HP must have a minimum 6.6 HSPF (Heating Seasonal Performance Factor) rating. Split system central air conditioning (CAC) units manufactured after January 1, 1992 have a minimum 10 SEER (Seasonal Energy Efficiency Ratio) rating, and in addition, a CAC/HP must have a minimum 6.6 HSPF (Heating Seasonal Performance Factor) rating.

The SEER is the energy efficiency rating based on DOE testing procedures that attempt to simulate a system's typical seasonal energy use. The SEER is expressed as the ratio of total seasonal cooling output in kBtu to the total electrical input in kWh. There is no scheduled date for updating these efficiencies. The HSPF is the heating equivalent of the SEER and indicates the seasonal heating efficiency of a heat pump. The HSPF is expressed as the ratio of total seasonal heating output in kBtu to the total electrical input in kWh.

Gas Furnaces. The NAECA requires residential gas furnaces manufactured after January 1, 1992 to have an annual fuel utilization efficiency (AFUE) rating of at least 78%.

The AFUE is the energy efficiency rating based on DOE testing procedures that simulate a system's typical seasonal energy use. The AFUE is the ratio of annual heat output to the annual gas input (in Btu). DOE conducted the initial analysis in 1993 for updating furnaces, but due to a shortage of funding this analysis has been put on hold. The improvement would most likely be for an 80% AFUE rating for the year 2006.

Gas Water Heaters. The standards on residential water heaters became effective on January 1, 1990. NAECA mandated that for gas water heaters manufactured on or after the effective date, the energy factor (EF) shall satisfy the requirement:

$$EF \geq 0.62 - (0.0019 \times \text{the rated storage volume in gallons})$$

For example, a 40 gallon water heater would have a .54 EF ($0.62 - (0.0019 \times 40)$). An EF is a unitless number and is the ratio of delivered heat from the tank (in Btu) to the heat content of fuel input (in Btu). The standards were also reviewed in 1991 but the review did not lead to efficiency level revisions. Modest improvements in gas standards to .60 EF are scheduled for the year 2001.

National Building Energy Efficiency Standards

The regulation of building construction in the U.S. is accomplished through building codes. Codes are adopted by a state or local government's legislative body, then enacted to regulate building construction within a particular jurisdiction. A building code is a collection of laws, regulations, ordinances, or other statutory requirements adopted by a government legislative authority involved with the physical structure and healthful conditions for occupants of buildings. There are three primary organizations of code development in the U.S.: the Building Officials and Code Administrators (BOCA), the International Conference of Building Officials (ICBO), and the Southern Building Code Congress International (SBCCI).

The Council of American Building Officials (CABO) was created in 1972 as a forum to coordinate the efforts of the three model code organizations at the national level. CABO is composed of members of the Board of Directors of each model code organization and is supported by their technical and educational staffs. In November 1997, CABO was incorporated into the International Code Council (ICC), another organization established by BOCA, ICBO, and SBCCI in 1994. The ICC is tasked with developing a single set of codes that can be applied nationally instead of the three sets of model codes currently used in the U.S.

CABO created the Model Energy Code (MEC) in 1978. The MEC is a document maintained by a Code Development Committee consisting of representatives from BOCA, ICBO, and SBCCI. The committee is responsible for incorporating appropriate emerging thermal performance issues reflecting state-of-the-art information in building energy performance. Beginning with the latest edition (1998), the code is now called the International Energy Conservation Code. The code is officially revised every three years based on annual code development cycles. Each year, CABO collects code revision proposals and publishes and distributes them to interested parties. A public hearing takes place in the spring to discuss the proposals, and those results are then published and distributed to interested parties. Comments on these are collected and discussed in an annual conference that takes place in the fall. At that time all proposed changes are voted on by the active members of the ICC and the results become a supplement to the current edition of the code.

The North American Insulation Manufacturers Association (NAIMA) produces the *MEC Thermal Envelope Compliance Guide* for determining MEC compliance. The guide presents applications and trade-off worksheets and R-values of numerous component constructions to enable users to determine MEC compliance of thermal envelope for one- and two-family dwellings. Compliance is defined as either a prescriptive or a performance requirement and categorized in three basic methods.

- **Component Performance Method (Prescriptive).** This approach is relatively simple and well defined. This compliance path establishes a limitation on the overall U-value for each building attribute. No trade-offs are allowed but this method allows builders to use a variety of materials and designs.
- **Systems Analysis Method (Performance).** The system analysis compliance method establishes an overall energy consumption level. It considers building envelope and equipment efficiency. Therefore, there can be a trade-off between insulation and HVAC systems.
- **Acceptable Practice Method (Prescriptive).** This is an alternative simplified compliance path to the Component Performance Method. The Acceptable Practice Method uses pre-calculated thermal properties of construction assemblies for buildings less than 5,000 square feet in gross floor area and three stories or less in height.

3

Survey Design and Implementation

3.1 Introduction

This section describes the primary data collection effort for the study. This includes a discussion of the survey design and implementation strategy used to complete the in-depth interviews and telephone surveys of key market actors.

3.2 Survey Design

In order to complete this primary data collection effort, a survey design consisting of four major elements was identified:

- Sample Design,
- Development of Sample Frames,
- Development of Interview and Survey Instruments, and
- Survey Protocol.

Each of the survey design elements is discussed below.

Sample Design

Table 3-1 presents a summary of the sample design for the data collection effort. Note that the consumer surveys and the builder interviews were conducted within PG&E's service area and in the national comparison area. While some of the other interviews could also be performed in the comparison area, it is our judgment that the primary benefits of cross-area comparisons can be extracted by focusing on consumers and builders, the two market actors whose behavior is most central to the success of market transformation programs in the new construction market.

Table 3-1: Sample Design for Surveys and Interviews

Market Actor	Format	Completed Sample Sizes		
		PG&E Area	Comp. Area	Total
Manufacturers	Phone interview	10	-	10
Distributors	Phone interview	10	-	10
HVAC Contractors	Phone interview	5	-	5
Window Contractors	Phone interview	5	-	5
Architects	Phone interview	10	-	10
Title 24 Consultants	Phone interview	5	-	5
Builders/Developers	Phone interview	30	50	80
Building Inspectors	Phone interview	10	-	10
Sales Agents	Phone survey	20	-	20
Lenders	Phone survey	10	-	10
Government Staff	Phone interview	10	-	10
Participating Homebuyers	Phone survey	255	-	255
Nonpart. Homebuyers	Phone survey	255	255	510

The sample design for the participant consumers was further stratified by type of program. The builders and nonparticipant consumers were further segmented by geographical region.

Participant Consumers. Table 3-2 presents the stratified sample design for the participant consumers. Included in the summary is the total number of committed homes under the 1998 PG&E Comfort Home (PCH) Program, the number of homes that have been owner/renter occupied to date,¹ and the targeted number of completed interviews. Note that the sample design was to attempt a census of PCH Plus Program participants and then fill in the remainder of the 255 required sample with Base Program participants.

¹ The information on program participants and “move ins” was supplied by PG&E program staff.

Table 3-2: Summary of Participant Consumers Completed Survey Targets by Program

PCH Program	Committed Participants	“Move Ins”	Targeted Surveys
Plus	202	61	61
Base	5,636	557	194
Total	5,838	616	255

Nonparticipant Consumers. The PCH Base Program is offered only in CEC climate regions 11, 12, and 13. The PCH Plus Program is offered to all PG&E customers regardless of climate zone. However, in 1998 all participants from the Plus Program were in climate zones 11, 12, and 13. Given these factors, the nonparticipant sample was heavily oversampled from climate zones 11, 12, and 13 to match the participants. Table 3-3 presents the completed survey targets by weather zone for the nonparticipant consumers. PG&E staff from the PG&E customer file developed the database of single family new homes. Essentially, new homes were defined to be homes with meter set dates after January 1, 1998 and with residential class indicator equal to 1.

Table 3-3: Nonparticipant Consumers Completed Survey Targets by Weather Zone

CEC Weather Zones in PG&E	SF New Homes	Targeted Surveys
11, 12, and 13	5,472	180
All others	30,127	75
Total	35,599	255

Comparison Area Builder and Nonparticipant Consumers. The national comparison area was constructed by selecting 14 regions outside of California. These regions were based on utility service territories, and were used to stratify the sample of builders and nonparticipant consumers. The sample design required a completed sample of at least three builders and 15 nonparticipant from each region, and a total completed sample of 50 builders and 255 nonparticipant consumers.² Table 3-4 presents the 14 regions in the control area.

² The remaining available surveys and interviews (five builders and 45 nonparticipants) were spread across these regions on an as surveyed basis.

Table 3-4: Builder and Nonparticipant Consumers Completed Survey and Interview Targets by Region

State	Major Utility	Targeted Builder Interviews	Targeted Nonparticipant Consumer Surveys
AZ	Arizona Public Service	3	15
	Tucson Electric	3	15
CO	Fort Collins Light & Power	3	15
FL	Florida Power & Light	3	15
	Tampa Electric	3	15
GA	Georgia Power	3	15
NV	Nevada Power	3	15
	Sierra Pacific Power	3	15
NY	Rochester	3	15
NC	Duke Power Company	3	15
TX	Houston Power & Light	3	15
	Texas Utilities	3	15
	Austin Electric Department	3	15
	San Antonio City Public Service Board	3	15
	Total	50	255

Note: These regional targets are minimums and do not add up to the total number of completed surveys for builders (50) and Nonparticipant consumers (255).

Data on key factors such as presence of residential new construction programs,³ building standards,⁴ weather,⁵ electricity prices⁶ and state-level residential new construction activity⁷ were also collected for these selected regions. These data will be used in the hypotheses

³ These data were collected by telephone interviews with DSM program staff at each of the Utilities.

⁴ These data were collected from the Department of Energy Building Standards and Guidelines Program or with a telephone interview with building departments of the major cities within the service territory.

⁵ Normal heating and cooling degree days were collected from NOAA records.

⁶ Electricity prices were gathered from the *Directory of Electric Power Producers*, Electrical World 1998 Edition, and The McGraw-Hill Companies.

⁷ Residential new construction activity by state were collected from *U.S. Housing Market Conditions*, U.S. Department of Housing and Urban Development, Office of Policy Development and Research, February 1999.

testing as control variables. A summary of these data is provided in Table 3-6, Table 3-5, and Table 3-7.

A set of weights was developed for use in the statistical analyses of consumers in the comparison area and the PG&E service territory. The weights were developed from data on single family new housing starts, California housing permit data and number of customers for each of the utility companies around which the regions were designed. The number of utility customers are presented in Table 3-6, the state level new housing starts data are summarized in Table 3-7, and the California housing permit data are presented in Table 2-1 in Section 2.

Table 3-5: Summary of Comparison Area Weather

State	Utility	1997 HDD ¹	1997 CDD ²	Normal HDD	Normal CDD
AZ	Arizona Public Service (APS)	1,430	3,816	1,619	3,365
	Tucson Electric	2,548	2,095	2,644	1,775
CO	Fort Collins Light & Power	7,557	241	7,354	251
FL	Florida Power & Light	149	4,454	260	3,955
	Tampa Electric	469	3,573	639	3,397
GA	Georgia Power	2,986	1,402	3,073	1,560
NV	Nevada Power	3,870	1,806	4,299	1,541
	Sierra Pacific Power	5,650	493	5,997	517
NY	Rochester	7,071	348	7,002	422
NC	Duke Power Company	3,054	1,513	3,102	1,664
TX	Houston Power & Light	1,818	2,653	1,698	2,716
	Texas Utilities	2,631	2,269	2,462	2,402
	Austin Electric Dept	1,827	2,761	1,659	2,880
	San Antonio City Public Service Board	1,620	2,881	1,452	2,997
		2,766	1,365	3,163	1,238

1 Heating degree days (base 64°F).

2 Cooling degree days (base 64°F).

Table 3-6 : Summary of the Comparison Area Profiles

State	Utility	Presence of 1998 New Const. Program	Presence of State Energy Standards	No. of Residential Customers	Cents per kWh	kWh per year
AZ	Arizona Public Service (APS)		no	636,239	9.57	11,853
	Tucson Electric	yes	no	278,055	9.44	9,050
CO	Fort Collins Light & Power	no	yes	35,932	5.98	7,858
FL	Florida Power & Light	yes	yes	3,152,626	8.05	13,101
	Tampa Electric	no	yes	445,664	8.17	14,824
GA	Georgia Power	yes	yes	1,515,452	7.69	11,763
NV	Nevada Power	no	no	415,507	6.46	13,228
	Sierra Pacific Power	no	no	230,778	n/a	n/a
NY	Rochester	no	yes	306,798	11.95	6,952
NC	Duke Power Company	no	yes	1,549,346	7.24	13,549
TX	Houston Power & Light	yes	no	1,341,680	8.42	14,197
	Texas Utilities	yes	no	2,087,742	7.91	15,100
	Austin Electric Dept	yes	no	264,867	7.40	10,548
	San Antonio City Public Service Board		no	464,567	6.50	13,306

Table 3-7 : Single Family New Housing Starts ⁸

State	New Single Family Housing Starts
Arizona	44,373
Colorado	31,941
Florida	90,309
Georgia	59,596
Nevada	23,462
New York	19,590
North Carolina	55,529
Texas	82,180
California (in PG&E Area) ⁹	43,069
California (outside PG&E Area) ¹⁰	41,080
California	84,149
United States	1,062,396

Sample Frames

The sources of the sample frames for the market actor interviews are diverse. Descriptions of the sample design characteristics for each of the market actors are presented below and detailed in Table 3-9.

- **Equipment Manufacturers and Distributors.** The sample frame for the manufacturer interviews was obtained from various industry trade associations. The project team identified the major equipment manufacturers on the basis of market shares of total shipments. The frame of equipment distributors was derived from references from the equipment manufacturers and other market actors. The sample design specifies a completion target of 10 interviews with manufacturers and 10 interviews with distributors.

⁸ *U.S. Housing Market Conditions*, U.S. Department of Housing and Urban Development, Office of Policy Development and Research, February 1999

⁹ These splits are based on housing permit data provided by Construction Industry Research Board, Burbank, California.

¹⁰ These splits are based on housing permit data provided by Construction Industry Research Board, Burbank, California.

- **Builders.** The sample frame for the builder interviews was primarily derived from the lists of builders that bid and/or participated in the PCH Program. These lists were augmented with data from trade associations and commercially available lists to identify the largest builders in each of the areas covered by this study. Consideration was given to include a range of “large” and “small” companies according to either the number of developments in progress, the number of employees, or number of electrical connections and/or sales in 1998. Further, both PCH Program participating and nonparticipating builders were interviewed. For the control area, lists of builders were constructed from trade association membership lists and Internet research with follow-up telephone calls to identify large residential builders in each area. Because of the importance of the builder interviews to this study, the sample design specified 80 interviews with builders—30 in the PG&E area and 50 in the comparison areas.
- **Architects, Title 24 Consultants, and HVAC Contractors.** The sample frames for the interviews with these market actors (all of which are usually subcontractors) were derived from referrals from builders, trade association membership directories, and telephone directories. The sample design specifies five complete interviews with HVAC contractors, 10 completed interviews with architects, and five with Title 24 consultants.
- **Building Inspectors.** A sample of city and county building inspectors and building plans reviewers was obtained from building departments in the PG&E area. The sample design specifies 10 completed interviews with building inspectors.
- **Sales Agents.** The sample frame for builder sales agents was obtained primarily from trade associations and publications, and web sites listing the communities developed by each builder. The final sample design specifies 20 complete interviews with builder sales agents.
- **Lenders.** The sample frame for lending institutions was derived primarily from trade association member lists. The sample design specifies 10 complete interviews with lenders.
- **Consumer Surveys.** The sample frame for the consumer surveys was derived from PG&E billing frame data, Comfort Home participant files and commercially available data.
 - **Participants.** The sample frame for participants was defined as PG&E customers who have moved into homes covered under the 1998 PCH Program.
 - **Nonparticipants.** PG&E staff provided the sample frame for nonparticipants. A nonparticipant is defined as a customer who has moved into a newly constructed single family home in the PG&E territory since January 1, 1998. As explained earlier, we stratified the sample by geographic area (Central Valley and Non-Central Valley) to reflect the applicability of the Base versus Plus Programs.

- **Control Area.** The sample frame for the control area was obtained from American Business Lists¹¹ and Hugo Dunhill Mailing Lists.¹² The lists obtained were required to meet the following criteria:
 - single family home,
 - constructed in 1998,
 - telephone number available, and
 - located in the city or counties listed.

Table 3-8 lists the utility in the control area and the corresponding cities or county from which the telemarketing lists were constructed.

Table 3-8: Control Area Telemarketing Lists

Utility	City/County
Arizona Public Service	Phoenix ¹
Tucson Electric	Tucson ²
Fort Collins Light & Power	Fort Collins ²
Florida Power & Light	Miami ²
Tampa Electric	Hillsborough county, Tampa ¹
Georgia Power	Atlanta ¹
Nevada Power	Las Vegas ¹
Sierra Pacific Power	Reno ²
Rochester	Rochester ²
Duke Power Company	Charlotte, Durham, Winston-Salem ²
Houston Power & Light	Houston ²
Texas Utilities	Dallas, Arlington ¹
Austin Electric Department	Austin ²
San Antonio City Public Service Board	San Antonio ²

¹ Mailing list provided by American Consumer Lists.

² Mailing list provided by Hugo Dunhill Mailing Lists.

■ **Government Agencies and Nongovernment Organizations.**

Respondents with government agencies were recruited from federal agencies such as the Department of Energy, the Environmental Protection Agency, national research laboratories, contractors conducting policy research, and California state agencies. In addition, several nongovernment organizations involved in promoting the energy efficiency levels of new homes were included in the sample frame.

¹¹ American Consumer Lists, Omaha, Nebraska.

¹² Hugo Dunhill Mailing Lists, New York, New York.

Table 3-9: Sample Frame Sources for Market Actor Interviews

Market Actor	Source of List	Description
HVAC Manufacturers	<ul style="list-style-type: none"> American Society of Heating, Refrigeration and Air conditioning Engineers (ASHRAE) 	
Window Manufacturers	<ul style="list-style-type: none"> National Fenestration Rating Council (NFRC) National Sash & Door Jobbers Assoc. (NSDJA) Window World Magazine 	<p>Member list.</p> <p>List of 45 companies.</p> <p>Manufacturer representatives (5).</p>
Equipment Distributors/Wholesalers	<ul style="list-style-type: none"> Referrals from equipment manufacturers Referrals from equipment distributors ASHRAE NSDJA 	Member list.
Builders and Developers	<ul style="list-style-type: none"> Referrals from PG&E National Association of Home Builders Homes for Sale Magazine Yellow pages 	<p>List of program participants.</p> <p>Member list.</p> <p>List of builders in California.</p>
Architects	<ul style="list-style-type: none"> Referrals from builders Referrals from building inspectors Yellow Pages 	
Title 24 Consultants	<ul style="list-style-type: none"> Referrals from PG&E California Association of Building Energy Consultants (CABEC) 	List of CABEC members
HVAC Contractors	<ul style="list-style-type: none"> Referrals from PG&E Referrals from builders. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) 	Member list.
Building Inspectors	<ul style="list-style-type: none"> Building Departments 	Names of building officials, field inspectors, and plan reviewers for each municipality.
Sales Agents	<ul style="list-style-type: none"> The Housing Guides of America Online, and other builder websites 	Lists of communities developed or being developing by builders, by region.
Lenders	<ul style="list-style-type: none"> Residential Energy Services Network Mortgage Association of California 	<p>List of lenders that are offering or that have offered energy-efficient mortgages.</p> <p>Member list.</p>

Table 3-9 (continued): Sample Frame Sources for Market Actor Interviews

Market Actor	Source of List	Description
Consumers-Participants	<ul style="list-style-type: none"> • PG&E 	PG&E records and billing frame.
Consumers-Nonparticipants	<ul style="list-style-type: none"> • PG&E • Consumer control areas 	PG&E records and billing frame. Commercially available list of residents in control areas.
Government Staff	<ul style="list-style-type: none"> • Personal references from CADMAC members, utility staff, and RER contacts 	

Although RER was responsible for generating the sample frames, PG&E staff provided valuable data on contacts for market actors. Further, it was recognized that there are a substantial number of market assessment, market baselines and program impact studies being conducted in California in 1999. These studies require the surveying of the same market actors. In order to minimize the number of survey requests for these market actors, PG&E reviewed these sample frames in conjunction with the sample frames of other studies for the purpose of allocating market actors across studies. After the review by PG&E staff, it was determined that there was only potential overlap for HVAC contractors. Therefore, PG&E provided a modified list of HVAC contractors.

Development of Interview Guides and Survey Instruments

The interview and survey questionnaires were developed to collect information from market actors to support a baseline market characterization, and to discern market effects from the PCH Program. Both surveys and in-depth interviews were used to collect primary data on actions and perceptions of key market actors.

- First, open-ended telephone interviews were conducted with manufacturers, distributors, contractors, architects, Title 24 consultants, builders and developers, building inspectors, and government staff. Open-ended interviews provide an excellent means for collecting data from these kinds of market actors as they provide insights into the mechanics of manufacturing, product distribution, marketing, and pricing that would be difficult to derive from a structured telephone survey.
- Second, a more structured quantitative survey was used for sales agents, lenders, and consumers.

A discussion of the survey questionnaire for each market actor is provided below. Included in each discussion is a brief overview of the purpose of the interview and the required structure of the interview. The survey instruments are included in Appendix C.

HVAC Manufacturers

High efficiency air conditioning units were a direct requirement of the PCH Base Program. In addition, these and/or high efficiency gas furnaces may be used to meet the PCH Plus Program requirements. The manufacturers of these units have a direct influence on product availability and pricing. In addition, they may work directly with various market actors or work through distributors and contractors. The objectives of interviewing HVAC manufacturers were to identify characteristics of the regional residential market for these products, assess operating procedures, and discern capital/R&D investments. Further, the interview was designed to aid in the assessment of market effects relating to perceptions, decision making, operational procedures, and behavior.

Interview Structure. The following are key issues and questions that were addressed in manufacturer interviews.

- **Manufacturer Characteristics.** What are the manufacturer's primary characteristics? Size, submarkets, competitive market, etc?
- **Awareness.** Is the manufacturer aware of Title 24 requirements? ENERGY STAR[®] specs? To what extent is the manufacturer aware of the PCH Base and Plus Programs? Are they aware of the air conditioning requirements of the Base Program?
- **Product Efficiency Levels.** What is the current product mix of the manufacturer with respect to SEER ratings? How has that product mix changed over the past seven years? Has the mix changed differently in California than in other states (if they ship to other states)? What were the primary drivers of the change in product mix? Energy efficiency? Comfort? Aesthetics? To what extent were state standards like Title 24 responsible for the shift in product mix? To what extent were public programs like ENERGY STAR[®] and Utility Programs like the PCH Program responsible? How permanent is the shift in the product mix? To what extent were programs such as ENERGY STAR and Comfort Home responsible? If utility and government programs were withdrawn, would they continue to offer products exceeding standards?
- **Organizational Practices.** Do they sell through a distributor? Do they also sell directly to some builders or contractors? How does the manufacturer interact with other market actors? How does the manufacturer keep abreast of energy efficiency standards and efficiency program requirements in California and other states? Has this approach changed over the past seven years? What are stocking practices? Changes? Distribution practices? Changes?
- **Perceptions.** How important is energy efficiency to homebuyers? To builders? Is this changing? Why?

Window Manufacturers

High efficiency windows are a key element of both the PCH Base and Plus Programs. To receive the optional windows incentive in the 1998 Base Program, builders had to meet windows requirements relating to both solar heat gain coefficients and U-values (as well as NFRC certification). Participation in the 1998 Plus Program was based on meeting the ENERGY STAR[®] New Home building performance level; high efficiency windows had the capability of contributing to the satisfaction of this requirement. Window standards in California are relatively complex, as Title 24 standards and ENERGY STAR[®] New Home specifications vary by climate zone. The California Window Initiative (CWI) is also recommending standards relating to U-values, solar heat gain, and visual transmissivity.

The objectives of interviewing window manufacturers was to identify characteristics of the regional residential market for these products, assess operating procedures, and discern capital/R&D investments. Further, the interview was designed to aid in the assessment of market effects relating to perceptions, decision making, operational procedures, and behavior.

Interview Structure. The following key issues and questions should be addressed in window manufacturer interviews:

- **Manufacturer Characteristics.** What are the manufacturer's primary characteristics? Size, submarkets, competitive market, etc?
- **Awareness.** Is the manufacturer aware of Title 24 window requirements? ENERGY STAR[®] specs? To what extent is the manufacturer aware of the Base and Plus Programs? Are they aware of the window requirements of the Base Program?
- **Product Efficiency Levels.** What is the current product mix of the manufacturer with respect to U-values? With respect to solar heat gain coefficients? How has that product mix changed over the past seven years? Has the mix changed differently in California than in other states (if they ship to other states)? What were the primary drivers of the change in product mix? Energy efficiency? Comfort? Aesthetics? To what extent were state standards such as Title 24 responsible for the shift in product mix? To what extent were public programs like ENERGY STAR[®] and Utility Programs like the PCH Program responsible? How permanent is the shift in the product mix? If utility and government programs were withdrawn, would they continue to offer windows exceeding standards?
- **Organizational Practices.** Do they sell through a distributor? Do they sell directly to builders or contractors? How does the manufacturer interact with other market actors? How does the manufacturer keep abreast of energy efficiency standards and efficiency program requirements in California and other states? Has

this approach changed over the past seven years? To what extent have marketing and promotional practices changed? Distribution practices? Changes?

- **Perceptions.** How important is energy efficiency to homebuyers? To builders? Is this changing? Why?

HVAC Distributors

HVAC equipment distributors are supply-side market actors that primarily serve as intermediaries between equipment manufacturers and HVAC contractors. The role of the distributor is generally limited to sales of heating and cooling equipment and air distribution system related materials. Because the PCH Base Program requires installation of high efficiency air conditioners and improved air distribution ducts, information obtained from HVAC equipment distributors contributed to RER's evaluation of market effects attributable to the program.

Interview Structure. The information obtained during the in-depth interviews with HVAC equipment distributors was used to 1) characterize the residential new construction market in PG&E's service territory, 2) assess the role of HVAC distributors in that market, and 3) test the hypothesized market effects. The general structure of the interviews and the issues they addressed are presented below.

- **Distributor Characteristics.** Job description of interview respondent and services offered by company. Is the distributor independent or manufacturer-owned? What is the geographic scope of distribution? What equipment types and brands are normally stocked? Who are the distributor's major customers (market actor type and specific names of contractors/builders)? What percentage of air conditioning equipment sales are installed in new construction?
- **Markets for Air Conditioning and Duct System-Related Equipment.** What are the unit sales of air conditioning equipment? Have there been significant changes in sales volumes since 1991? Have similar changes been observed in other regions? What are the primary reasons for these changes? What is the volume of duct system equipment sales (duct tape, mechanical fasteners, mastics, etc.)? Have there been significant changes in sales of these products since 1991? Have similar changes been observed in other regions? What are the primary reasons for these changes?
- **Organizational Practices.** Describe standard organizational and business practices. How does the distributor interact with other market actors? What are the primary factors that influence your stocking and inventory practices? How do you normally promote the products you stock? How would you compare these practices to those of other distributors? Do you promote equipment that exceeds the minimum efficiency standard differently than those that just meet the standard? How so? Do you promote high quality duct sealing materials differently than other materials? How so? What are the advantages or disadvantages for your

company in stocking air conditioning equipment that exceeds the minimum energy efficiency standard? For stocking high quality duct sealing materials?

- **Efficiency Mixes of Air Conditioning Equipment.** What is the break down of unit sales of air conditioners by efficiency level (in study area and all other regions)? Have there been significant changes in these efficiency mixes over the past seven years? Have similar changes occurred in other regions? What are the primary reasons for changes in efficiency mixes? Are these changes permanent? Are changes in efficiency mixes attributable to any particular government or utility program (such as ENERGY STAR[®] or utility-sponsored program)? If such programs or promotions ceased, would you continue to stock the current efficiency mix of air conditioners?
- **Awareness.** Are you aware of federal energy efficiency standards for air conditioning equipment? Are you aware of codes pertaining to duct installation and sealing practices (i.e., recent revisions to California's Title 24)? Are you aware of energy efficiency programs (general)? Are you aware of PCH Program (Base and Plus), and the program requirements? Are you aware of ENERGY STAR specifications?
- **Perceptions.** How important is energy efficiency to homebuyers? To builders? Is this changing? Why/why not?

Window Distributors

The PCH Program offered an optional additional incentive for installing high performance windows. Window distributors play a supply-side role in the RNC market and act as intermediaries between window manufacturers and window contractors. The objective of these interviews was to ascertain their attitudes and business practices in conjunction with characterizing the RNC market. In addition, some specific hypotheses were tested regarding related market barriers.

Interview Structure. The following key issues and questions should be addressed in window distributor interviews.

- **Distributor Characteristics.** Job description of interview respondent and services offered by company. Is the distributor independent or manufacturer-owned? What is the geographic scope of distribution? What equipment types and brands are normally stocked? Who are the distributor's major customers (market actor type and specific names of contractors/builders)? What percentage of window sales is installed in new construction?
- **Markets for Residential Windows.** What are the unit sales of windows? Have there been significant changes in sales volumes since 1991? Have similar changes been observed in other regions? What are the primary reasons for these changes?

- **Organizational Practices.** How does the distributor interact with other market actors? How does the distributor keep abreast of energy efficiency standards and efficiency program requirements in California and other states? Has this approach changed over the past seven years? What are stocking practices? Changes? Distribution practices? Changes? Do you promote equipment that exceeds the minimum efficiency standard differently than those that just meet the standard? How so? What are the advantages or disadvantages for your company in stocking windows that exceed the minimum energy efficiency standard?
- **Efficiency Mixes of Windows.** What is the current product mix of the distributor with respect to U-values? With respect to solar heat gain? How has that product mix changed over the past seven years? Has the mix changed differently in California than in other states (if they ship to other states)? What were the primary drivers of the change in product mix? Energy efficiency? Comfort? Aesthetics? To what extent were state standards like Title 24 responsible for the shift in product mix? To what extent were public programs like ENERGY STAR[®] and utility programs like the PCH Program responsible? How permanent is the shift in the product mix? If utility and government programs were withdrawn, would you continue to offer windows exceeding standards? How many windows were sold in 1998? How many were high performance windows? How many of these were sold in the Central Valley, California area? Have there been significant changes in sales volumes since 1992? Have similar changes been observed in other regions? What are the primary reasons for these changes?
- **Awareness.** Is the distributor aware of Title 24 window requirements? ENERGY STAR[®] requirements? To what extent is the distributor aware of the Base and Plus Programs? Are they aware of the window requirements of the Base Program?
- **Perceptions.** How important is energy efficiency to homebuyers? To builders? Is this changing? Why?

HVAC Contractors

Information obtained from HVAC contractors was crucial to assess the market effects of the PCH Base and Plus Programs for two primary reasons. First, HVAC contractors have two key functions in the residential new construction market: air distribution system design and HVAC equipment purchases and installation. Contractors work directly with several market actors to complete these functions, including builders, Title 24 consultants, and equipment distributors. In other words, HVAC contractors typically have considerable input regarding the efficiency parameters of HVAC equipment and the design of the air distribution system. Second, the PCH Base Program required the installation of high efficiency air conditioning units and enhanced HVAC ducts. Furthermore, training, seminars, and educational materials directly targeted builders and their contractors.

Interview Structure. The information obtained during the in-depth interviews with HVAC contractors was used to 1) characterize the residential new construction market in

PG&E's service territory, 2) assess the role of HVAC contractors in that market, and 3) test the hypothesized market effects. The general structure of the interviews and the issues they addressed are presented below.

- **HVAC Contractor Characteristics.** Job description of interview respondent and scope of services provided by company. What percentage of installations is in new construction? Who are the contractor's major customers (market actor type and specific names of builders)? What percentage of installations was in the Central Valley area last year?
- **Standard Business and Organizational Practices.** How does the contractor interact with other market actors? Has this role changed significantly over time? What are the current equipment specification practices? What factors influence efficiency specification of air conditioning equipment? Have there been significant changes in these practices during the past seven years? What are the primary reasons for these changes? What are the current duct design and sealing practices? What factors influence duct design and sealing practices? Have there been significant changes in these practices during the past seven years? What are the primary reasons for these changes? What are the contractor's primary sources for information/training? What are the contractor's normal marketing and promotional practices? Does the contractor normally offer equipment that exceeds minimum standards as an alternative? How do the contractor's standard practices compare to those of other contractors?
- **Awareness.** Is the contractor aware of federal energy efficiency standards for air conditioning equipment? Is the contractor aware of codes pertaining to duct installation practices (i.e., recent revisions to California's Title 24)? Is the contractor aware of energy efficiency programs (general)? Is the contractor aware of the PCH Program and its requirements?
- **Perceptions.** How important is energy efficiency to homebuyers? To builders? Is this changing? Why/why not?

Window Contractors

Window contractors work directly with several market actors including builders, Title 24 consultants, and equipment distributors, and typically have considerable input regarding the efficiency parameters of window performance. The PCH Base Program offered an optional incentive, which required the installation of high performance windows that meet the ENERGY STAR[®] New Home Program requirements. The objective of these interviews was to ascertain contractors' attitudes and business practices in conjunction with characterizing the RNC market. In addition, some specific hypotheses were tested regarding related market barriers.

Interview Structure. The information obtained during the in-depth interviews with windows contractors was used to 1) characterize the residential new construction market in

PG&E' s service territory, 2) assess the role of windows contractors in that market, and 3) test the hypothesized market effects. The general structure of the interviews and the issues they addressed are presented below.

- **Window Contractor Characteristics.** Job description of interview respondent and scope of services provided by company. What percentage of installations is in new construction? Who are the contractor' s major customers (market actor type and specific names of builders)? What percentage of installations was in the Central Valley area last year?
- **Standard Business and Organizational Practices.** How does the contractor interact with other market actors? Has this role changed significantly over time? What are the current equipment specification practices? What factors influence window efficiency specification? Have there been significant changes in these practices during the past seven years? What are the primary reasons for these changes? What are the contractor' s primary sources for information/training? What are the contractor' s normal marketing and promotional practices? Does the contractor normally offer equipment that exceeds minimum standards as an alternative? How do the contractor' s standard practices compare to those of other contractors?
- **Awareness.** Is the contractor aware of federal and state energy efficiency standards for windows? Is the contractor aware of Title 24 code standards for windows? Is the contractor aware of energy efficiency programs (general)? Is the contractor aware of the PCH Program and program requirements?
- **Perceptions.** How important is energy efficiency to homebuyers? To builders? Is this changing? Why/why not?

Architects

The 1998 PCH Program offered technical assistance and product information to architects who assisted builders in the design of homes. Architects often work directly with builders in the designing of residential homes. Thus, they may influence the choices builders make regarding the types of energy efficient measures included in their plans. The objective of these interviews was to identify architects' perceptions of energy efficiency, their awareness of energy efficient products, and changes in their business practices that have resulted from the PCH Program.

Interview Structure. The objective of the architect interviews was to identify 1) standard business practices, 2) assess architects' awareness levels of high efficiency equipment and features and the PCH Program, 3) discern efficiency choice criteria and decision-making practices, and 5) evaluate general market perceptions. The in-depth interview guide was designed to address the following issues.

- **Architect Characteristics.** Background and experience in Northern California market of interviewee. Number of single family homes designed in 1998. Percent in PG&E service territory. Percent in Central Valley. Relationship with other market actors, particularly builders. Changes in these relationships.
- **Business Practices.** What percentage of single family homes designed in 1998 exceeded Title 24? What methods do you use to exceed Title 24 requirements? Have these methods changed over the last seven years? Have you made any changes in your business practices as a result of participation in the PCH Program and/or the ENERGY STAR[®]? If so why? If not why not?
- **Awareness.** Are you aware of the PCH Program? How many homes designed in 1998 were covered under the PCH Program? Ask questions designed to provide a historical perspective on participation in the PCH Program. Are you aware of the Home Energy Rating System (CHEERS in California)? Are you aware of Title 24 requirements?
- **Equipment and Building Shell Specification Decisions.** Awareness of energy efficient equipment and features. How influential are architects on decision-making process for energy efficient equipment? What is their main source of information on energy using equipment? What are main factors considered when specifying the efficiency parameters of equipment and shell measures?
- **Perceptions.** What are architects' perceptions of consumers demand for energy efficient housing. Has this changed over the last seven years? What are the main features looked for in new construction? General perceptions of importance of energy efficiency in marketability of home. Reasons for not designing energy efficient home.

Title 24 Consultants

Title 24 consultants work with builders and architects to ensure compliance with local building codes. Previous studies have shown that Title 24 consultants are typically knowledgeable and influential regarding energy efficient measures, and they may influence builders' and architects' decisions regarding the types of energy efficient measures used in their new homes. Title 24 consultants in the Comfort Home area were interviewed to ascertain their role in the RNC market and to test specific hypotheses regarding their function in the market.

Interview Structure. The following are key issues and questions addressed in Title 24 consultant interviews.

- **Consultant Characteristics.** Consultants were asked how long they have worked in this field and whether or not they work independently or with a company. In addition, they were asked in which geographical area and sector they primarily work.

- **Business Practices.** How many plans did you review last year? What method did you use to review them and report? Has this changed over time? How many of the plans you reviewed were for homes that exceeded Title 24? Is this changing over time? If so, describe the changes and their causes. How do you interact with other market actors? Do you see your relationship to builders changing as a result of market changes or the programs?
- **Awareness.** How aware are consultants of emerging technologies? Of the PCH Program (Base and Plus)? Of the ENERGY STAR[®] New Homes Program? Are they aware of the requirements of these programs? Do they attribute any changes over time to these programs?
- **Perception.** Do you perceive increased energy efficiency as a benefit to the builder, to the consumer, or to both? Do you perceive a problem with product availability? Would you recommend more energy efficient products if they were more prevalent and/or lower priced? How do you perceive customer demand for energy efficiency?

Builders

The PCH Program promotes high efficiency equipment, shell measures, and the ENERGY STAR[®] New Home Rating System. The program also offers technical assistance and product information to builders. In 1998, the PCH Program was designed to serve as a bridge from the existing Base Program to the ENERGY STAR[®] New Homes Program. As such, it sought to influence relative market actors and market barriers. Builders and developers are key decision-makers relating to efficiency choices in new construction.

Interview Structure. The objectives of the builder interviews were to 1) identify the key characteristics of the regional residential new construction market, 2) assess builders awareness levels of high efficiency equipment and features and the PCH Program, 3) discern efficiency choice criteria and decision-making practices, and 5) evaluate general market perceptions. The in-depth interview guide was designed to address the following issues.

- **Builder Characteristics.** Background and company responsibilities of interviewee. Number of single family homes constructed in 1998. Percent in PG&E service territory. Percent in Central Valley. Relationship with other market actors. Changes in these relationships.
- **Business Practices.** How do you interact with other market actors? What percentage of single family homes built in 1998 exceeded Title 24? Have these practices changed since 1991? What methods do you use to exceed Title 24 requirements? Have these methods changed since 1991? Do you market energy efficient homes differently than you market standard homes? How many homes built in 1998 were built under the PCH Program? Has the company made any changes in their building practices as a result of participation in the PCH Program

and/or the ENERGY STAR[®]? If so why? If not, why not? Did you build homes under ENERGY STAR[®] that were not covered by PCH? If so why?

- **Equipment and Building Shell Specification Decisions.** Who are the main influencers on the decision making process for energy efficient equipment? What is the main source of information on energy using equipment? What are the main factors considered when deciding on energy efficient equipment?
- **Awareness.** Are you aware of the PCH Program? Are you aware of the ENERGY STAR New Homes Program? Are you aware of Title 24 requirements? Are you aware of energy efficient equipment and features?
- **Perceptions.** What are builders' perceptions of consumers demand for energy efficient housing. Has this changed over the last seven years? What are the main features sought in new construction? What are the perceptions of builders on willingness to pay for energy efficient upgrades? General perceptions of importance of energy efficiency in marketability of home. Reasons for not building energy efficient home.

Building Inspectors

The primary task of plans examiners and building inspectors in the residential new construction market is to ensure that all new residential buildings comply with state and federal building codes. Plans examiners review the building plans and Title 24 documentation submitted by builders. Compliance must be verified before the building department will issue a building permit to the builder. Building field inspectors check for compliance at various stages of construction. The field inspectors verify that the equipment and shell measures installed match those specified in the plans and ensure that all equipment and measures are installed properly. Building inspectors and plans examiners interact directly with builders and/or Title 24 consultants. Communication is minimal unless plans or installations do not comply with code requirements.

The 1998 PCH Program did not target building department staff, with either direct incentives or informational or training services. However, building departments can be a valuable *unbiased* source of information regarding the standard shell design and efficiency specification practices of builders and their contractors. For this reason, RER interviewed building inspectors and plans examiners to assess the market effects of the PCH Program.

Interview Structure. The information obtained during the in-depth interviews with building inspectors and plans examiners was used to 1) characterize the residential new construction market in PG&E's service territory, 2) assess the role of building inspectors and plans examiners in that market, and 3) provide supportive information to test the hypothesized market effects relating to other market actors. The general structure of the interviews and the issues they addressed are presented below.

- **Building Inspector/Plans Examiner Characteristics.** Job description of interview respondent and scope of services offered. How many new construction plans were reviewed and how many buildings were inspected by this building department last year?
- **Market Observations.** What trends in the residential new construction industry have you observed over the past seven years? Have you observed any changes in how builders typically specify equipment/measures to comply with Title 24? What primary factors have induced these changes?
- **Perceptions.** How important is energy efficiency to homebuyers? To builders? Is this changing? Why/why not?

Sales Agents

Builders' sales agents provide consumers with information on the features of the home and can directly influence consumers' choices regarding those features. The objectives of these interviews were to characterize the role of sales agents in the RNC market, to assess current awareness levels and attitudes, and to test hypotheses related to market barriers.

Interview Structure. The following are key issues and questions addressed in sales agent interviews.

- **Agent Characteristics.** How long has the agent worked in the industry? How many and for which builders do they work? Are they employed or working as a contractor?
- **Business Practices.** How many homes do they sell each year? How many of these have exceeded Title 24? Have any of these been ENERGY STAR[®] Homes? Have these numbers changed over time? How influential are they in assisting consumers to buy homes that exceed Title 24? Have they tried to influence consumers to buy homes that exceed Title 24? Have they ever recommended or worked with Energy Efficient Mortgages or ENERGY STAR[®] Mortgages?
- **Awareness.** Is the agent aware of any emerging technologies? How do they get this information? How knowledgeable are they about Title 24 and about energy products that exceed Title 24? Have they heard of the PCH Program? PCH Plus? ENERGY STAR[®] New Homes? CHEERS ratings? Energy Efficient Mortgages? ENERGY STAR[®] mortgages?
- **Perceptions.** How do they perceive consumer demand for energy efficiency? Is it changing? What, in their opinion, is causing the change? What features do consumers look for in new homes? Is the importance of any of these changing over time? Do they perceive increased energy efficiency to be a benefit for the builder, consumer, or both? How do they perceive the marketability of an ENERGY STAR[®] Home? Is an Energy Efficient Mortgage a strong selling feature?

Lenders

Lenders provide financing for consumers, thus indirectly influencing homebuyer preferences for new homes. The objective of these interviews was to identify the role that lenders play in the RNC market. Further, the interview was designed to test specific hypotheses about relative market barriers and to aid in the assessment of current perceptions, operational procedures, and behavior.

Interview Structure. The following are key issues and questions addressed in lender interviews.

- **Lender Characteristics.** How long has the lender worked in the industry? Do they work for a particular builder?
- **Business Practices.** How many home mortgages do they write each year? How many of these have been energy efficient mortgages? How many energy efficient mortgages have been for residential new construction? Have these numbers changed over time? How influential are they in assisting consumers to buy homes that would help them qualify for an energy efficient mortgage? Do they offer other financial incentives for buyers of homes that exceed Title 24? Do they offer financial incentives to builders who build homes that exceed Title 24?
- **Awareness.** Is the lender aware of Title 24 and about energy products that exceed Title 24? Have they heard of the PCH Program? PCH Plus? ENERGY STAR[®] New Homes? CHEERS ratings? Energy Efficient Mortgages? ENERGY STAR[®] Mortgages?
- **Perceptions.** How do they perceive consumer demand for energy efficient mortgages? Is it changing? What, in their opinion, is causing the change?

Government Staff

Government agencies implement building energy codes and standards and provide informational services regarding energy efficiency. The objectives of these interviews were to identify relevant programs and policies and their objectives, to determine the influences these have on the RNC market, and to learn about the past and future trends in this area. The interviews were designed to aid in the assessment of market characterization.

Interview Structure. The following are key issues and questions addressed in interviews with government agencies.

- **Program Information.** Respondents were asked to describe their program or association and how it relates to or influences the RNC market. What market actors and geographical areas are targeted? How long has the program or agency been in operation? What are the goals? Are there any tracking procedures or enforcement policies in place? How has this changed over time? What changes

are planned for the ENERGY STAR[®] New Homes Program? For the Model Energy Code?

- **Awareness.** Are government agents aware of the PCH Program (Base and Plus)? How strong an influence do they perceive it has had?
- **Perceptions.** Do government agencies perceive that the market for energy efficient measures is changing? What, in their opinion, is causing the change? What do they see as their role in the market? What other market actors do they see as being influential? What are their attitudes about RNC DSM programs? Does the EPA see programs like PCH Plus as having a large influence on the success of their ENERGY STAR[®] Program? How do they perceive consumer attitudes regarding energy efficiency?

Consumers

Consumers living in Comfort Homes are the ultimate purchasers and users of the energy efficient measures installed under the program. Their awareness levels and their perceptions of costs and benefits affect their efficiency choices. As part of this study, consumers living in homes built under the PCH Program were interviewed as well as consumers living in nonparticipant homes. A comparison of responses from these two groups will help to determine if the program has had a perceptible influence on homebuyers' attitudes about energy efficiency.

Interview Structure. The information collected during the interviews with consumers was used to test the hypotheses and to characterize the consumers' role in the residential new construction market. Additionally, it provided a baseline of consumer attitudes and awareness levels, which could be used in future studies. The general structure of the interviews and the issues they addressed are presented below.

- **Consumer Characteristics.** General demographic information were asked including length of time living in the home, number of people living in the home, age of head of household, and typical monthly energy costs.
- **Awareness Levels.** Consumers were asked about their awareness of energy efficiency standards, energy efficiency levels of their air conditioners and windows, and the importance of energy efficiency to their home purchase decision. They will also be asked about their awareness of the ENERGY STAR[®] Program and Energy Efficient mortgages. Additionally, they were asked if their awareness has changed over time.
- **Product Satisfaction.** Consumers were asked if they are satisfied with the performance of their air conditioning costs, and if they are satisfied with the energy costs of their new home. Consumers living in Comfort Homes were asked whether or not their energy bills have decreased and if their experience with their

Comfort Home appliances has increased the likelihood of purchasing high efficiency appliances in the future.

- **Financing Options.** Consumers were asked if they have experience with an Energy Efficient Mortgage, if they believe it can or will save them money and if it would be a deciding factor in purchasing a new home.
- **Efficiency Choices.** Questions were asked regarding their willingness to consider efficiency options, willingness to purchase energy efficient measures in the future, willingness to pay more for energy efficient measures, and preferences of optional efficiency packages.

Survey Protocols

Two very basic protocols were followed to complete the market actor surveys: one for in-depth interviews and another for the telephone surveys.

In-Depth Interviews

Although the protocols varied slightly for each market actor in general (depending on the sample, sample size, etc.), the in-depth interview procedure included the following:

- As mentioned above, the samples of equipment manufacturers, builders, and sales agents included “large” and “small” companies. This enabled RER to oversample the larger companies, thus ensuring adequate market coverage of these market actors.
- All referrals (particularly from builders) were considered to be “priority” sample points and a strong attempt was made to recruit these companies for participation. In most cases, a referred company was removed from the sample after five unsuccessful contact/recruit attempts. Using referrals not only helped minimize recruiting time (screening was not necessary, and in some cases the source of the referral provided a contact name), but also helped to ensure adequate market coverage.
- A “non-referred” company was removed from the sample after a maximum of three or four unsuccessful contact/recruit attempts. If the contact was identified as “large,” the company was not removed from the sample until after five failed attempts.
- During the first contact, each “non-referred” company was screened to ensure that the majority of their business was for residential new construction in either the PG&E area or the assigned comparison region.

Telephone Surveys

A typical three-callback procedure was used for the telephone survey of nonparticipant consumers, sales agents, and lenders.

- Each name on the market actor list was called up to a maximum of three times. If a completed survey was not obtained at that point, the name was dropped from the list.
- For each telephone survey, there are screening questions that ensured that the respondent is a qualified respondent. For example, in the consumer survey, the respondent had to occupy a home built in 1998. For sales agents and lenders, the respondent had to do the majority of their business in Northern or Central California.

The three-callback protocol was extended to five callbacks for PCH Plus participant consumers. This was because a census of these market actors was attempted.

Incentives

The initial survey protocol did not include the use of incentives for any of the market actor surveys or interviews. However, it became evident that, given the unwillingness to participate in the interviews, an incentive to participate for builders outside of California would be needed. Therefore, an incentive of \$50 was offered to builders outside of California. This proved to be very successful and allowed the research interviewers to reach and, in fact, exceed the required goal of 50 completed surveys.

The interview team also faced stringent timeframes for completing the market actor in-depth interviews. Again, in a few cases for architects (4), sales agents (3), builders inside California (4), and contractors (6), a \$25 to \$50 incentive was offered in order to reach the required completed sample sizes within the project schedule. Again, the use of these incentives proved to be invaluable in completing the last few interviews.

3.3 Completed Interviews and Surveys

Table 3-10 presents the targeted and completed number of surveys and interviews by market actor. As shown, 942 surveys and interviews were completed. In particular, 790 telephone surveys and 152 in-depth surveys were completed. All targets were either met or exceeded, except for participant consumers.

Table 3-10: Summary of Targeted and Completed Interviews and Surveys by Market Actor

Market Actor	Targeted Interviews	Completed Interviews
HVAC Manufacturers	5	6
Window Manufacturers	5	5
HVAC Distributors	5	5
Window Distributors	5	5
HVAC Contractors	5	5
Window Contractors	5	5
Architects	10	10
Energy Consultants	5	7
Builders in California	30	31
Builders in Control Area	50	52
Building Inspectors	10	10
Sales Agents	20	20
Lenders	10	10
Government/Nonprofit Association Representatives	10	11
Participant Consumers	255	244
Nonparticipant Consumers in California	255	256
Nonparticipant Consumers in Control Area	255	260
Totals	940	942

Participant Consumers. Table 3-11 presents the completed numbers of surveyed participant consumers by program. As shown, 9% of the completed surveys are with consumers living in homes built under the PCH Plus Program. The remaining participant consumer surveys are with consumers living in homes built under the PCH Base Program. The target of 255 completed surveys was not met. The reasons for not being able to meet the target for participants include the following:

- Nearly 25% of the contacts provided were wrong numbers or numbers belonging to the developer,
- A few of the contacts have blocked numbers so they could not be reached, and
- Approximately 14% of the consumers contacted refused to participate.

Table 3-11: Participant Consumers Targeted and Completed Surveys by PCH Program

PCH Program	Committed Participants	“Move Ins”	Targeted Interviews	Completed Surveys
Base	202	61	61	22
Plus	5,636	557	194	222
Total	5,838	616	255	244

Nonparticipant Consumers and Builders. Table 3-12 presents the numbers of completed nonparticipant consumer and builder surveys in the control area. Note that in all cases but one targets were met or exceeded.

Table 3-12: Builders and Nonparticipant Consumers outside California Target and Completed Surveys

State	Major Utility	Targeted Builder Interviews	Completed Builder Interviews	Targeted Nonpart. Consumer Surveys	Completed Nonpart. Consumer Surveys
AZ	Arizona Public Service	3	3	15	15
	Tucson Electric	3	3	15	19
CO	Fort Collins Light & Power	3	2	15	21
FL	Florida Power & Light	3	3	15	17
	Tampa Electric	3	4	15	19
GA	Georgia Power	3	4	15	19
NV	Nevada Power	3	3	15	19
	Sierra Pacific Power	3	3	15	20
NY	Rochester	3	3	15	16
NC	Duke Power Company	3	5	15	20
TX	Houston Power & Light	3	3	15	18
	Texas Utilities	3	6	15	19
	Austin Electric Department	3	4	15	19
	San Antonio City Public Service Board	3	6	15	19
	Total	50	52	255	260

Note: These regional targets are minimums and do not add up to the total number of completed surveys for builders (50) and nonparticipant consumers (255).

Response Rates

Table 3-13 presents a summary of the response rate by market actor. For the in-depth surveys, the response rates vary from 17% to 88 % with an overall response rate of 34%. For the telephone surveys, the response rates vary from 31% for nonparticipant consumers in the control area to 59% for sales agents. The overall response rate for the telephone surveys was 37%.

Table 3-13: Summary of Survey and Interview Response Rates by Market Actor

Market Actor	Contacted	Completed Interviews	Response Rate
HVAC Manufacturers	8	5	63%
Window Manufacturers	12	6	50%
HVAC Distributors	11	5	45%
Window Distributors	13	5	38%
HVAC Contractors	30	5	17%
Window Contractors	10	5	50%
Architects	16	10	63%
Energy Consultants	8	7	88%
Builders in California	81	31	38%
Builders in Control Area	218	52	24%
Building Inspectors	14	10	71%
Government and Nonprofit Association Representatives	14	11	79%
Total In-Depth Surveys	435	147	34%
Sales Agents	34	20	59%
Lenders	23	10	43%
Participant Consumers	619	244	39%
Nonparticipant Consumers in California	633	256	40%
Nonparticipant Consumers in Control Area	828	260	31%
Total Telephone Surveys	2,137	790	37%

4

Baseline Market Characterization

One objective of this study is to provide a baseline characterization of the residential new construction market in the PG&E service area. RER obtained data on baseline attitudes, perceptions, and behaviors through in-depth interviews with key market actors. This section details this information, along with market functions and influences on decision-making processes. In addition, market share data on efficiency levels is also presented.

4.1 The Market for Residential New Construction

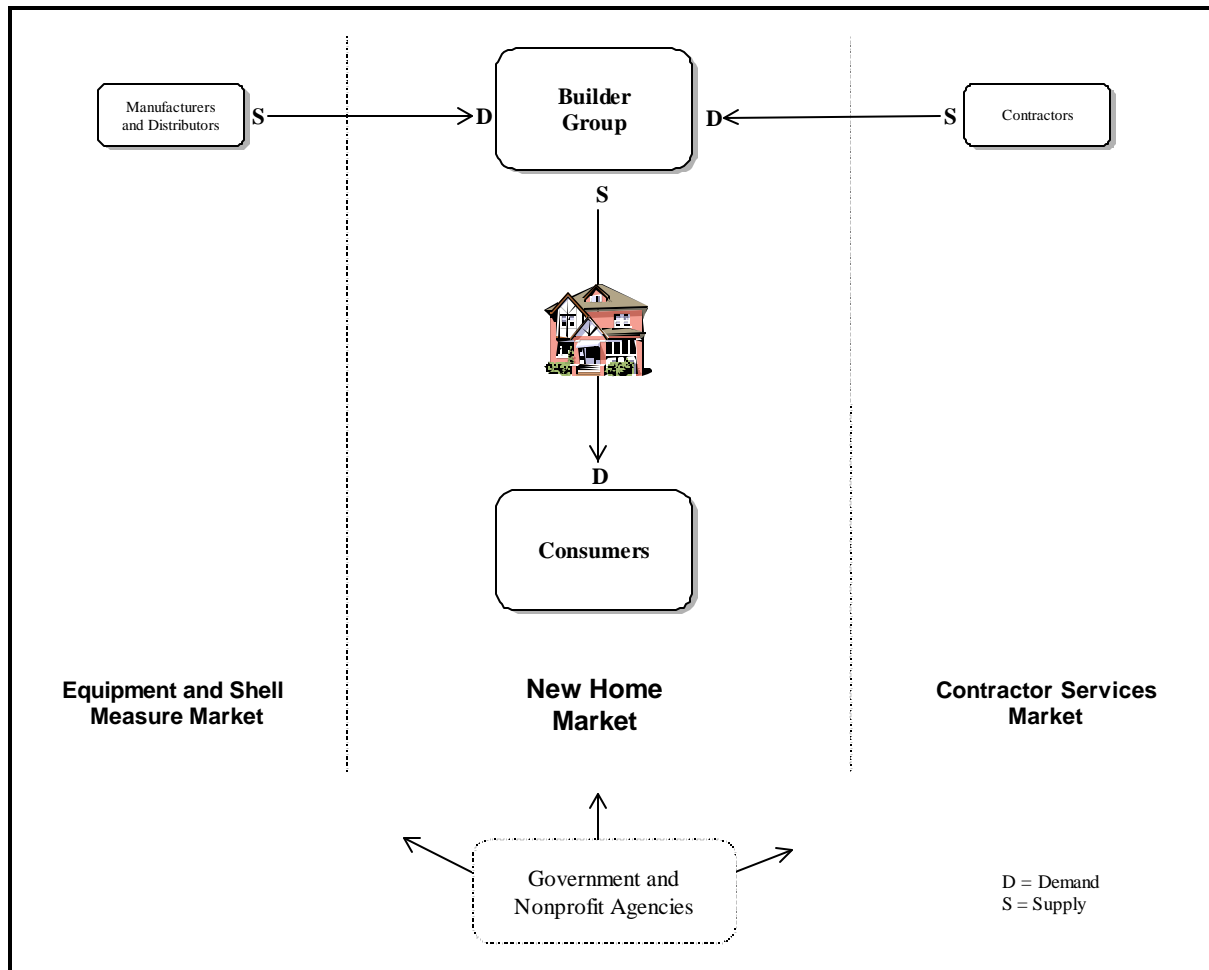
This subsection gives an overall picture of the residential new construction market in Central and Northern California. An overall picture facilitates thinking about changes in the market, identifies market actors involved, how they interact and function in the market, and how market intervention programs fit in the picture.

Overview

The basic economic transaction in the residential new construction market is the purchase of new single family detached housing, referred to herein as the market for residential new construction (RNC). (Note that for the purposes of this study we do not consider multifamily and attached residences.) To understand this market, it is essential to recognize and understand the numerous interactions and transactions between a variety of market actors that occur prior to the purchase of a new home. For example, the HVAC equipment installed in a new home must first be specified (by an engineer or contractor), purchased (from a contractor, distributor, or manufacturer), installed (by a contractor), then inspected (by a building inspector). Such transactions and relationships between market actors formulate traditional markets in themselves. In this sense, one might consider the new construction market on different levels – as having distinct but overlapping equipment and services markets, in addition to the market for the completed home itself.

Figure 4-1 provides an overview of the residential new construction market. As shown, the residential new construction market can be thought of as consisting of the new home market and two ancillary markets: the equipment and shell measure market and the contractor services market. As expected, each of these ancillary markets consists of suppliers and demanders of the product. These markets are summarized below.

Figure 4-1: The Market for Residential New Construction

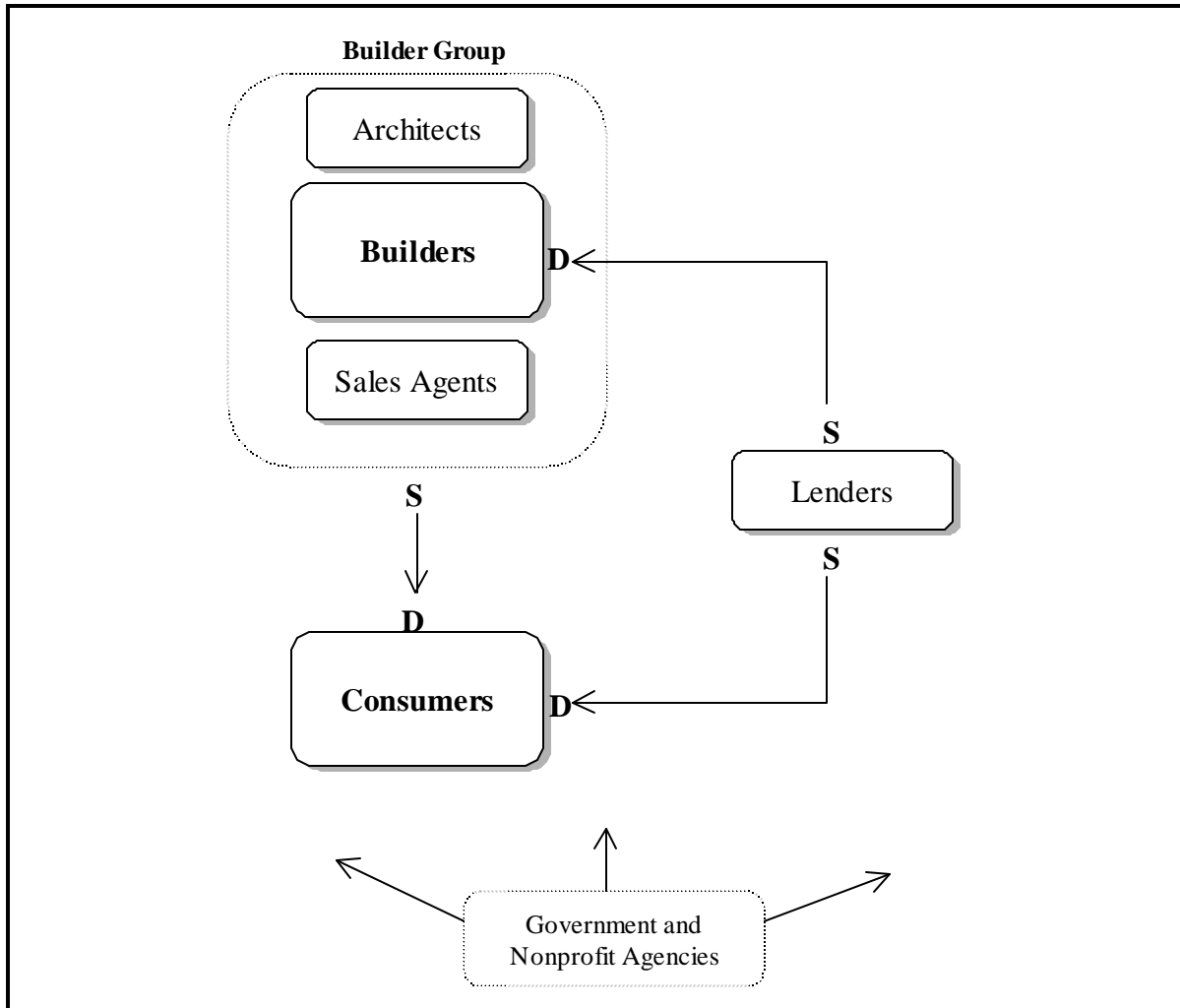


The New Home Market

The new home market is the dominant sub-market in residential new construction, as the commodity bought and sold is the actual completed home. As shown in Figure 4-1, builders and those directly involved in the design and construction of the new home (referred to here as the “builder group”) play the dominant supply side role and homebuyers play the demand-side role in the new home market.

Figure 4-2 provides more detail about the market actors and their interactions in the new home market. During the process of producing their product (a new house), builders rely on a number of transactions with other market actors within the new home market. For example, architects are responsible for the overall design of the home and sales agents assist builders in marketing and selling the homes to consumers. Lenders facilitate the home buying process for both the builder and the consumer by supplying construction loans and consumer mortgages, respectively.

Figure 4-2: Overview of the New Home Market



As the supplier of a product to consumers, one strategy a builder might follow is to differentiate his product in order to gain an edge or niche in the market. While all new homes in California are required to meet Title 24 energy standards, some builders see a benefit in exceeding those standards and marketing their product as better, more efficient, or more comfortable than a “standard” new home. In so doing, certain components of the product assembly process are changed, and these altered components become indicators of increased supply of the differentiated, more efficient house. Indicators identified in this study include the increased prevalence of high efficiency air conditioners, windows, and enhanced duct system installation and sealing, the increased use of duct blaster tests and other diagnostics, and the increased demand for home energy ratings and energy efficient mortgages. In order to examine these indicators more closely, it is helpful to get an overall picture of the markets for these products and services.

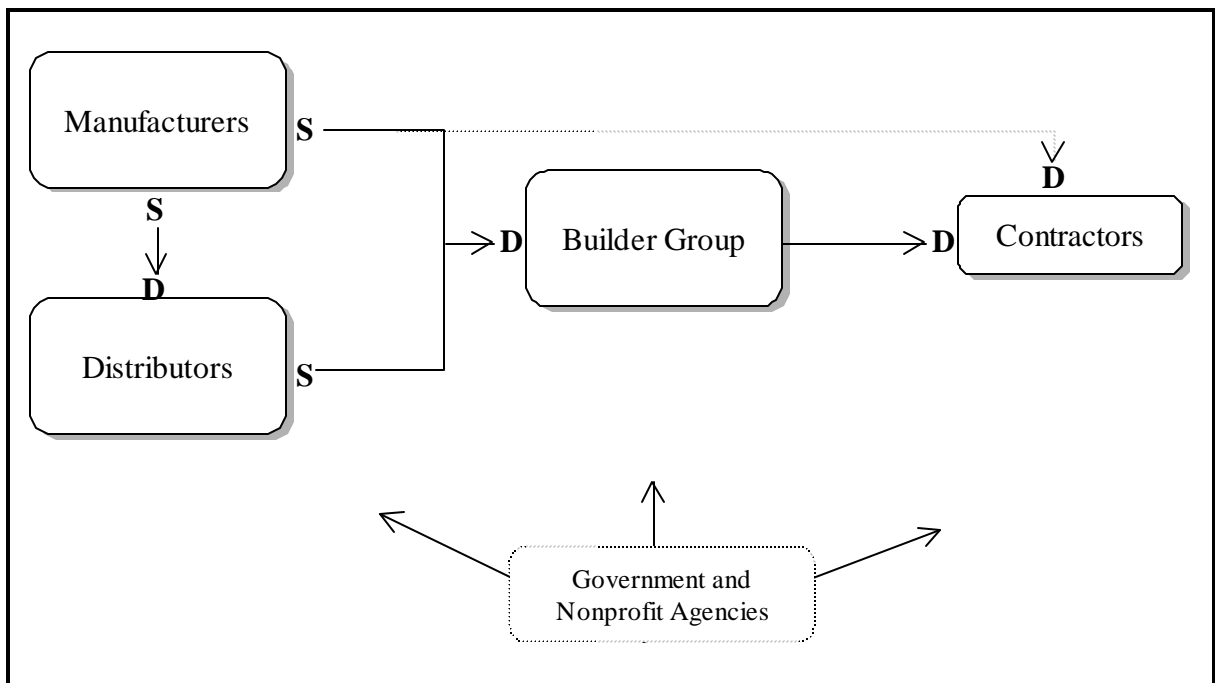
Builders also rely on those outside of the new home market, as well. In particular, builders hire equipment contractors to install and test of equipment and ventilation systems. Title 24 consultants help builders to document their compliance with the required energy standards, and architects and engineers assist builders in drawing up plans and solving design problems.

The Market for Equipment and Shell Measures Installed in the Residential New Construction Market

The markets for HVAC equipment and windows, are of particular relevance here, as these measures were covered by the 1998 PG&E Comfort Home (PCH) Program. As shown in Figure 4-1 above and detailed below in Figure 4-3, in this market builders (or the builder group) are the primary demand-side actors in this market as they purchase the central air conditioning units, furnaces, and windows to be installed in the new homes. Manufacturers are the ultimate suppliers of these products, though the contractor and/or builder might purchase them through a distributor.¹

Manufacturers also supply information to distributors, contractors, and builders. This information concerning new product development, pricing, service, reliability, and efficiency mixes assists the demand-side actors in making informed decisions. Further detail on the market roles of manufacturers and distributors is provided below in Subsection 4.2.

Figure 4-3: Overview of the Equipment and Shell Measure Market

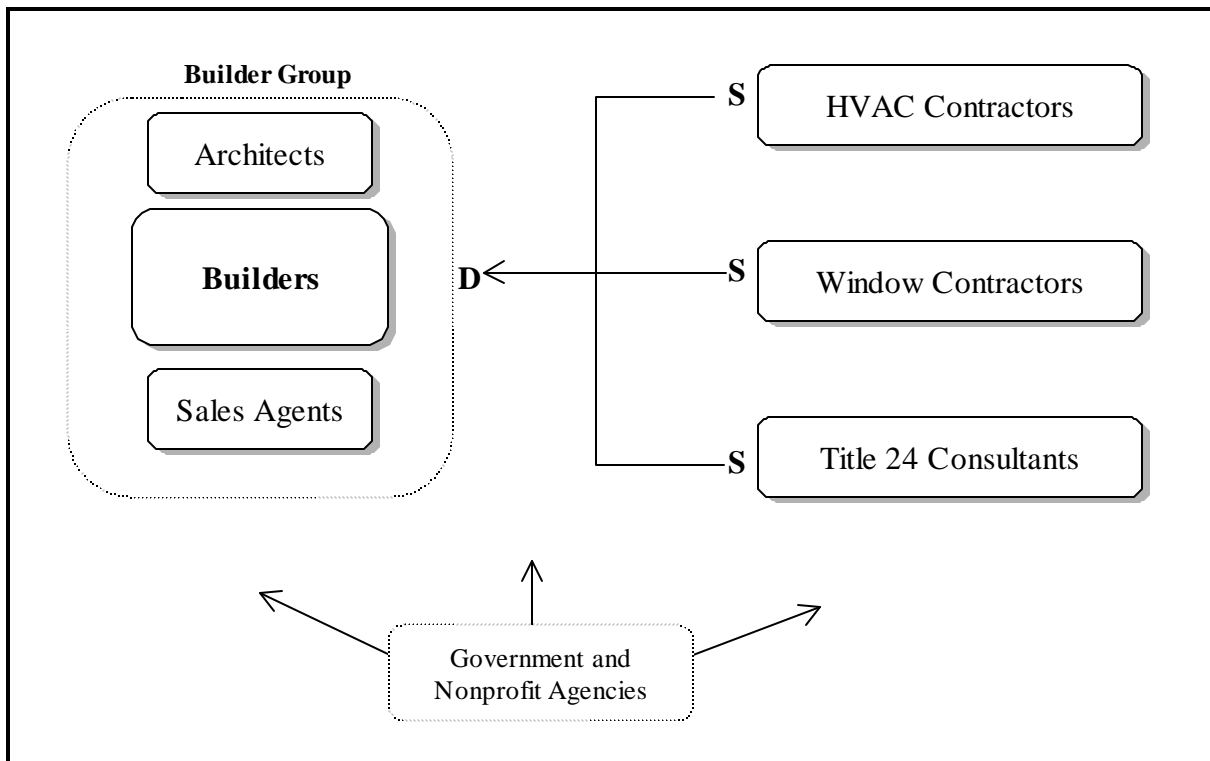


¹ In some cases contractors provide equipment and windows to builders directly, their role is more fully explored in the next subsection.

The Market for Contractor Services in the Residential New Construction Market

Figure 4-1 reveals that builders, or the builder group, play a demand-side role and contractors play a supply side role in the market for contractor services. Specifically, as depicted below in Figure 4-4, builders rely heavily on HVAC contractors to provide HVAC equipment, to install the HVAC system, and, in some cases, to perform diagnostics. Other contractors assisting in the building process include window contractors and Title 24 energy consultants, who work with the builder to ensure compliance with Title 24 and to prepare the required documentation. The role of each of these market actors is discussed in more detail in Subsection 4.2 below.

Figure 4-4: Overview of the Contractor Services Market



Government and Nonprofit Agencies

As shown in Figure 4-1, government and nonprofit agencies have a broad influence on all market actors described in this section. The government influences builders directly through the imposition of minimum energy efficiency standards, and compliance with these standards is recorded by building inspectors. Numerous government and nonprofit organizations exist to support and influence various other market actors by means of research and informational programs, professional associations, and consumer advocacy groups. The roles of these actors are discussed in more detail in Subsection 4.2 below.

4.2 Individual Market Actor Functions, Attitudes, and Perceptions

RER interviewed a variety of participants in the residential new construction market for this study. This Subsection describes each market actor, how they function in the market, primary decision-making influences, and their attitudes and perceptions regarding energy efficiency. The descriptions of market actors are presented here according to the sub-market in which they predominantly operate. Market actors in the new home market are presented first:

- Builders,
- Architects,
- Sales agents,
- Lenders, and
- Consumers.

Market actors of the equipment and shell measure market include the following:

- HVAC equipment manufacturers,
- Window manufacturers,
- HVAC equipment distributors, and
- Window distributors.

The following work primarily in the contractor services market:

- HVAC equipment contractors,
- Window contractors, and
- Title 24 consultants.

Finally, the following market actors interact and influence all sub-markets in residential new construction:

- Building inspectors, and
- Government and nongovernment agency representatives.

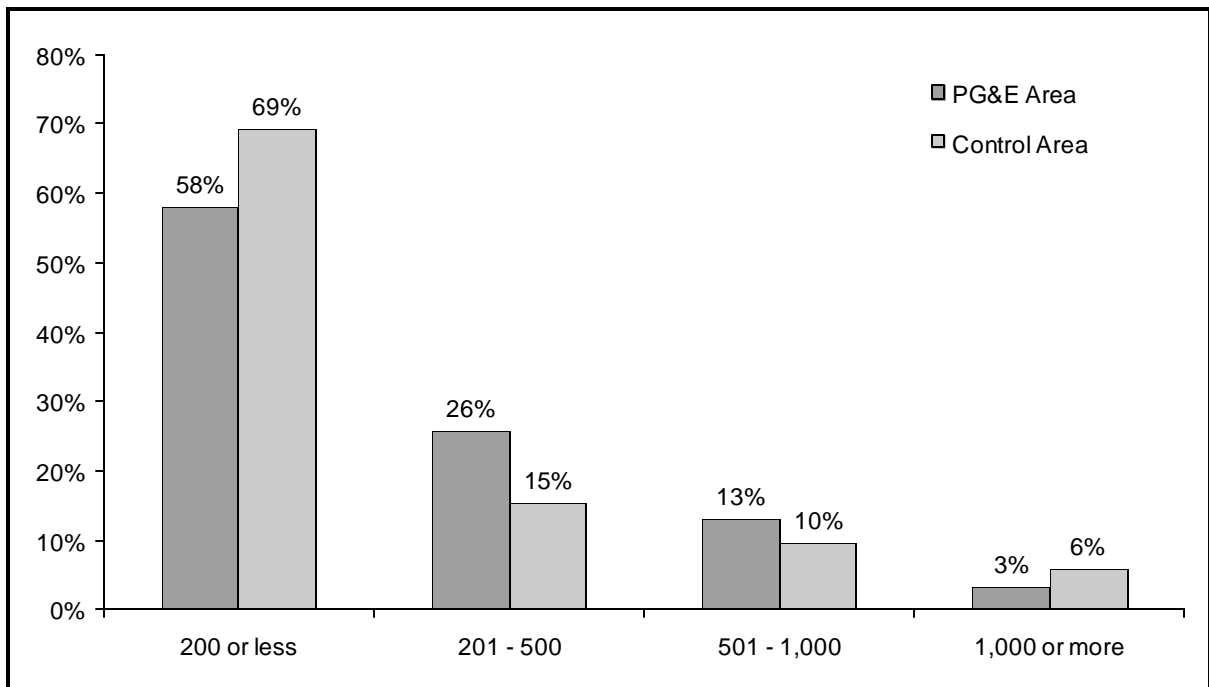
It is important to recognize that some market actors might have a role in more than one sub-market. For example, HVAC contractors could function as suppliers in the equipment and shell measure market, as some purchase equipment directly from manufacturers, then supply (install) the units directly to (for) the builder. Alternatively, a market actor could have two functions within the same sub-market. Lenders operate in the new home market, but work as agents for consumers and builders.

Builders

As indicated above in Figure 4-2, the builder group – a consortium of market actors working together to produce a new home – functions as the primary supplier in the new home market. The dominant actor in the builder group is the builder, who is responsible for coordinating the other actors and making final decisions. The discussion here centers around production builders; variations in the market functions of custom builders are described where applicable. The distinction is notable; production builders are typically larger corporations with various departments and managers sharing the decision-making responsibilities, while custom builders tend to be smaller companies or individual contractors.

Figure 4-5 presents a distribution of the builders interviewed for this study according to their location and the number of homes they reported building in 1998. As shown, the distribution of nonparticipant builders in the control area closely resembles that of builders in the PG&E service area.

Figure 4-5: Number of Homes Built in 1998



Of the builders interviewed, the mean number of years in business is 32.² For California builders interviewed, the mean number of years in the PG&E area is 16. Table 4-1 presents the characteristics of the homes built in 1998 by the sample builders. As shown, nearly 100% of the homes built in the PG&E area by builders interviewed in this study are production homes with gas service.

Table 4-1: Mean Characteristics of Homes Built in 1998

	PG&E Service Area	Control Area
Percentage of homes built in 1998 with gas service	99.84% (0.33)	71.51% (4.81)
Percentage of homes built in 1998 that are production homes	99.68% (0.97)	58.87% (6.58)
Percentage homes built in 1998 that exceed the energy code	47.24% (8.50)	51.61% (7.42)
Percentage of exceeding homes that are production homes	99.53% (1.31)	74.68% (7.55)

Responses are weighted by (normalized) self-reported number of homes built in 1998. Standard errors are in parentheses.

The remainder of this section describes the attitudes and behaviors of builders as reported in the in-depth interviews. In particular, the following items are discussed as they relate to the supply of energy efficient housing:

- The builder's primary functions and interactions,
- Influences on the decision-making process,
- Perceptions and attitudes toward energy efficiency,
- Perceptions and attitudes toward the PCH Program, and
- Self-reported awareness levels.

Primary Functions and Interactions in the Residential New Construction Market

Builders are the central figure and interact with a variety of other market actors within the new home sub-market, as well as with those in other sub-markets. The market actors that the builder directly interacts with include architects, engineers, energy consultants, subcontractors, building inspectors, and sales agents. As the coordinator of these various skills, the builder acts as the organizing force in the supply of new homes. Facing a number of constraints, such as mandatory building and energy codes, local building ordinances,

² All means reported in this section are normalized weighted means using self-reported number of homes built in 1998 as the weight.

project schedules, and budget constraints, builders seek to maximize profit subject to these constraints.

The production builder/developer performs a number of functions, including the following:

- Implementing market research,
- Securing land,
- Overseeing the design and planning of the home(s) and the subdivision or community,
- Securing required permits and compliance documentation,
- Specifying equipment and shell measures,
- Soliciting and awarding bids for contractors,
- Overseeing construction, and
- Marketing and selling the home(s).

Production builders tend to be corporations with a structure that allows various department managers and professionals to share decision responsibilities. The positions within a building company can include any of the following:

- President or Owner,
- Vice President,
- Regional Manager,
- Land Coordinator,
- Contracts Coordinator,
- Director or Manager of Construction,
- Project Manager,
- Director or Manager of Purchasing,
- Director or Manager of Customer Service,
- Engineer,
- Architect,
- Interior Designer, and
- Director or Manager of Sales and Marketing.

The Vice President and Division or Regional Manager have broad areas of responsibility and oversee all company operations, including planning and development. The Vice President or Director of Development typically oversee all company subdivisions and company operations, including land development, marketing, product development/design, construction, architecture, engineering, and sales. Purchasing Directors often oversee all project bidding, product specifications, budgets, and design development. The Director of Construction supervises the development of all projects, while the Project Managers oversee

the operations of one or more particular project. They are typically involved in the product development, mapping, design, subcontracting, and construction of specific projects.

All large developers have a Sales Department to initiate the sales of the homes, usually during an early stage of construction, and to provide input in the preliminary design phase of a project as well. At the “point-of-sale,” consumers might have the opportunity to choose color schemes, flooring, appliances, and possibly upgrade energy related equipment and features to be installed in the home. Some builders combine the Sales and Marketing Departments or have a Sales/Customer Operations Division that is responsible for all sales and marketing tasks. Customer Service personnel also handle callbacks from customers with questions or problems on their new home.

The areas of responsibilities of the individuals within the company often overlap, even though each has its own area of expertise. All of these individuals are involved in the product development process (i.e., the planning, design, and specification of equipment and shell measures in the home), which will be discussed further in subsequent sections. Depending on the size of the company, one individual might be responsible for several of the tasks described above. The marketing, purchasing, design, and construction departments are combined in small building companies, in which the owner or partner typically handles these responsibilities.

Decision Making and Market Influences

The process of designing and building a house requires the coordination and input of a variety of people and decision makers. While wide variations exist across companies, interviews with building companies revealed that many large production builders follow similar production processes. The builders might purchase land and develop it themselves, or purchase finished lots from developers, depending on the size of the building companies. In the former case, they will need to deliver a set of lot plans to the local utilities and arrange for utility services.

Once the land is available, the design of the development and individual house plans begins. Design concepts are developed internally, usually by a team of professionals including designers, architects, marketing and sales personnel, and senior management. Decisions on demographics are made, such as whether or not to target first-time buyers, move-up buyers, or retirement buyers, along with what home features are popular among the chosen target group. Marketing and sales personnel contribute their knowledge of what is selling and what the target buyer will be seeking. Characteristics such as square footage, floor plans, and number of rooms are designated and passed on to an in-house or contracted architect. The architect prepares the preliminary floor plans and building elevations based on this information.

The architect's plans are then reviewed by company engineers. A structural engineer will calculate loads based on the design plans and develop a loading plan. This plan will be reviewed and approved by a soils engineer based on soil samples collected from the site. A foundation system then will be designed by a structural engineer, and reviewed and approved by other in-house engineers.

Title 24 compliance runs are typically conducted by a contracted Title 24 consultant. Some builders request several options from the consultant and then consult with purchasing and construction personnel before specifying equipment, windows, and insulation features. Once the Title 24 compliance documents are complete, the plans are checked by the building department. Changes suggested by the building department's plans examiner will be reviewed by the architect, engineers, and Title 24 Consultant.

Specification of the equipment and shell measures is made by the builder with recommendations from the purchasing manager and subcontractors. Some builders rely heavily on their HVAC contractor to assist in planning the HVAC equipment and duct system, while others specify some initial parameters and solicit contractor bids. In the latter case, the builder will specify the brand of the equipment desired and may also accept recommendations for equipment of equal value and reputation.

Equipment is purchased from a manufacturer, distributor, or contractor. Table 4-2 presents the sources of equipment purchased by builders summarized from interview responses. Note that the majority of HVAC equipment and windows used in residential new construction are purchased from subcontractors. In the case of windows, the proportion purchased from subcontractors in California is smaller as compared to HVAC equipment, possibly due to the presence of some small window manufacturers in Northern California.

Table 4-2: Equipment Sources

Sources	PG&E Builders	Comparison Area Builders
Purchase Air Conditioner from:		
Manufacturer	0.002 (0.009)	0.003 (0.008)
Distributor	0.222 (0.081)	0.077 (0.038)
Subcontractor	0.776 (0.082)	0.920 (0.039)
Purchase Gas Furnaces from:		
Manufacturer	0.002 (0.009)	0
Distributor	0.222 (0.081)	0.047 (0.032)
Subcontractor	0.776 (0.082)	0.953 (0.032)
Purchase Windows from:		
Manufacturer	0.298 (0.088)	0.179 (0.055)
Distributor	0.257 (0.084)	0.164 (0.053)
Subcontractor	0.445 (0.096)	0.657 (0.069)

Sources are indicated with binary variables with a 1 indicating equipment is purchased from that source; variable names are in italics.

Results shown are weighted means; responses are weighted by (normalized) self-reported number of homes built in 1998.

Standard errors are in parentheses.

Most of the builders interviewed for this study claimed to have the ultimate decision-making responsibility while considering recommendations from other market actors. When asked what influenced their decisions regarding the energy efficiency levels of the equipment and shell measures they use in the homes they construct, the following responses were typical:

- Title 24,
- Cost,
- Market competition, and
- Comfort Home rebates.

Although builders are the ultimate decision maker for the energy related features of the home, they rely on the expertise and recommendations of the various professionals with whom they work. As shown in Table 4-3, builders interviewed in the PG&E area claimed to make approximately 86% of the decisions regarding energy related components that go into

building the home. Energy consultants were identified as making roughly 9% of the decisions, while contractors were described as making 5% of the decisions.

Note that the small proportion of homebuyer decisions are due to the nature of the project. Production builders design plans for a set of models, then reproduce those models with minimal options. Typically, those options do not include energy-saving home features. In a custom home project, however, the homebuyer would have considerably more decision-making authority.

Table 4-3: Proportion of Homes for Which Parties Make Efficiency Decisions

Decision Maker	PG&E Builders	Comparison Area Builders
Homebuyer	0.069 % (0.377)	14.649 % (3.429)
Architect	0.094 % (0.443)	4.488 % (1.619)
Consultant (Title 24 in CA)	8.616 % (4.942)	1.172 % (0.980)
Contractor	5.015 % (2.946)	6.407 % (1.882)
Builder/Developer	86.205 % (5.460)	64.475 % (4.834)
Other	0 %	12.085 % (4.157)

Results shown are weighted means; responses are weighted by (normalized) self-reported number of homes built in 1998.

Standard errors are in parentheses.

Interview discussions clarified that while builders take responsibility for all ultimate decision making, they often solicit and value the recommendations of their staff and contractors. Builders interviewed indicated if they thought the various market actors they worked with were influential or very influential in helping them choose efficiency levels. Their responses are summarized in Table 4-4 and the discussion following.

Table 4-4: Influences on Choice of Efficiency Measures

Market Actor	PG&E Builders	Comparison Area Builders
Recommendations of Energy (Title 24) Consultant	0.785 (0.099)	0.195 (0.057)
Recommendations of HVAC Contractors	0.547 (0.129)	0.507 (0.071)
Recommendations of Distributors	0.00 (0.0)	0.233 (0.060)
Recommendations of Manufacturers	0.00 (0.0)	0.478 (0.071)
Recommendations of Architects	0.003 (0.013)	0.184 (0.055)
Recommendations of Other In-House Personnel	0.574 (0.156)	0.699 (0.066)
Recommendations of Sales Agents and Realtors	0.092 (0.087)	0.151 (0.051)
Competition from other builders	0.456 (0.133)	0.702 (0.065)
Own experience	0.927 (0.048)	0.832 (0.053)

Market actors are indicated with binary variables with a 1 indicating they were identified as influential or very influential; variable names are in italics.

Results shown are weighted means; responses are weighted by (normalized) self-reported number of homes built in 1998.

Standard errors are in parentheses.

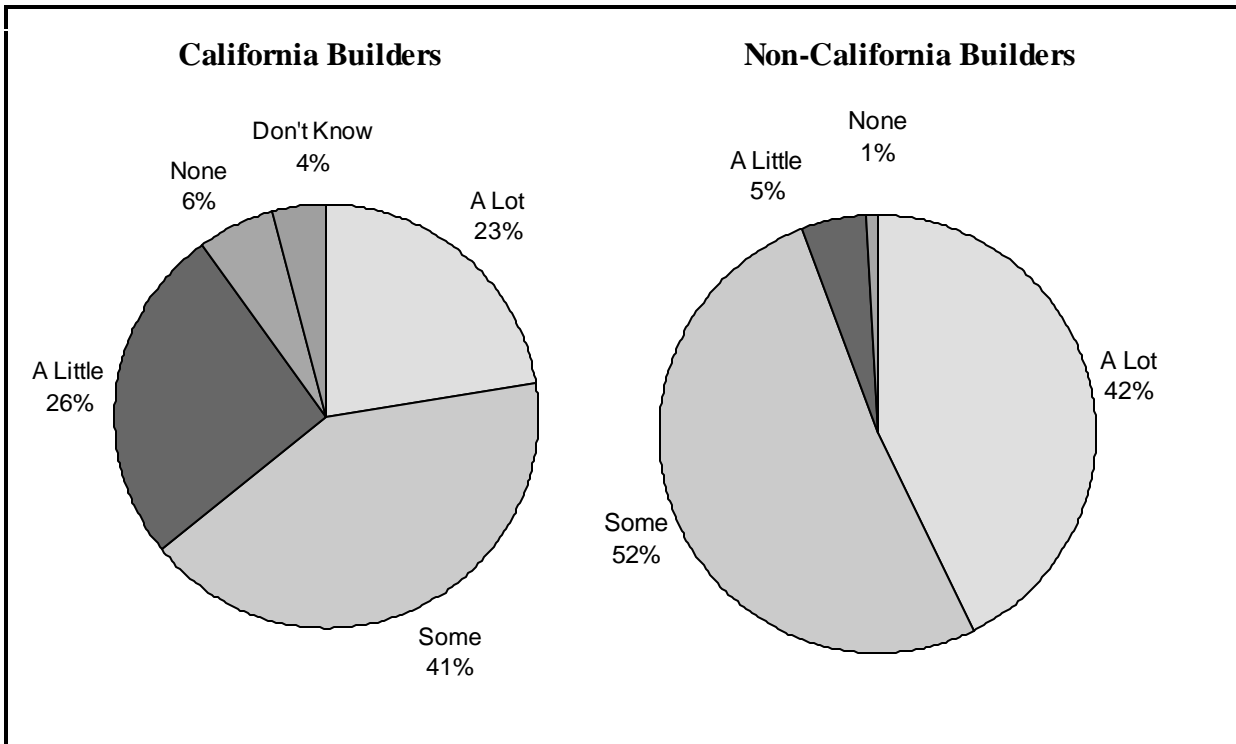
- **Energy Consultant.** Responses from California builders interviewed indicate that approximately 79% consider Title 24 consultants to be very influential. Some of the ways consultants assist builders include presenting various options for complying with Title 24 and their related costs, suggesting different types of equipment to use, and recommending various rebate programs that may be available. With changes taking place in the Title 24 code this year, energy consultants are particularly active with builders since builders rely on them to understand what they need to do to comply with the code. Outside of California, only 20% of builders interviewed considered energy consultants to be very influential. This result may be related to the lack of energy codes or to the relatively less stringent codes in some of these areas.
- **Contractor.** As shown in Table 4-4, roughly 55% of builders in the PG&E area consider contractors influential. Some builders rely heavily on their HVAC contractor to assist in planning the HVAC equipment and duct system, while others specify some initial parameters and solicit contractor bids. In the latter case, the builder will specify the brand of the equipment desired and may accept recommendations for equipment of equal value and reputation. Information obtained during the interviews revealed that many builders in the PG&E area rely

on one particular HVAC contractor who provides both Title 24 and HVAC services and has gained a substantial market share. Many builders rely on this contractor's expertise and follow their recommendations regarding HVAC equipment and ventilation. The role of window contractors is not as prominent in the decision process as that of HVAC contractors, possibly due to the large number of callbacks builders receive from customers on HVAC systems. As one builder explained, "we spend extra on equipment because we don't want callbacks and complaints; so we buy better equipment and our HVAC contractor tells us what he thinks is good."

- **Architect.** Architects are rarely involved in the specification of energy related features of the home. Among builders interviewed in the PG&E area, less than 1% identified this market actor as being very influential. Interestingly, 18% of builders in the control area find architects to be influential in their decisions regarding efficiency measures.
- **Equipment Manufacturers.** Manufacturers were described as being a primary source of information on new equipment technologies for builders. This information is received in the mail, during presentations by sales representatives, through publications, and through trade shows and conferences. (Despite this much used source of information, builders still claimed to rely more on contractors.) One builder noted, "my contractor knows about things six months before I see it anywhere else." None of the California builders interviewed for this study described manufacturers as being influential. However, 48% of builders outside of California identified manufacturers as being very influential in their decisions regarding energy efficiency.
- **Equipment Distributors.** As with manufacturers, none of the California builders interviewed for this study described distributors as being influential. However, 23% of builders outside of California identified distributors as being very influential.
- **Sales Agents.** Sales Agents are the representatives for the builder to the consumer. Most of what the consumer learns about the builder's product is communicated through the sales agent, or through literature that the sales agent provides. Responses from California builders indicate that approximately 9% of builders find sales agents very influential. Outside of California, the proportion is roughly 15%.
- **Other In-house Personnel.** Other in-house personnel include purchasing, marketing, and customer service departments. Responses from California builders indicate that 57% of builders find these personnel very influential. For outside California, the proportion is 70%.
- **Consumers.** The consumer's influence in this market is expressed through his demand and acceptance of the finished product. Builders interviewed were questioned as to how much demand they experienced from consumers for energy saving equipment and features. When questioned about consumer demand, 67% of builders in the PG&E area indicated they found some to a lot of demand. For

builders in the control area, the proportion is 94%. Figure 4-6 illustrates builders' perceptions of consumer demand for energy efficient features.

Figure 4-6: Builder Perceptions of Consumer Demand for Energy Efficiency



Builders who perceived little or no demand for high efficiency were also asked to speculate on why they thought this was so. Some of the reasons mentioned included the following:

- Homebuyers do not know enough to ask about it,
- Energy efficiency is a low priority; other house features are more desirable and homebuyers have a limited budget,
- Homebuyers do not understand payback, and
- The weather is too mild in California for energy efficiency to be an issue.

When asked if consumer demand for energy saving features has changed over the past eight years, the majority of builders responded affirmatively. Eighty percent of builders in the PG&E area thought demand had increased,³ mostly due to increased awareness because of media advertising, the Internet and builder competition. Two California builders ascribed the change to Comfort Home advertising. In addition, 99% of all builders interviewed stated that they thought homebuyers expect new homes to be energy efficient.

³ The proportion is 83% for builders in the control area.

Builders were also asked to speculate on how much consumers value energy efficient options in a new home. Specifically, builders were asked what proportion a homebuyer would be willing to pay of the incremental cost needed to build a home that exceeded the energy code by 10%. As shown in Table 4-5, builders in the PG&E area indicated they thought homebuyers would pay only 31% of the extra cost, while builders in the control area estimated the proportion at 53%.

Table 4-5: Builder Perceptions of Homebuyer Attitudes

	PG&E Builders	Comparison Area Builders
There is some to a lot of demand from homebuyers for energy saving equipment or features	0.668 (0.091)	0.944 (0.032)
Customer demand for energy saving features has increased since 1991	0.799 (0.077)	0.833 (0.053)
Homebuyers expect new homes to be energy efficient	0.999 (0.005)	0.997 (0.008)
If you were to build a home that exceeded code by 10%, what proportion of the incremental cost would homebuyers be willing to pay?	31.40 (10.07)	53.48 (32.85)

DEMANDA, *DEMANDB*, and *EXPECTEE* are binary variables with a 1 indicating an affirmative response; variable names are in italics.

Responses are weighted by (normalized) self-reported number of homes built in 1998.

Standard errors are in parentheses.

Builders of custom homes are influenced more directly by consumers than are production builders. During the building of a custom home, the homebuyers may prescribe the type and efficiency level of equipment they want in the house, or they may choose from the options that are presented by the builder. In either case, a more direct communication exists between the homebuyer and builder in this situation.

In addition to influence from the above market actors, builders mentioned several other areas of influence. Competition from other builders was considered a very influential factor by 46% of California builders and 70% of non-California builders interviewed. Even more importantly, their own experience was cited as very influential by 93% of California and 83% of non-California builders. Furthermore, a large number of builders interviewed identified market conditions as being a factor in their choice of efficiency levels. They explained that in a slower market they might consider higher efficiency as a marketing edge.

Perceptions and Attitudes Toward Energy Efficiency

During the in-depth interviews, builders explained that they rarely discuss their home's energy efficiency as a selling point. In fact, several builders commented that buyers do not

understand payback and do not think about long-term operating costs; rather, they are concerned with their up-front costs and the value they perceive they are getting. Therefore, builders who do build more energy efficient homes tend to market them as more comfortable, better quality homes. In fact, some builders have built their reputation on this and they only build homes that exceed the standards.

Table 4-6 presents builders' responses regarding the importance of various reasons for not exceeding the energy code. As shown, 86% of builders in the PG&E area rated cost a very important reason for not exceeding code. Other reasons are comparatively low in importance. One reason for this may be the role that Title 24 consultants play in California. As one builder put it, "you can just talk to your Title 24 guy and tell him you want to build (above code) and he'll tell you what you need to do."

Table 4-6: Importance of Reasons for Not Exceeding Minimum Energy Efficiency Code Requirements

Reason	PG&E Builders	Comparison Area Builders
Cost	0.855 (0.068)	0.58 (0.08)
Lack of information on energy efficiency measures	0.071 (0.051)	0.12 (0.05)
Lack of availability of energy efficiency measures	0.005 (0.013)	0.00 (0.00)
Difficulty in choosing among alternatives	0.102 (0.062)	0.23 (0.07)
Hassle	0.007 (0.018)	0.30 (0.07)
Difficulties in financing	0.341 (0.150)	0.03 (0.03)
Other*	0.00 (0.00)	0.09 (0.10)

Reasons are indicated with binary variables with a 1 indicating they were identified as important or very important; variable names are in italics.

Responses are weighted by (normalized) self-reported number of homes built in 1998.

Standard errors are in parentheses.

* Includes customer demand, competition, lack of trained installers.

Builder Perceptions and Attitudes Toward the PCH Program

All of the California builders interviewed in this study are aware of the Comfort Home Program and 77% are aware of the ENERGY STAR® New Homes Program. Furthermore, of those who knew of the ENERGY STAR® Program, nearly twice as many reported hearing about the program apart from PCH Plus, rather than as a result of it.

Most California builders value the PCH Program's marketing benefits. In fact, 40% of participant builders responded that they would remain with the program for its marketing benefits if the rebate was no longer offered. The following comments concerning the program were given:

- "Comfort Home gives a selling advantage; it helps ecology and energy efficiency."
- Homebuyers are looking for "location, elevation, floor plan, light fixtures, kitchen, plumbing fixtures. After all of that, if you also have Comfort Home that's a plus. But no one wants it primarily."
- "You have to have it (Comfort Home) to be up to the norm."
- "Comfort Home is not cost effective; the upgrades cost more than the rebate. You may need it as a selling point in a poor market, but in a good market it just adds to our costs."
- "Homes are selling without the PCH Program."

Regarding the PCH Plus Program or the ENERGY STAR[®] New Homes Program, a number of builders had just received some information on the program and were not ready to comment on it. One builder, who was building homes under the PCH Plus Program, commented that he thought it was a tremendous hassle to arrange for the inspections and energy ratings. In fact, he was considering foregoing the inspections and the ENERGY STAR[®] certification for this reason. A similar comment was heard from a Title 24 consultant on the hassle and paperwork involved with the ENERGY STAR[®] New Homes Program. In fact, that consultant stated that he actively dissuades builders from participating in the program for that reason. Furthermore, another builder who was considering building under the ENERGY STAR[®] New Homes Program expressed his frustration of not finding a lender to work with him.

Self-Reported Awareness

Table 4-7 presents builders' self-reported awareness of the latest energy saving technologies for various building components.⁴ As shown, builders in the PG&E area rated themselves lower than builders in the control area for every technology except duct sealing and duct testing. Furthermore, interview discussions revealed that some California builders interviewed had learned about their current duct sealing and testing practices as a result of being in the program.

⁴ Each respondent was asked "For the following equipment and shell features, do you consider yourself very aware, somewhat aware, or not at all aware of the latest available energy saving technologies?" This question is generic, and did not provide a reference point to which respondents could base answers. As such, responses should be interpreted with caution.

Table 4-7: Awareness of Latest Technology

Technology	Builders in PG&E Area	Builders in Control Area
High efficiency air conditioning (<i>BAC1</i>)	0.308 (0.086)	0.633 (0.068)
Gas furnaces (<i>BGASFURI</i>)	0.308 (0.086)	0.561 (0.070)
High efficiency windows (<i>BWINDOW1</i>)	0.384 (0.090)	0.657 (0.067)
Insulation (<i>BINSULA1</i>)	0.373 (0.097)	0.741 (0.062)
Duct testing (<i>BDUTEST1</i>)	0.383 (0.095)	0.172 (0.053)
Duct sealing (<i>BDUTSEA1</i>)	0.383 (0.095)	0.252 (0.061)

Awareness is indicated using binary variables with a 1 indicating they were very aware; variable names are in italics.

Responses are weighted by (normalized) self-reported number of homes built in 1998.

Standard errors are in parentheses.

When asked about the primary source of their information on new technologies, builders within California identified trade magazines, subcontractors, Title 24 consultants, HVAC contractors, conferences and trade shows, and literature from manufacturers. Nearly 20% of the California builders interviewed also mentioned receiving information from PG&E, either through the mail, in meetings, or in training classes. Non-California builders identified contractors, trade magazines, conferences and trade shows, vendors, universities, and energy centers.

Builders were also questioned regarding the factors they consider when purchasing HVAC equipment and windows. Typical responses from California builders were brand name and quality, especially for HVAC equipment. Builders explained that they are highly motivated to reduce customer callbacks and therefore provide reliable air conditioning equipment. No California builders interviewed mentioned energy efficiency as a factor. Non-California builders also mentioned reliability, but more frequently mentioned price and availability as factors they consider. In addition, several non-California builders identified efficiency as a factor they consider when purchasing HVAC equipment and windows.

Builders were also questioned concerning their awareness of the energy code and their practices related to it. Table 4-8 presents mean builder responses in this area. As shown, all

the PG&E builders interviewed for this study are aware of Title 24 and nearly 90% claimed to have a working knowledge of the code. For the control area, roughly 54% of builders reported awareness of an energy code in their area, and 98% of these had a working knowledge of the code.

Table 4-8: Awareness and Practices relating to Codes and Standards

Indicator	PG&E Builders	Comparison Area Builders
Aware of energy efficiency code (Title 24 in CA) requirements for residential new construction	1.00 (0.00)	0.538 (0.079)
Have working knowledge of energy efficiency code (Title 24 in CA) requirements	0.882 (0.060)	0.976 (0.030)
Proportion of single-family homes that exceed energy efficiency code (Title 24) standards in 1998	47.245 (8.496)	51.615 (7.422)
Of those that exceeded code (Title 24) in 1998, proportion that were tract homes	99.528 (1.313)	74.679 (7.547)
Report that proportion of houses built that exceed code has increased since 1991	0.186 (0.089)	0.378 (0.084)
Will company continue to build homes that (intentionally) exceed code (Title 24)?	0.996 (0.016)	0.828 (0.066)

Responses are weighted by (normalized) self-reported number of homes built in 1998. Standard errors are in parentheses.

Builders in the PG&E area reported on average that 47% of their homes intentionally exceed the energy code, with nearly 100% of these being production homes. When asked if this proportion has changed over the past eight years, nearly 19% affirmed that they are building a higher proportion of homes that exceed Title 24 now than they were in 1991. Moreover, nearly 100% of them said they will continue to build such homes.

Architects

Builders employ architects to design the home and prepare the building plans for inspection. While most builders hire an outside architect or architectural firm, large national builders typically have an in-house architecture department. Architects in California are licensed by the Architectural Examiners Board. Currently, the state has approximately 24,000 licensed architects.⁵

Nearly 70% of the architects interviewed for this study work for an architectural firm. On average, almost 80% of the residential building plans completed in 1998 were for builders. Other parties – mostly homebuyers for custom home projects – contracted the remaining

⁵ California Board of Architectural Examiners (CBAE). <http://www.cbae.cahwnet.gov/>

plans. On average, each architect (or architectural firm) worked for 19 different builders last year (responses ranged from 3 to 60 builders).

The remainder of this section describes architects' primary functions, interactions with other actors, and influences in the residential new construction market in Northern California.

Primary Functions and Interactions of Architects in the Residential New Construction Market

The architect's primary function in the residential new construction market is to design a home that is structurally sound, comfortable, and aesthetically pleasing to the homebuyer. Architects interact primarily with builders and Title 24 consultants in the residential new construction market. The architect prepares the preliminary building plans, incorporating information from marketing studies and the builder's general parameters, such as square footage, number of rooms, and basic floor plans. Working from these preliminary plans, the architect works with several market actors, such as the builder, Title 24 consultant, engineers, and other members of the design team, until the plans are finalized. For tract development planning, the building plan often represents the "worst case" in terms of meeting Title 24 requirements. With custom home projects, the architect works closely with the homebuyer and the builder during all stages of design and specification.

Decision Making and Market Influences

The architect interviews revealed that although these market actors are not directly involved with energy efficiency levels, they can be very influential on the builders with respect to energy related specifications. Over 60% of the architects interviewed reported that they had the opportunity to suggest that the builder exceed Title 24. The majority of architects that have made such suggestions to their clients indicated that their suggestions were followed. It is important to note here that the architects who indicated that builders are receptive to suggestions designed mostly custom homes or high-end production homes last year. All of the architects who design production homes explained that energy efficiency issues are not in the scope of their responsibilities, and that builders rely on Title 24 consultants to specify energy related features, such as windows and insulation.

Because of the nature of their profession, and the fact that architects often interact with Title 24 consultants, they generally have a good working knowledge of Title 24 requirements. Overall, architects are fairly aware of the latest available energy efficiency technologies. The architects tended to be very aware of high efficiency air conditioning, gas furnaces, high efficiency windows, and insulation. Architects were least aware of current duct testing and sealing methods. Architects' primary source of information included Title 24 energy consultants, manufacturer sales representatives, trade shows, and various other newsletters and trade publications.

Awareness and Perceptions of Demand for Energy Efficiency

Ninety percent of the architects interviewed had heard of the PCH Program, although one respondent did not know the program was sponsored by PG&E. Two of the 10 architects interviewed had heard of the PCH Plus Program, and two had heard of the ENERGY STAR[®] New Homes Program.

There was some diversity on architects' opinions about the demand from homebuyers for energy saving equipment or features. Roughly 50% perceived a lot of demand, while the remaining half reported that there was very little demand. The reasons cited for low demand for energy efficient features in new homes included costs, high standards creating a lack of need from the buyers because they already expect that level, lack of knowledge on the buyer's part, and lack of interest. Despite the range of answers regarding current demand, many of the architects (60%) agreed that demand for energy saving features had increased since 1990. Recommendations for stimulating buyer demand leaned heavily toward marketing through different media sources.

Sales Agents

Builders' sales agents facilitate the sale of the home and are responsible for all transactions between the consumer and the builder or developer. Their primary function is to help consumers find a home in which they feel comfortable and that fits their lifestyle. Essentially, a buyer who employs an agent relies on their judgment and knowledge of the market to help them in their decision-making process. This subsection discusses the responsibilities of builders' sales agents in the new construction market, their interactions with other market actors, and their primary influences within the market.

A builder's sales agent is either employed by the builder or works on a contract basis. Of those interviewed for this study, 55% of the sales agents were employed by the builder, 35% worked on a contract basis, and 10% said they did both. The Department of Real Estate must license all real estate agents, brokers, and sales agents in California. Currently, there are over 298,000 licensees in California.⁶

Primary Functions and Interactions in the RNC Market

Sales agents, who are representatives of *builders*, are the key players with respect to new construction tract home sales. Sales agents typically work out of a sales office within a community or development during construction. They provide the consumer with literature and sales and marketing materials made available by the builder regarding the home's features and about the community in general.

⁶ California Department of Real Estate (DRE). <http://www.dre.cahwnet.gov/licstat.html>

Decision Making and Market Influences

Sales agents can influence and be influenced by both builders and consumers. The level of influence largely depends upon the following items:

1. Consumer awareness levels regarding energy efficiency (if consumers are not aware of energy efficiency, they do not know to ask the sales agents the “right” questions),
2. The level of consumer interest in energy related features (regardless of actual knowledge),
3. The knowledge of the sales staff regarding equipment and shell measures, and
4. The extent to which builders train sales staff and provide them with information regarding equipment and shell measures.

Given the above, the degrees to which sales agents influence and are influenced by builders and consumers are discussed below.

- **Consumers.** The first two items above refer to consumer demand and awareness of energy efficient equipment and features. The extent to which sales agents are involved with and can influence consumer decisions regarding energy efficiency levels could depend largely upon how sales agents perceive consumer interest in energy efficiency of their new home. Only one of the sales agents interviewed for this study estimated that 75% “have asked about homes that were more energy efficient than [what] the state building code requires.” The remainder of the sales agents’ estimates fell at the 40% level and below, with half of those indicating that none of the customers asked about such homes. The level of interest from the buyer for features that exceed minimum energy efficiency building code standards regardless of the buyer’s awareness of code standards was slightly higher. In this case, 21% felt that there was a lot of demand. The highest percentage fell into the *some demand* category at 42%.

Sixty-three percent of sales agents indicated that there is at least *some* consumer demand for energy saving features that exceed the minimum energy efficiency standards (42% indicated *some* demand and 21% *a lot* of demand). In addition, 67% of the respondents felt that consumer demand for energy saving features has increased since 1991; the remaining 33% indicated that demand has remained about the same.

In most circumstances, sales agents are the only market actors with whom consumers interact during the selection and purchasing process. The results discussed above suggest that sales agents do perceive homebuyer interest in the energy efficiency of new homes. In fact, almost all of the respondents (95%) thought that homebuyers expect new homes to be energy efficient. The interview results also suggest that agents feel they are fairly influential in consumer

decisions regarding the energy related features in new homes. In particular, over 28% of the agents indicated they were *very influential*, 17% *somewhat influential*, 39% *not very influential*, and approximately 17% considered themselves *not at all influential*.

It is important to note that *having* strong influence and *utilizing* strong influence are not necessarily synonymous. Although, 28% indicated they were *very influential* in encouraging homebuyers to buy homes that exceed the minimum standards, only 5% indicated that they had suggested such a purchase. In addition, almost 90% of the agents *do not* market the homes that exceed the minimum energy efficiency standards any differently than those that just meet the standards.

It is also interesting to mention that although the sales agents interviewed indicated that there was usually only some interest from homebuyers for energy saving features, 13 of the interviewees (72%) classified 100% of the single family detached homes they sold in 1998 as exceeding the minimum energy efficiency standards.

- **Builders.** With respect to builders, the sales department provides input during the initial project development phase and conveys to the builder the characteristics and features of homes that consumers find to be most appealing. While most builders seriously consider input from the sales department, they do not rely on sales agents for feedback regarding energy related equipment and measures.

Items 3 and 4 above essentially refer to how knowledgeable the sales staff is with energy efficiency and Title 24 requirements and how proactive the builder is in promoting energy efficiency to the sales staff and, therefore, the consumer. On average, sales agents reported being at least *somewhat aware* of the latest available energy saving air conditioning, gas furnaces, duct systems, and high efficiency windows. The least amount of knowledge, as expected, lies in the duct systems. Eighty-five of the agents indicated being aware of Title 24 requirements.

Most of the sales agents reported that their primary source of information was the builders. Other sources included contractors, suppliers, and other literature. Eighty-five percent of the sales agents would take advantage of training on energy efficient housing if it was offered as education credit with the Real Estate Licensing Board and it was at a reasonable cost.

When asked about their influence on builders to exceed Title 24, generally, sales agents reported being not very influential. About 6% reported being *very influential*, 33% *somewhat influential*, 13% *not very influential*, and 47% indicated they were *not at all influential*.

Most of the sales agents (70%) had at least heard of the PCH Program. Only one agent had heard of the PCH Plus program and another person had heard of Energy Star New Homes Program. Only 20% recalled selling homes that were built under the program.

Forty-five percent of the agents knew about special mortgages available to help buyers purchase energy efficient homes. Of those that had heard of an energy efficient mortgage, over 77% mentioned the Energy Efficient Mortgage. No one had heard of the ENERGY STAR[®] Mortgage and one sales agent mentioned an FHA mortgage.

Lenders

Functions and Interactions of Lenders in the Residential New Construction Market

Lenders can provide financing for both consumers and builders. For the purposes of this study, lenders provide homebuyers with the financing required to purchase a new home. Some lenders specialize in mortgages for new residential construction. These are usually mortgage companies specializing in new housing mortgages, a division of a mortgage company, or a mortgage company owned by a builder. In addition, lenders can provide builders with the financing necessary for land development (construction loans).

Over 30% of the lenders interviewed for this study were involved with both homebuyer loans/mortgages and construction loans. The majority of the lenders (56%) specialized in homebuyer loans. Only one lender focused on construction loans.

Decision Making and Market Influences

Lenders do not directly influence the consumer or the builder. A lender can only assist homebuyers and builders financially. Energy efficiency is generally not in the scope of their profession. Lenders may have some effect on the marketplace by simply making energy efficient mortgages available to the homebuyer. In some cases, the energy efficiency of the homes being built may influence the terms of the loan. Although none of the respondents in this study indicated that they provided these types of loans. Consumer mortgages and construction loans are discussed below.

- **Consumer Loans and Mortgages.** The majority of lenders (63%) indicated that the energy efficiency levels of new homes do not influence consumer mortgage terms. Respondents indicated that they did not require any information about the equipment or features of a home beyond the fact that it passed the minimum codes.

Since October 1993, newly constructed homes must meet or exceed the energy conservation standards established by the Council of American Building Officials (CABO) in the 1992 Model Energy Code (MEC). California's Title 24 energy standards are higher than this.

Only 38% of the lenders had heard of mortgages available to help buyers purchase homes that exceed energy efficiency standards. The only loan that respondents knew about was the FHA loan. HUD allows borrowers purchasing these homes to

qualify for FHA mortgages at 2% higher than normal qualification ratio.⁷ That is, FHA will insure the additional loan amount for the energy efficient measures without further qualification or down payment. None of the companies that the lenders worked for currently offered these types of mortgages to homebuyers.

- **Construction Loans.** Construction loans are short-term loans to either a developer for a tract community or an individual for a custom home. For an individual building a custom home, a construction loan is taken out after the lot is purchased. The typical term is one year, after which the homeowner usually has the option of converting the loan into a mortgage or seeking other financing. For tract builders, the typical loan period is one year and the loan is paid off as the homes are sold.

As mentioned previously, none of the respondents in this study indicated that they provided construction loans that were influenced by the energy efficiency of the home being built. None of the lenders even required proof that the plans met building and energy efficiency codes. The lenders interviewed for this study indicated that they were *somewhat influential* in assisting builders seeking financing for homes that exceed Title 24. Several indicated that because they work with both the buyer and the builder as the middleman, they could convey some of the buyers preferences to the builder.

Awareness and Perception of Demand for Energy Efficiency

Most of the lenders had not heard of the PG&E programs. Thirty percent had heard of the PCH Program and one person had heard of the PCH Plus program. Of those that had heard of the programs, two (50%) of them had worked with a builder who received incentives under the program. One had worked with the homebuyer and the other had with the builder for a construction loan.

Consumers

Consumers represent the demand-side of the market for residential new construction. They may or may not be aware that the home they purchased was constructed under the PCH Program or of the benefits from the installation of high-efficiency equipment and shell measures. However, as the final end users of these products, they are the ultimate beneficiaries of the utilization of these products.

This subsection presents the baseline characterization of consumers in the PG&E service area as revealed from survey responses. Responses from consumers in the PG&E area are weighted averages of participating and nonparticipating households whose homes were built in 1998 or later. For reference, comparable information is included for the control area, which is defined as the rest of the country. Differences between consumers in the PG&E service area and consumers in the control area will not be considered in any detail at this

⁷ HUD Mortgage Letter 93-26.

point. Instead, they will be analyzed in the course of testing various hypotheses relating to the market effects of the Comfort Home Program (See Section 5). The following items are discussed below.

- The function and interactions of the consumer in the RNC market,
- Consumer demographics,
- The general importance of energy efficiency in the consumer's choice of residence,
- Consumer awareness of energy efficiency programs and standards, and
- Consumers' perceptions of energy efficiency in their own homes.

Primary Functions and Interactions in the Residential New Construction Market

As shown above in Figure 4-2, market interaction for consumers comes through contact with sales agents and lending institutions that provide informational and financing services and with government agencies and nongovernment organizations. Market interaction influences differ substantially between tract and custom projects. Functions and influences of consumers vary by project type (custom or production home) and consumer type (first-time or repeat buyers). For example, in the custom home market, the consumer's role and level of influence are expanded. In the tract home market, the consumer has very little influence, if any at all, and the influence of other market actors is more dominant.

Project Type. The project type refers to whether a home is a custom home or part of a tract development. With respect to custom homes, the consumer is the primary decision maker on all aspects of design and construction, including the specification of energy efficiency levels and equipment and shell measures. While the architect and contractors consult directly with the builder (as with all projects, whether custom or tract), there is a considerable amount of communication between these market actors and the homebuyer. Thus, the architect and contractors have more influence on homebuyer preferences in a custom project than in a tract home. In a tract home development, the builder is the primary decision maker. Although the builder relies heavily on the architect and contractors, he usually makes all final decisions pertaining to equipment and shell measure specification. Homebuyers may be offered option packages to upgrade the model of home they choose; however, these packages rarely include energy-saving options.

Consumer Type. First-time homebuyers have different preferences and priorities in their purchase decisions than do repeat buyers. In particular, first-time homebuyers are less likely to request equipment and measure upgrades, "they are just happy to get into a home." They are more concerned about the *fixed costs* (the purchase price of the home) and are less familiar with a home's *variable costs*, or the monthly utility expenses and equipment

operating and maintenance costs. Repeat homebuyers, on the other hand, have more experience with such variable costs and are less likely to “settle” for minimum specifications. First-time homebuyers also have more restricted budgets and are more likely to purchase a tract home.

Consumer Demographics

Table 4-9 presents mean characteristics of the consumers surveyed in the PG&E area. The control area consumers are also presented for reference. The PG&E sample is split between consumers living in program homes and a random sample of remaining PG&E customers that moved into new single-family detached homes in 1998. Roughly 30% of both the PG&E and the control area samples are made up of first-time homebuyers.

As shown, the average PG&E customer is a middle-aged person with a small family, two-year college degree, and annual income of approximately \$55,000.

Table 4-9: Mean Characteristics of Consumers in PG&E Area

Indicator	PG&E Customers	Control Area
Income	\$55,336 (1,248)	\$60,854 (1,400)
Household size	3.38 (0.07)	2.97 (0.08)
Age of head of household	41.81 (0.57)	42.70 (0.85)
Highest education level achieved (in years)	15.05 (0.10)	15.548 (0.13)
Local or state standards	1.00 (0.00)	0.90 (0.02)
New Construction Programs	1.00 (0.00)	0.51 (0.03)
Average electricity price	\$0.119 (0.00)	\$0.079 (0.08)
Normal HDD	3,066 (7)	2,794 (130)
Normal CDD	972 (20)	2,191 (70)

Responses are weighted means.
Standard errors are in parentheses

Importance of Energy Efficiency in the Consumer's Choice of Residence

According to research done for this study, consumers in the PG&E area report that energy efficiency is important to them and is a factor in their decision to buy a new home. As shown in Table 4-10, most consumers in the PG&E area rated energy efficiency as important or very important to them, and more than 70% indicated that it was an important factor in buying their current home. Furthermore, consumer awareness has been increasing over time. As shown, a majority of consumers reported increased importance over the past seven years. Slightly less (43%) reported increased importance over the past four years.

Table 4-10: Importance of Energy Efficiency

Indicator	PG&E Customers	Control Area
Energy efficiency is important or very important	0.909 (0.013)	0.892 (0.019)
Energy efficiency of this home was important or very important in the decision to buy or rent it	0.711 (0.020)	0.654 (0.030)
Energy efficiency has become more important over the past four years	0.429 (0.022)	0.324 (0.029)
Energy efficiency has become more important over the past seven years	0.539 (0.022)	0.380 (0.030)
Given experience with energy efficient home, energy efficiency will be important or very important in purchase of next home*	0.929 (0.018)	NA
If looking for a new home, would look for one with energy efficiency measures	0.900 (0.014)	0.794 (0.025)
If I could upgrade the efficiency of a new home and save \$10/month, I would be willing to pay more for the home	0.697 (0.021)	0.503 (0.031)
Assuming I could finance at least part of the cost, I would be willing to pay a premium of \$_____ on the sales price of the home	\$1,849 (238)	\$1,313 (228)

Responses are weighted means.

Standard errors are in parentheses.

* This question was asked only of PG&E consumers living in a program home.

Ninety percent of consumers in the PG&E area indicated that if they were to look for a new house, they would look for one with energy-efficient measures. When questioned as to what features they would look for, windows and insulation were the most typical answers. Interestingly, most responses mentioned dual pane windows, which are already used in most standard homes. Roughly 20% mentioned HVAC systems and several consumers (less than 1%) mentioned sealed ducts or more efficient ducts. Several of the consumers living in program homes mentioned they would look for a Comfort Home and one indicated he would look for an ENERGY STAR home.

Consumers were asked if they would be willing to pay more for a home that saved them \$10 a month on their utility bills. As shown in Table 4-10, 70% responded affirmatively and indicated they would be willing to pay \$1,849 more on average.

Consumer Awareness of Energy Efficiency Programs and Standards

On the average, most PG&E customers are aware of energy efficiency standards. As shown in Table 4-11, 95% of consumers in the PG&E area reported a general awareness of energy

efficiency standards and 70% and 78% reported awareness of standards for air conditioners and windows respectively. These awareness levels are fairly close to averages outside of California.

Roughly 48% of PG&E customers are aware of the Comfort Home program. Awareness of the ENERGY STAR New Homes Program and energy efficient mortgages is low (15% and 20% respectively), but higher in California than outside the state.

Table 4-11: Awareness of Energy Efficiency Programs and Standards

Indicator	PG&E Customers	Control Area
Aware of energy efficiency standards relating to appliances, windows and insulation levels	0.951 (0.011)	0.854 (0.027)
Aware of minimum energy efficiency standards for air conditioners	0.678 (0.027)	0.713 (0.038)
Aware of differences in windows	0.781 (0.020)	0.809 (0.026)
Aware of Energy Star Program	0.154 (0.016)	0.089 (0.018)
Awareness of energy efficient mortgages	0.205 (0.019)	0.138 (0.021)

Responses are weighted means.
Standard errors are in parentheses.

Part of the marketing campaign for Comfort Home Program included television and magazine advertising aimed at consumers, as well as a toll-free information number. Of the consumers surveyed in the PG&E area, approximately 40% remembered seeing a Comfort Home advertisement and roughly 8.5% reported that they called the 800 number to get additional information.

Consumers' Perceptions of Energy Efficiency in Their Own Homes

As shown in Table 4-12, consumers are less aware of the efficiency levels used in their own homes. Although roughly half the sample of PG&E customers are living in program homes, only 35% of consumers were aware that their home or air conditioner exceeded required standards. Yet, 82% of consumers living in program homes claimed to know their home qualified as energy efficient.

Table 4-12: Awareness of Energy Efficiency in Own Home

Indicator	PG&E Customers	Control Area
My home exceeds energy efficiency standards on appliances, windows and insulation levels	0.357 (0.025)	0.477 (0.042)
My air conditioner exceeds energy efficiency standards	0.345 (0.032)	0.499 (0.051)
Was aware that this home qualified as an energy-efficient home when purchased it*	0.819 (0.025)	NA
Satisfied with performance of air conditioner	0.870 (0.016)	0.960 (0.013)
If replacing present air conditioner, would replace it with a model with equal or higher efficiency*	0.990 (0.008)	NA

Responses are weighted means.

Standard errors are in parentheses.

* These questions were asked only of consumers in program homes.

Most consumers (87% in the PG&E area) are satisfied with the performance of their air conditioner, and 99% of consumers in program homes stated they would replace it with a similar efficiency model if needed.

HVAC Equipment Manufacturers

HVAC equipment manufacturers produce a variety of heating and cooling equipment for the residential sector (including central and room air conditioners, heat pumps, gas furnaces, electric furnaces, and air filters), and the commercial sector (such as packaged systems, split systems, chillers, refrigeration systems, and building controls). HVAC equipment manufacturers also produce a variety of air comfort equipment for the transportation industry.

Nationwide, roughly 2.8 million gas-fired forced-air furnaces are produced each year, in addition to approximately 200,000 gas-fired boilers (for hydronic central heat systems). In total, natural gas-fired furnaces and boilers account for approximately 85% of the national market for central heating equipment. The gas furnace market, as a whole, increased by roughly 3% between 1994 and 1997.

As shown in Figure 4-7, nine manufacturers account for nearly the entire gas furnace market in the United States. The top three manufacturers (Carrier, Goodman, and Rheem) account for 52% of all gas furnace sales. The remaining six manufacturers account for 47% of all furnace sales, while the remaining firms account for only 2% of the market.⁸ The unitary air

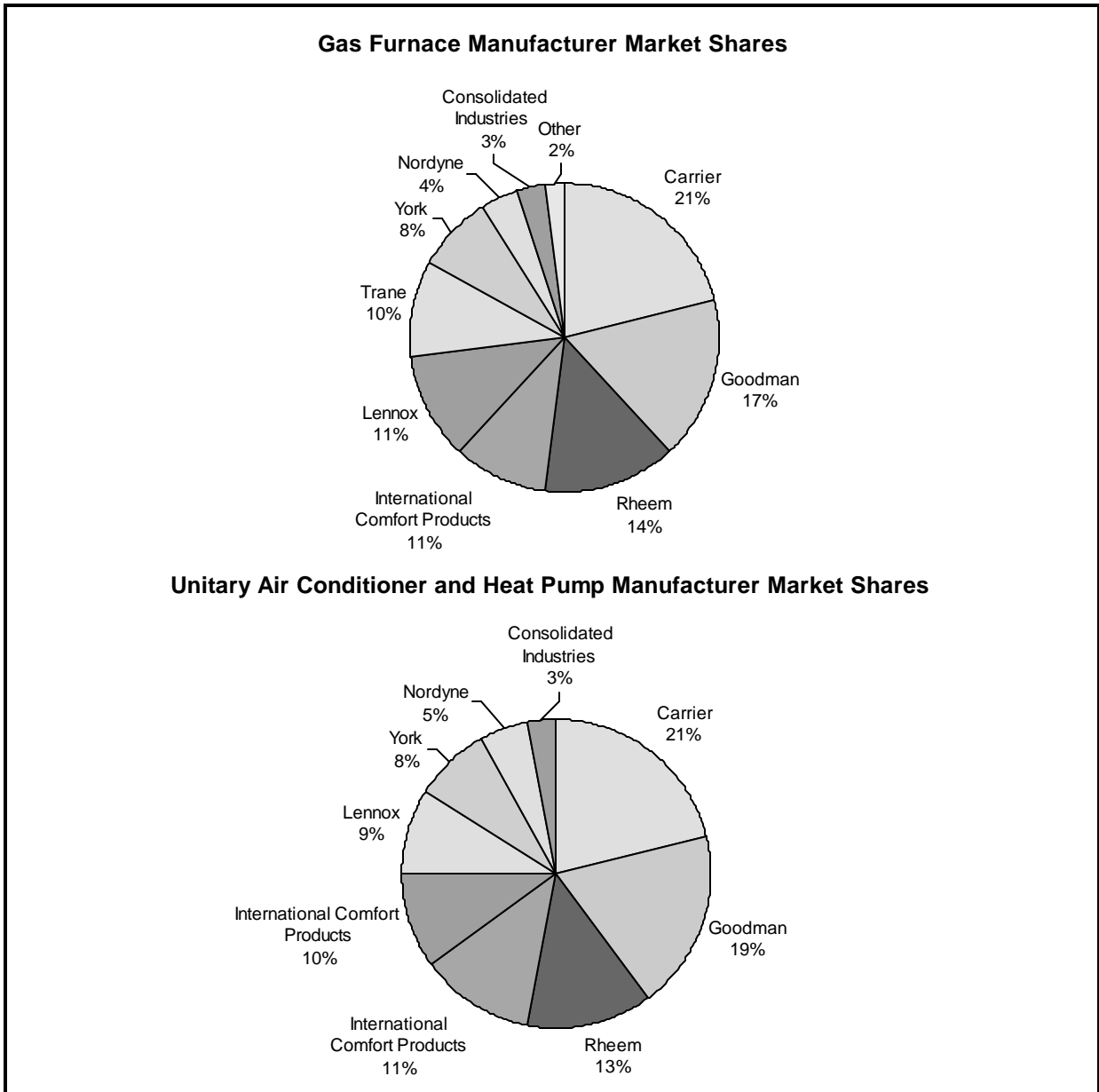
⁸ Appliance Magazine. September 1998. These statistics refer to both the residential and nonresidential gas furnaces.

conditioning and heat pump market is nearly twice the size of the gas furnace market, with roughly 5.4 million units produced each year. Shipments of these HVAC units have increased nearly 40% between 1994 and 1997. As shown below, the same handful of manufacturers also dominates this market. Carrier, Goodman, and Rheem again accounted for over 50% of the shipments of space cooling units in 1997.⁹

RER interviewed five of the nine major HVAC equipment manufacturers for this study. The primary functions and market interactions in the residential new construction market, size and sales volumes, research and development efforts of HVAC equipment manufacturers, and perceptions of demand for high efficiency units are described below.

⁹ Appliance Magazine. September 1998. These statistics refer to both the residential and nonresidential gas furnaces.

Figure 4-7: Manufacturer Market Shares of Heating and Cooling Equipment (1997)



Functions and Interactions of HVAC Equipment Manufacturers in the Residential New Construction Market

HVAC equipment manufacturers are the ultimate suppliers in the efficiency measure market, as shown above in Figure 4-1. Manufacturers have two primary roles in this market, including the design, development, and production of HVAC equipment, and the dissemination of information about the equipment to other market participants.

HVAC equipment manufacturers interact primarily with HVAC equipment distributors, through the distribution of equipment, and with HVAC contractors and other industry participants through the dissemination of information. The government also has a significant influence on the manufacturing industry through the regulation of new equipment efficiency levels. These market interactions are discussed briefly below.

- **HVAC Distributors.** Manufacturers interact with distributors primarily through equipment sales – the manufacturer sells equipment to the distributor. All manufacturers sell their products to an equipment distributor, who then sells the units to the HVAC contractor. As discussed below, some manufacturers own their own distribution channels, while others sell their equipment to independent distributors. Some manufacturers sell to both independent and factory-owned distribution companies.
- **HVAC Contractors.** While the production of HVAC equipment is their most critical role, manufacturers provide a significant amount of information to demand-side market actors, primarily to HVAC contractors, and the industry, in general. With the primary objective of increasing sales and brand/company loyalty, manufacturers provide a great deal of equipment information relating to new technologies, equipment features, and proper installation. There are several means by which information is disseminated to the marketplace, including in-person contact between a manufacturer (sales) representative and the HVAC contractors, trade literature, and trade association meetings and conventions.
- **Government Agencies.** The primary interaction between government agencies and equipment manufacturers is through the regulation of energy efficiency levels. In particular, the National Appliance Energy Conservation Act (NAECA), effective January 1991, mandated efficiency level benchmarks for appliances.

Company Size and Sales Volume

All of the manufacturers interviewed for this study reported having an international market for the units they produce. Most interviewees hesitated to provide company-specific information. While manufacturers were hesitant to provide company-specific data that could reveal the competitive nature of their business, the following generalizations can be made with respect to company size and sales growth:

- Manufacturers reported a growth in air conditioner shipments from 1997 to 1998 of 2% to 15% and a growth of shipments of gas furnaces of about 6% during the same period.
- Manufacturers consider California to be the largest residential HVAC equipment market in the United States. In particular, manufacturers reported that shipments to California ranged from 5% to 10% of total sales.
- Roughly, 20% to 30% of residential gas furnaces and about 25% to 30% of residential air conditioners produced are installed in new construction. A majority (90% to 100%) of these units are designed for detached single family homes

Inventory Practices

Stocking and inventory practices vary among HVAC equipment manufacturers. Before the 1990s, most manufacturers practiced traditional batch manufacturing methods – producing and stocking equipment to cover orders for a specified period in the future. In the early 1990s, many switched to “just-in-time” or “build-to-order” systems, implying that, in general, inventory levels are kept as low as possible. Essentially, keeping an inventory of equipment costs money. To reduce overall operating costs and to remain competitive, manufacturers are reducing or completely eliminating their inventory levels and shifting toward a “build-to-order” production, not producing HVAC units until an order is received from a regional branch or distributor. This is a relatively new practice adopted to reduce lead times, reduce overall inventory, and increase overall company operating efficiency.

Some manufacturers pressure distributors to inventory and warehouse the equipment themselves, while other manufacturers maintain some regional inventory stocks that can be shipped to distributors. As discussed below, changes in stocking and inventory practices seem to be coincidental with consolidation in the regional HVAC distribution market. Several manufacturers noted that there are fewer small, independent equipment distributors. This could very well be due at least in part to increased demands on distributors to inventory product.

Distribution Practices

Distribution practices are typically classified as direct, one-step, or two-step distribution. The distinction is the number of intermediaries between the manufacturer and the final consumer. (In the context here, the final consumer is the HVAC contractor.) Direct distribution entails the sale of products from the manufacturer directly to the contract. As will be explained below, some distribution of HVAC equipment – particularly central air conditioners – is direct. With one-step distribution, the manufacturer sells products to a distributor who then sells them to either a builder or contractor. One-step distribution is also very common in the residential new construction market. Two-step distribution implies that

products are sold to a distributor and then to a retailer, who then sells directly to the contractor.

All of the HVAC equipment manufacturers interviewed for this study employ a traditional one-step distribution of products sold for installation in the new construction market, though one company reported also selling to licensed HVAC contractors. The manufacturers interviewed for this study reported that the majority (between 70% and 90%) of HVAC equipment distributors are independently owned. Most companies did not report significant changes in their distribution practices, though one manufacturer even explained that it is getting out of the distribution business completely and now sells its product to independent HVAC equipment distributors.

Research and Development of New Technologies and Innovations in HVAC Equipment Manufacturing

All of the manufacturers interviewed indicated that their firms engage in research and development, but two of the five companies would not divulge specific data regarding research and development expenditures. According to those who did respond, research and development efforts account for between 5% to nearly 10% of the manufacturer's total operating budget. Overall, expenditures have not significantly changed since 1991.

Nearly all manufacturers reported that changes in manufacturing practices and technologies are continuous and driven by the need to decrease overall manufacturing costs to maintain or increase competitive position in the market and to increase efficiency of the manufacturing process. Furthermore, none reported any noteworthy product innovations; most research and development has resulted in gradual improvements in equipment design.

Even though all companies conduct their own research and development activities, respondents cited trade publications, research and trade organizations, equipment vendors, energy councils, and competitors as sources of information on new technologies and manufacturing techniques.

Perceptions of Demand for Energy Efficiency

The manufacturers interviewed for this study perceive "some" demand from homebuyers for residential HVAC equipment that exceeds the minimum efficiency standards, and that demand for high efficiency equipment has increased slightly in recent years.¹⁰ Interview respondents cited high first cost and the fact that buyers pay more attention to products that

¹⁰ Due to the reluctance of manufacturers to provide specific sales volume data, responses regarding manufacturer perceptions of buyer attitudes are unweighted averages of responses from all interview respondents.

increase the aesthetic value of a home than to increasing energy efficiency as primary reasons for slow demand growth for these units. Manufacturers also see geography as a primary demand driver. Regions in the nation with high heating and/or cooling loads exhibit higher growth rates for high efficiency HVAC units than those with relatively low loads. Although California is the largest market of most manufacturers, it has not yet shown strong demand for residential HVAC units that exceed minimum standards.

HVAC equipment manufacturers explained that education and rebates should be used to increase buyer demand for high efficient units. In particular, education, lower first costs (i.e., rebates), and influence on builders, in general, will be the most influential strategies in the new construction market. Manufacturers viewed rebates to consumers as the most influential strategy to increase efficiency levels of HVAC replacements.

HVAC Equipment Distributors

HVAC equipment distributors function as intermediaries between manufacturers and HVAC contractors. Most distributors carry a variety of HVAC equipment and related products for the residential and small commercial market, including central air conditioners, room air conditioners, evaporative cooling units, fans ventilators, and duct equipment and sealing products.

The distribution market in Central and Northern California, as in many other areas of the country, has consolidated over the past 20 years with many of the smaller distribution firms being bought out by larger rivals. (One manufacturer stated that all of the distributors it sells product to are “large.”) Currently, there are over 22 distributors of HVAC equipment for the residential and small commercial markets in California. Some of the larger distributors have large areas of distribution that could span over state lines and have as many as 30 individual locations.

Functions and Interactions of HVAC Equipment Distributors in the Residential New Construction Market

As indicated in Figure 4-1, distributors function as suppliers in the efficiency measure market. In general, the distributor’s function in the new construction market is limited to the sale of product. Distributors typically purchase HVAC equipment from manufacturers and sell it to contractors or builders. Most distributors sell units for new construction only to HVAC contractors, though one respondent indicated that they sold roughly 30% of the units directly to the builder. Distributors typically have little influence on equipment purchase decisions because they do not interact directly with the builder or project development/specification team. Furthermore, distributors are not viewed as market actors that provide the builders and contractors with a significant amount of information. Although

some might have their own sales representatives, distributors do not typically market the products they carry and rely heavily on the manufacturers' marketing and advertising efforts.

Company Size and Sales Volume

The majority of distributors were unwilling or unable to provide detailed sales information for this study. Those that did respond reported selling between 350 and 1,200 residential gas furnace units and between 600 and 700 residential air conditioners in 1998. One large distributor indicated about 4,800 furnaces and 2,400 air conditioners were sold company-wide last year. Most distributors experienced rapid growth in the early 1990s, but report volume increases of less than 10% in recent years. Most of the distributors interviewed for this study explained that a large percentage of their total sales are in the Central and Northern California region. Distributors in the sample estimated that 70% to 80% of units sold are for single family detached homes. Sales for new construction projects account for 10% to 40% of total sales.

Inventory Practices

Some distributors are "full-line supply houses" that stock all products that the HVAC contractor requires for all residential or small commercial projects. The stocking and inventory practices of HVAC equipment distributors can be described as a balance between the ability to meet current demand for a variety of products and the prevention of stock-outs on popular items. It is crucial that the distributors ensure that they stock all advertised and promoted items. Distributors often forecast sales and inventory needs based on past demand, future orders, and marketing plans. After accounting for these factors, inventory levels are then set to meet the expected demand.

Half of the respondents indicated that inventory practices have not changed in recent years. One indicated that they are now stocking higher levels than in the past in response to changing inventory practices of manufacturers, while one explained that they are keeping less inventory to keep inventory costs at a minimum.

Distribution Practices

As explained above, the distribution channel of residential HVAC equipment for new construction is a "one-step" process, in which the manufacturer sells product to distributors, who then re-sell the product to HVAC contractors. Distributors then ship the HVAC equipment to HVAC contractors or directly to the job site, depending on the size of the order.

While some manufacturers own these distribution companies (i.e., "factory branches"), others exclusively use privately owned independent firms. Manufacturers that own their distribution companies are the exception rather than the rule – all of the firms interviewed for this study are independently owned companies that specialize in the products of just one or

two manufacturers. Ownership independent of the manufacturer gives the distributor freedom to competitively choose its equipment stock from a wide selection of products offered by a number of manufacturers and set its own prices.

Most HVAC distribution firms reported that, while some changes have occurred in the HVAC industry, in general, no major changes have occurred to their distribution practices during the 1990s.

Perceptions of Demand for Energy Efficiency

The HVAC equipment distributors interviewed for this study perceive “very little” to “some” demand for residential HVAC units that exceed the minimum efficiency standards.¹¹ In addition, there was some consensus among distributors that consumers are more interested in high efficiency units than builders, primarily because builders are mostly concerned with first cost, rather than operating costs, of the units they install in new homes. Distributors also agreed that demand for residential HVAC units that exceed the minimum efficiency standards has been increasing slightly in recent years. They attributed the increase to “word of mouth,” manufacturer advertising, and better HVAC contractor knowledge and awareness.

Similar to manufacturers, the HVAC equipment distributors interviewed for this study indicated that educating consumers, contractors, and rebates are the best strategies for increasing demand for high efficiency equipment.

Window Manufacturers

There are several thousand firms manufacturing residential and nonresidential windows nationwide.¹² The firms in the industry vary in structure and produce a wide variety of window and non-window products. Many of these manufacturers tend to be small firms that sell their product only in one local area or region, while a few of the largest window manufacturers have well over a thousand employees and distribute their products internationally. The characteristics of large, medium, and small window manufacturers are summarized below.

Large Manufacturers. The four largest national window manufacturers, having an estimated combined market share of 20% to 30% of the overall market, are Andersen, Marvin, Pella, and Weather Shield Manufacturing (Eto, Arasteh, Selkowitz, 1996). The total

¹¹ Due to the reluctance or inability of most distributors that were interviewed to provide specific sales volume data, responses regarding distributor perceptions of buyer attitudes are unweighted averages of responses from all interview respondents.

¹² As of December 1997, the NFRC listed 120 manufacturers of NFRC certified products, 24 of which are located in California.

number of large window manufacturers (producing more than 1,000 windows per day) is estimated to be between 12 and 20 firms within the U.S. and Canada.

Medium Manufacturers. Roughly 200 manufacturers can be characterized as medium-sized and have a combined market share estimated between 30% and 50% (Eto, Arasteh, Selkowitz, 1996). These firms tend to focus on serving the needs of their region, rather than only a local area or a national territory. Much as with the industry as a whole, it is difficult to generalize about what these firms “look” like. Some millworking firms produce a variety of wood products for the building industry and produce wood doors and windows. Other firms engaged in the production of metal or plastic building materials may also produce aluminum or vinyl windows. Still other firms will buy either linear aluminum or vinyl from extrusion firms, glass from a manufacturer, and assemble the finished window themselves. Firms that mold the purchased framing materials, cut the glass to required sizes, and assemble the window are known as “fabricators,” which are also considered to be window manufacturers.

Small Manufacturers. The majority of window manufacturers are small firms operating within a localized geographic area. Among these small firms, there is said to be substantial entry and exit into the window manufacturing industry, as well as “intense” price competition among the firms (Eto, Arasteh, Selkowitz, 1996). These small manufacturers (estimated to number over 2,000 nationwide) are believed to have a combined market share of 20% or less (Eto, Arasteh, Selkowitz, 1996). Many serve only their immediately local markets and have sales forces based out of the same facility where manufacturing occurs. Due to the expertise and capital required, many of these smaller firms do not have a strong offering of energy efficient products (Eto, Arasteh, Selkowitz, 1996).

RER interviewed six window manufacturers for this study, three of which are considered “large” and have national or international distribution. The primary functions and market interactions in the residential new construction market, size and sales volumes, and research and development efforts of window manufacturers are described below. Perceptions of demand for high efficiency windows are also presented.

Functions and Interactions of Window Manufacturers in the Residential New Construction Market

Window manufacturers are also primary suppliers in the efficiency measures. Window manufacturers have three primary functions in this market, including the design, development, and production of fenestration products; sales of fenestration products to distributors or directly to contractors and builders; and the dissemination of information to key market actors.

Window manufacturers interact primarily with window distributors, dealers, builders, and contractors. While their primary role in the new construction market is the production of windows and other building products, some firms also serve as distributors by owning their own distribution outlets. Some manufacturers also retain subcontractors for window installation for some builders.

- **Window Distributors.** Manufacturers interact with distributors mainly through product transfer – the distributors sell the units that the manufacturer produces. Window manufacturers either own their own distribution companies or sell to an independently owned distributor or dealer. Window manufacturers mostly employ either a “two-step” or a “one-step” distribution process, selling their product for new construction projects to distributors, who then sell to either contractors (for installation in new homes) or retail stores (for purchase by contractors).
- **Builders.** Interviews with both builders and window manufacturers reveal that roughly 30% of the builders in California purchase windows directly from the manufacturer.¹³ With the primary objective of increasing sales and brand/company loyalty, manufacturers also provide a great deal of equipment information relating to new technologies and materials. Manufacturers disseminate information through in-person contact between a manufacturer (sales) representative and the builders, trade literature, and trade association meetings and conventions.
- **Window Contractors.** Window manufacturers interact with window contractors primarily by providing information related to new technologies, equipment features, and proper installation. However, this research reveals that many purchase agreements between builders and manufacturers include window installation. In particular, some of the smaller, local firms also contract directly with window contractors for window installation. Builders will often contract directly with these manufacturers for *installed* windows, but the manufacturer typically subcontracts out the actual installation of the windows to a window contractor.
- **Government Regulation.** All equipment manufacturers are subject to government regulations, though competition between manufacturers also has significant influence on product characteristics. Manufacturers cited the Model Energy Code and California’s Title 24 as influential on their manufacturing processes.

The demand-side actors (builders and contractors) have a great deal of influence on manufacturing decisions and the characteristics of the windows produced. The government also has a significant influence on the industry through the regulation of efficiency levels and other window characteristics.

¹³ The remaining 70% are purchased from a window distributor (26%) and from subcontractors (44%).

Company Size and Sales Volume

Among the firms interviewed, production ranged from 15,000 units to over 2 million units in 1998. Most manufacturers indicated that sales have increased since 1991 (20% to 50%), while a few explained sales have not changed, or even decreased slightly. Respondents and other industry representatives estimate that sales to California account for 5% to 10% of the national window market.

The following generalizations can be made about the residential new construction window market:

- Manufacturers reported that roughly 57% of the units sold in 1998 were installed in residential new construction projects (estimates ranged from 50% to 100%).
- About 80% of the units installed in new construction are designed for single family detached homes (estimates ranged from 60% to 100%).

Inventory Practices

All of the manufacturers interviewed for this study described their current stocking and inventory practices as “build-to-order.” They typically stock a significant number of parts, but windows are not assembled until an order is received. While nearly all manufacturers indicated these practices have not changed in recent years, previous research indicates that manufacturing innovations in glass cutting, for instance, have drastically reduced production time, enabling manufacturers to fill orders more quickly and reduce storage costs.

Distribution Practices

Distribution practices varied among the manufacturers interviewed for this study. While most firms indicated that at least a portion of units are sold to distributors, who then sell product to contractors or builders, one company sells only to window contractors. About 30% of all units shipped to California are sold through distributors (estimates ranged from 0% to 90%).

As will be explained below, window distributors are either manufacturer or independently owned. For example, one manufacturer has sales offices throughout the world and distributes its product only through these outlets. Another large firm in the sample owns distributors only in a specific region in the U.S., and sells to independent distributors in all other areas. Other distributors are independently owned, such as Home Depot, Home Base, and lumber and builder supply chains.

Research and Development of New Products and Innovations in Window Manufacturing

All window manufacturers have a research and development department, with R&D spending accounting for roughly 1% to 2% of the annual operating costs. All manufacturers except one indicated that R&D spending has been relatively stable since 1991. In general, R&D efforts and manufacturing innovations accomplish the following:

- To continue to improve product quality and durability,
- To continue to improve manufacturing processes,
- To develop low maintenance products,
- To remain competitive in the industry, and
- To develop new energy saving technologies.

Perceptions of Demand for Energy Efficiency

On average, the window manufacturers interviewed for this study perceive “some” demand from homebuyers for high efficiency windows. Furthermore, manufacturers indicated that consumer and/or builder demand for high efficiency windows has increased in recent years. Manufacturers attributed demand increases to heightened homeowner awareness, training, marketing and publicity, and availability of high efficiency alternatives. Interview respondents suggested education and increased incentive programs as strategies for stimulating demand for high-efficiency fenestration products.

Window Distributors

Window distributors in the residential new construction industry function as intermediaries between manufacturers and contractors or builders – the link between the window supply and demand markets. In fact, two of the five manufacturers interviewed for this study explained that they serve both manufacturer and distributor roles. The majority of distributors are independently owned companies that stock and sell a variety of windows, doors, and other building products and interior entry components. Sales regions of companies in the sample ranged from regional (California or “most of Northern California”) to international (Western U.S. and overseas). Window distributors sell new construction products primarily to builders and contractors, and to retail and building supply outlets, such as Home Depot and lumberyards for replacements and retrofits.

The following sections discuss their primary functions in the residential new construction market, size and sales volume, and inventory and distribution practices. Distributor perceptions of demand for high efficiency windows are also presented.

Functions and Interactions of Window Distributors in the Residential New Construction Market

Distributors sell products for residential new construction projects to both builders and contractors. In the case of large builders purchasing a national brand, the issue of going through the distributor occurs on paper only and the manufacturer ships the product directly to the builder. Other manufacturers sell directly to retail outlets, such as window and door stores or lumberyards, and require the builder to purchase from these retailers. Smaller custom home builders can usually only purchase national brand windows from a window retailer.

Company Size and Sales Volume

The majority of window distributors operate in regional areas consisting of multiple cities or counties. The characteristics of the distributors interviewed for this study include the following:

- Estimated sales volumes of residential windows ranged from 200 to over 50,000 units in 1998.
- Most firms could not provide historical sales data, but reported production growth rates since 1997 ranging from 17% to 45%.
- New construction projects account about 50% of residential window sales (estimates ranged from 40% to 90% of total sales).
- Over 85% of the units sold in 1998 for residential new construction were for single family detached homes.
- Roughly 78% of units sold were shipped to California, indicating that the distributors in the sample tended to have regional distribution areas (estimates ranged from 25% to 100%).

Inventory Practices

Stocking and inventory practices vary across distributing companies, but there is a common trend toward decreasing inventory levels, placing more orders from the manufacturer, and selling more product that is shipped directly from the manufacturer to the customer. About half of the distributors indicated that they maintain inventory levels on hand of between \$250,000 million to \$1 million, while the remaining firms operate on a “build-to-order” basis, and fill orders only when they are received.

Perceptions of Demand for Energy Efficiency

On average, the window distributors interviewed for this study perceive “some” to “a lot” of demand for high efficiency windows. Furthermore, consumer and/or builder demand for high efficiency windows has increased in recent years. Interviewees attributed demand to

consumer education and increased awareness of energy efficient alternatives. Interview respondents suggested education, advertising programs focused on savings, rebates, targeting energy efficiency programs at the dealer level (to cover the replacement market as well as new construction) as some strategies for stimulating demand for high efficiency windows.

HVAC Contractors

HVAC contractors are employed by builders to design, select, purchase, and install all HVAC system materials and components. These systems include heating, cooling, fans/blowers, control systems, and air distribution (duct) systems.

RER interviewed five HVAC contractors for this study. Three were conventional small-to-medium sized HVAC contractors. Two were large HVAC contractors with onsite Title 24 analysis service, which is apparently typical for larger HVAC contractors. One of the contractors even commented that they are “the largest contractor in Central/Northern California and have saturated” the region.¹⁴

Three of the contractors interviewed work for an HVAC company and two were independent contractors. Last year, each contractor worked with an average of 72 different builders (ranging between eight to 100 builders) and installed HVAC systems in anywhere from 350 to 12,000 homes. The majority of the projects to which HVAC subcontractors provided HVAC equipment were single family tract homes (92%).

Several trends in the HVAC industry are worth mentioning here. First is the effect of deregulation of the electric power industry on the HVAC market. Actions by electric utilities to have their unregulated affiliates sell both power and “added value services,” which include HVAC service and repair has the small HVAC contractors very concerned.¹⁵ In fact, one contractor mentioned this concern as the reason he did not want to participate in the survey. Second is the consolidation and purchase of smaller HVAC contractors by larger national chains, which is a topic of constant discussion in the HVAC trade journals.

The remainder of this subsection details HVAC contractors’ primary functions and interactions in the residential new construction market, decision-making practices and influences concerning HVAC equipment specification, and their perceptions and attitudes towards energy efficiency programs and customer attitudes about energy efficient equipment.

¹⁴ This contractor’s self-reported installations compared to the number of new homes built in the Central and Northern California indicates they have close to a 25% market share, which backs up their claim. Keep this in mind when reviewing the statistics pertaining to HVAC contractors, as they are weighted according to the number of installations completed in 1998.

¹⁵ “Electric Utility Restructuring: Impact on HVAC Industry” ASHRAE Journal, May 1999, pages 82-83, Conrad F. Newberry, Jr., P.E.,

Functions and Interactions of HVAC Contractors in the Residential New Construction Market

Typically, the HVAC contractor works predominantly in the contractor services market though some also function as suppliers in the HVAC equipment market. HVAC performance specifications (sizing and efficiency) are typically determined jointly by the Title 24 consultant and the HVAC subcontractor, although the builder always makes the final decision due to cost concerns. The HVAC contractor will work with the Title 24 consultant, the builder, and equipment manufacturers/distributors to size and select the heating and cooling units that will be used in the HVAC system. Typically this is an iterative process, first between the Title 24 consultant and HVAC subcontractor to choose systems complying with Title 24 and the builder's personal standards, and then between the Title 24 consultant and/or HVAC contractor to present the builder with options for a final decision. Once finalized, the HVAC contractor would order the needed units from an HVAC equipment supplier.

Regarding duct design, once the heating and cooling systems are selected and sized, the HVAC contractor works with the architect to design the air distribution duct system. When finalized, the HVAC contractor is responsible for fabricating, installing, and sealing the duct system. The HVAC contractor is also responsible for duct testing if required for compliance with a program, such as PCH Program

Decision Making Practices and Influences

The HVAC contractor often chooses the equipment brand and type. The builder supports this because typically the HVAC subcontractor is responsible for handling "callbacks" after the home is sold. Thus, the builder lets the contractor choose equipment that they are familiar with and that is therefore most likely good quality, low maintenance product. If the builder has a national account, however, the contractor could be directed to purchase that particular brand of equipment.

As shown in Table 4-13, more than 80% of contractors purchase equipment exclusively from the manufacturer, while only about 20% purchase either from both manufacturers and distributors or exclusively through a distributor.

Table 4-13: HVAC Contractor Equipment Purchasing Practices

Purchase Equipment from Manufacturer Only	Purchase Equipment from Manufacturer and/or Distributor	Purchase Equipment from Distributor Only
82.0% n=2	8.2% n=2	9.8% n=1

Means are weighted according to the number of installations in 1998 as reported by each respondent.

As mentioned, HVAC contractors work closely with other market actors when designing the HVAC system. The in-depth interviews revealed that the builder, HVAC contractor, and Title 24 consultant have different responsibilities regarding HVAC equipment and system design and specification. Equipment sizing and duct installation methods were reported to be almost exclusively the responsibility of the HVAC contractor, with no involvement at all from the builder. Contractors also reported that efficiency rating and the decision for duct insulation R-value are mostly handled by Title 24 consultants.

The following observations can be made regarding duct sealing and testing practices:

- Duct sealing practices have changed in the last few years to incorporate new methods and products. Most changes are attributable to new materials, such as UL approved duct tapes.
- Duct testing is now being conducted for compliance with energy efficiency programs, such as PCH Program and the ENERGY STAR[®] New Homes Program. Duct testing is sometimes requested by builders to assess the quality of their HVAC contractor’s duct work, as reported by one respondent.
- Duct testing is still not being conducted in the majority of new homes. In particular, respondents indicated that duct blaster tests were conducted on only 0% to 30% of their homes.
- Interviewee comments indicated that even though duct blaster tests are not conducted on most homes, the lessons learned from duct blaster tests can be applied to improving general installation methods and procedures that ensure tight ducts even on non-duct blasted homes.

Table 4-14 indicates that the HVAC contractor is primarily responsible for this determination to exceed Title 24 standards.¹⁶ However, this weighted value hides the fact that two of the

¹⁶ Regarding awareness of Title 24 standards, all respondents indicated they had a working knowledge of the standards, and those two firms employing Title 24 consultants of course knew the standards intimately. Due no doubt to close interaction with the Title 24 consultants and the need to stay abreast of the latest developments, all HVAC contractors indicated that they had attended utility sponsored training sessions.

respondents indicated a 90/10 (builder/contractor) responsibility, one indicated a 100/0 responsibility, and two indicated a 10/90 responsibility.

Table 4-14: Decision to Exceed Title 24 Standards

Builder	HVAC Contractor
19.5% n=5	80.5% n=5

Means were weighted according to the number of installations in 1998 as reported by each respondent.

The two contractors with in-house Title 24 staff indicated that they were very influential in encouraging the builder to exceed minimum Title 24 requirements, while the others indicated they were either somewhat or not influential. Regardless, all subcontractors indicated that they have do have the opportunity to suggest exceeding Title 24 requirements to the builder. Most indicated that they also usually take advantage of this opportunity, although, as expected, sometimes their suggestions are adopted and sometimes not.

Nearly all respondents explained that being knowledgeable on the HVAC products and “selling” the builder on the benefits and quality aspects was the best thing they could do to encourage the builders to exceed Title 24. One subcontractor also suggested handling all aspects of a rebate program for the builder in order to make it easy for them to participate. The main reasons for not meeting with success was builders’ concern with costs. Also, as one contractor observed “*If there’s no initial interest, you don’t stand a chance.*”

Awareness and Perceptions of Demand for Energy Efficiency

All HVAC contractors interviewed for this study are aware of the existence of energy efficiency programs, in general. The PCH Program was mentioned the most, along with programs administered by SMUD and ENERGY STAR[®]. Most contractors were unaware of the program details, though one handles the compliance documentation for its builders as an “added value” service.

On average, HVAC contractors are very aware of the latest cooling, heating, duct sealing and duct testing technologies. Most reported being at least somewhat aware of the latest developments in window and insulation technologies. Furthermore, the contractors with the Title 24 consultants on staff indicated being very aware of all technologies. HVAC contractors maintain their awareness of energy efficiency standards and program requirements through trade magazines, the California Energy Commission (CEC), training sessions, Title 24, mailing lists, manufacturers, and distributors.

Contractors seem to have varying perception of homebuyer demand for energy efficient products and for features that exceed Title 24 requirements; responses ranged from *a lot to very little*. Those who responded that there was very little demand explained that although there is much interest from the consumer side, consumers/builders are unwilling to pay the additional costs and, in fact, most builders do not even offer the homebuyer such options due to cost concerns.

All but one HVAC contractor indicated that this demand for energy saving features has increased, primarily due to increased consumer awareness about energy use through programs like the PCH, mailers inserted into their utility bills, and even home improvement TV shows.

Window Contractors

Window contractors operate predominantly in the contractor services market in the residential new construction industry. They are typically retained by either builders or window manufacturers to install windows in new homes. The majority of the installation projects performed by the contractors were single family, tract homes (92%). All but one indicated that their sales were 95 to 100% to single family tract homes. The one subcontractor whose end market was less than this (85% single family homes and 60% tract homes) also indicated sales of single pane windows, and therefore must be selling to multi-family homes since all other window contractors indicated they sell only double-paned windows

Functions and Interactions of Window Contractors in the Residential New Construction Market

Window contractors are diverse in the scope of services they offer. In particular, those interviewed for this study performed manufacturing, delivery, sales, service, distribution, and installation services in the market. The characteristics of window contractors who service the new construction building industry in Central and Northern California vary according to 1) the purchasing agreement for the windows, and 2) the arrangements for the installation of the windows. The three most observed transactions include:

- Builders contract with manufacturers/distributors for *installed* windows, in which case the actual window installation is typically further subcontracted.
- Builders contract with manufacturers or distributors for window units, which are installed by the builder or his own window subcontractor.
- Builders contract for installed windows with window contractors who can order windows from either manufacturers or distributors as needed.

RER interviewed each of these types of window contractors for this study. Referrals from builders yielded two manufacturers of double-paned vinyl windows for which builders usually obtain contracts for installed windows (roughly 90% of sales). These manufacturers were interviewed as window contractors rather than manufacturers. Two window contractors indicated that they purchase their windows directly from the manufacturer and indicated “window sales” as part of their services, one might consider this similar to a window distributor that also performs installations. The remaining contractors in the sample indicated that they purchase windows from both manufacturers and distributors, making this business seem more like the “traditional” window contractor (i.e. their primary business is window installation).

Decision Making and Market Influences

All subcontractors indicated that double-paned windows are now the standard for newly constructed single family homes. One interview respondent even indicated that “*vinyl* dual-paned windows were the new standard.” Only one contractor indicated installation of something other than 100% dual-paned windows were installed. Even for this contractor, though, the percentage of dual-paned windows installed (85%) exactly matched the percentage of single family homes specified. The primary driver for the use of double-paned windows is the Title 24 requirement, so no changes were expected in the future.

Contractors differed with respect to their specification practices of window U-values and SHGCs, however, all respondents agreed that Title 24 consultants are responsible for specifying the number of panes for each window. Other observations with respect to the specification of panes include:

- Although Title 24 does not directly require the use of double-paned windows for single family homes, they are required, for all intents and purposes, indirectly by the U-value specified in the standard.
- One of the manufacturing contractors suggested that the “new standard in residential construction is vinyl dual-paned windows.” Sales data by the number of panes obtained from the contractors seem to support this (see subsequent discussion).

As shown in Table 4-15, respondents believed that the window contractor and Title 24 consultant share the determination of the window thermal performance values. This is most likely a result of the process in which the Title 24 consultant can determine the minimum values required to achieve compliance with Title 24, but then must work with the window contractor to determine what products are available for meeting these requirements and what their actual thermal performance values are.

Table 4-15: Window Specification Responsibilities

	Builder	Window Contractor	Title 24 Consultant
U-value (n=8)	16.5 %	43.6 %	39.9 %
SHGC (n=7)	15.4 %	44.1 %	40.5 %

Percentages represent the portion of window contractors who indicated the market actor who determines the U-value and SHGC values.

Means were weighted according to the number of installations in 1998, as reported by each respondent. Note that some contractors indicated that more than one market actor was responsible for each task.

Only one of the five subcontractors surveyed indicated that they did not have a working knowledge of the Title 24 fenestration requirements for residential new construction. This fact supports high interaction with Title 24 consultants regarding fenestration issues. In regards to who performs their Title 24 calculations, only one subcontractor responded with “builders or architects use their own Title 24 consultants.” A lack of responses by other subcontractors to this question and the results of builder interviews further substantiate this statement.

Awareness and Perceptions of Demand for Energy Efficiency

Window subcontractors consider themselves to be very aware of the latest available energy saving window technologies. Moreover, all contractors reported being generally aware of the existence of energy efficient window programs. The PCH Program was the most frequently mentioned in response to this general question, although most respondents did not know program details or when the programs were offered. Other programs mentioned include Habitat for Humanity and ENERGY STAR®. Window contractors stay informed of energy efficiency standards and program requirements through trade magazines, glass manufacturers, their own corporate offices, PG&E, and various organization/program agencies.

The majority of contractors indicated that the builder was the ultimate decision maker regarding whether or not windows exceed minimum Title 24 requirements. However, the contractors also indicated that they were “very” to “somewhat” influential in that decision making process. All respondents indicated that they have the opportunity to suggest exceeding Title 24 requirements to the builder, and most indicated that they take that opportunity and meet with mixed success. Reasons for not meeting with success included the builder’s concern for costs and California’s mild climate.

Most contractors reported not taking any action to encourage builders to exceed Title 24 requirements, though one stated that they explain the benefits and trade-offs to the builder. To encourage the builders to exceed Title 24, contractor suggestions ranged from offering

more information, better explaining the benefits, offering financial incentives, encouraging the builders to attend seminars, offering a different product line of glass. One subcontractor also commented that “if Title 24 requirements do not fulfill existing concerns then Title 24 should be modified.”

On average, window contractors perceive moderate to high demand for high-performance windows by homebuyers. All contractors indicated that demand has increased, primarily due to consumer awareness about the comfort and energy saving aspects of high performance windows.

Title 24 Consultants

Title 24 consultants are energy consultants who help builders complete the forms required by the state in order to prove compliance with California’s Title 24 energy efficiency standards.^{17,18} Typically, Title 24 consultants work with builders, architects, and sometimes HVAC contractors to ensure that building plans comply with Title 24 requirements. For the majority of projects, the consultants utilize computer software to simulate the energy usage of the designed house. The most widely used energy analysis program is called Micropas.^{19,20} Other packages include Calres2, Comply 24, Energy Pro, NRG-24, and REA.

There are no requirements or certifications needed to become a Title 24 energy consultant. Typically, these consultants are already working in the industry as designers, engineers, or building plans examiners. There is optional certification available through the California Association of Building Energy Consultants (CABEC). CABEC requires its members to pass a state building code exam and undergo additional training.²¹

¹⁷ The CF-1R and C-2R forms are generally used; one or both may be required.

¹⁸ *Energy Efficiency Standards for Residential and Nonresidential Buildings*, California Energy Commission, July 1995

¹⁹ Micropas simulates energy usage based on temperature and other factors and produces a figure of kBtu per square foot per year.

²⁰ The analysis does not need to be done with a computer simulation, however most consultants use the software.

²¹ CABEC is a nonprofit organization that provides certification and training to professionals involved in Title 24 compliance work. Its members include energy consultants, architects, engineers, utility companies, and vendors of energy conservation products and services. CABEC offers a Certified Energy Analyst Program that requires work experience, training, and testing. In addition, all CABEC members subscribe to a code of ethics.

Primary Functions and Interactions of Title 24 Consultants in the Residential New Construction Market

Title 24 consultants directly interact with builders and architects. In most cases, the Title 24 consultant is provided with the preliminary plans and provides input and recommendations for final specifications in order for the plans to comply with the minimum requirements. The Title 24 consultant might also attend the design meetings to discuss specification options with the architect and other members of the development team. *Cost effectiveness* is the operative term here and the most important concept to the builder during the specification stage. As such, the consultant's most important function is to provide the builder with cost-effective options for compliance.

The vast majority of builders interviewed for this study indicated that they use the services of a Title 24 consultant. However, builders are not required to do so if they complete the analysis and the required paperwork on their own. The latter is more common in custom projects and rare, possibly nonexistent, for tract developments. Most builders employ the same Title 24 consultant for every project. In doing so, the builder and Title 24 consultant develop a strong working relationship in which the consultant becomes very familiar with the builder's preferences for meeting Title 24 requirements (i.e., specification priorities, cost-efficiency trade-offs, etc.), and their business practices, in general.

An exception to this practice was identified during the in-depth interviews. In particular, one Title 24 consultant was associated to an HVAC contracting firm. This firm offers to complete the Title 24 documentation for builders or homeowners who purchase their HVAC equipment. This "free" service has been well received in the residential new construction market and this particular firm has completed the required paperwork for upwards of 8,000 building plans over the last 12 months.

Five of the seven consultants interviewed for this study work for companies; the remainder are independent consultants. On average, each consultant worked for roughly 40 different builders and prepared Title 24 reports for about 200 building plans in 1998. These plans represent approximately 2,000 homes. While all respondents explained that they provide the builder with hard copies of the final Title 24 reports and calculations, some also submit their own summary report. Only one consultant reports results differently to different builders. In this case, it was explained that this consultant's clients require different reports. These report formats are mainly due to the compliance software preferred by each builder.

Decision Making and Market Influences

Given their role in the RNC market, Title 24 consultants are in a very influential position to recommend that builders exceed the minimum energy efficiency standards. The in-depth interviews with both builders and Title 24 consultants provided information on whether or

not consultants exercise this influence and builders' receptiveness to such recommendations. In general, the Title 24 consultant is very influential in the specification of equipment and shell measures designed to *cost effectively* meet or exceed Title 24. However, they are not very influential in the decision to build homes that exceed Title 24 requirements.

In particular, Title 24 consultants perceive that they are very influential on builders to build homes that exceed Title 24 standards. Further, they have the opportunity to make suggestions to exceed code and the vast majority has exercised this option. Those that do not have the opportunity to suggest the builder exceed Title 24 explained that doing so would be out of the scope of their position or that the builder does not want to do anything above minimum requirements.

The results of the in-depth surveys are mixed when it comes to the builders adopting Title 24 consultants' suggestions to exceed Title 24. In general, the results of the in-depth surveys suggest that custom builder's are more likely to heed Title 24 consultants' advice on exceeding Title 24 than are production builders.²² In particular, despite their relatively high influence with builders, Title 24 consultants generally operate within the builder's guidelines, budget constraints, and predisposition to build homes that exceed Title 24. That is, Title 24 consultants only influence the specification of the equipment and building shell by presenting options for the builder once the builder has decided to build a home that exceeds Title 24. This is particularly true for production homebuilders and large developers who indicate that they are responsible for the decision to build homes that exceed Title 24. In the custom home market, Title 24 consultants can play a bigger role in influencing builders to exceed Title 24 requirements.

Indications of Title 24 consultants' influence on exceeding minimum energy efficiency requirements include the following:

- Less than 10% of builders indicated that Title 24 consultants make the final specification decision on equipment and building shell measures on all or some projects.
- Roughly 55% of the builders indicated that recommendations by Title 24 consultants were *very influential* in their decision process, while another 16% considered their recommendations at least *somewhat influential*.

²² There is some suggestion from the in-depth surveys that this factor is influenced by market conditions. That is, the RNC market in California in 1999 is active. Builders are very busy and are having trouble keeping up with the demand. As such, certain builders indicated that there is no need for them to build homes that exceed Title 24 in order to differentiate themselves in the market. That is, in a slower market, Title 24 consultants might be more influential on the decision to build homes that exceed Title 24 by suggesting to builders that a home that exceeds Title 24 is a more comfortable home and therefore a more marketable home.

- All but one of the consultants interviewed indicated that they are *very influential* in assisting builders that want to exceed Title 24. Typically, this is accomplished by providing technology data, information on available programs, and presenting design options to the builders.
- All of the consultants interviewed indicated that they have the opportunity to suggest that the builder exceeds Title 24, and all but one has actually done so. When such suggestions were made to the builder, the suggestions were followed about half the time. What is particularly evident is that the Title 24 consultants who primarily work for production builders indicate that their suggestions are not taken. While the Title 24 consultants who work predominately for custom homebuilders suggest that their suggestions are taken at least some of the time.

Awareness and Perceptions of Demand for Energy Efficiency

Title 24 consultants are very aware of the latest technologies of energy-related features and measures. Table 4-16 includes Title 24 consultants’ self-reported awareness levels of the latest available technologies of equipment, measures, and duct testing and sealing methods.²³

Table 4-16: Average Awareness of Latest Energy Efficient Technologies

Gas Furnaces	High Efficiency AC	High Efficiency Windows	Insulation	Duct Testing Methods	Duct Sealing Methods
4.5 (0.47) n=7	4.7 (0.31) n=7	5.0 (0.12) n=7	4.9 (0.23) n=7	4.4 (0.63) n=7	4.4 (0.63) n=7

Each of the seven respondent rated their own awareness, with a one 1 meaning “not at all aware,” a 3 meaning “somewhat aware,” and a 5 indicating “very aware.”

Means were weighted according to the number of plans reviewed in 1998, as reported by each respondent. Standard errors are presented in parentheses.

Consultants’ primary sources of information include manufacturer’ s literature, distributors and sales representatives, PG&E training and equipment and practices literature, CABEC, industry trade shows, and various trade literature and publications.

On average, Title 24 consultants perceive very little demand for energy efficient products and services from homebuyers. Those who felt there was little demand attributed it to relatively low energy prices, the high cost of high efficiency equipment. They also emphasized that, when facing a trade-off between increasing the energy efficiency of the home and other aesthetic or utilitarian features (such as kitchen appliances or carpeting), homebuyers prefer

²³ Respondents indicated on a scale of 1 to 5, with a 5 meaning “very aware”, a 3 representing “somewhat aware,” and a 1 meaning “not at all aware,” how aware they were of the latest available energy saving technologies.

to spend more money on the latter. All of the respondents reported that demand for more energy efficient has increased in recent years.

The Title 24 consultants interviewed for this study agreed that education is a useful strategy to stimulate buyer demand for energy efficient products and services. For example, one respondent suggested television commercials to reach the general population, while another suggested educating senior citizens (who are likely to have fixed incomes) about the benefits of energy efficiency. Another suggested the development of a rating system that would simplify and aid buyers in their decision process.

Respondents were not as hopeful with respect to strategies to increase builder demand for energy efficient equipment and shell measures. In general, builders are viewed as “creatures of habit” that will only change their practices if they have the financial and economic incentive to so.

Building Inspectors

The primary task of building inspectors in the residential new construction market is to ensure that all new residential buildings comply with both state and federal building codes. It is important to note that although state and federal government agencies design and administer the building energy codes, enforcement occurs at the local level, typically through a municipal building department. The enforcement of building codes actually occurs at two different stages of development and is conducted by different individuals within the building department. First, a *building plans examiner* reviews both the building plans and Title 24 compliance forms submitted by the builder before issuing a building permit. Second, during on-site visits, *field inspectors* check for code compliance as various stages of construction are completed. The *building official* oversees both the plans examiners and the field inspectors. During an on-site visit, the field inspector ensures that the equipment and shell measures installed coincide with those specified in the building plans. More importantly, however, inspectors ensure that all equipment and measures were installed properly, as per the manufacturer’s recommendations. Building officials, plans examiners, and field inspectors were interviewed for this study.

Most building plans examiners and field inspectors have engineering backgrounds and specialize in a specific aspect of construction. For example, most building departments have structural, mechanical, plumbing, electrical, and general building inspectors. Most building officials were either a plans examiner or field inspector earlier in their career.

Primary Functions and Interactions of Building Inspectors in the Residential New Construction Market

Building plans examiners and field inspectors operate in the new home market and interact directly with the builder. Note that in-person communication between builders and plans examiners is minimal, unless the plans do not comply with the building code requirements and require revision before issuance of a building permit. In-person communication between builders and field inspectors is more common, and typically occurs with a project manager or site manager. Again, builders interact more with inspectors if problems are identified.

Decision Making and Market Influences

The in-depth interviews with building officials, plans examiners, and inspectors revealed that these market actors typically have no influence on builders' decisions regarding the efficiency levels of equipment and shell measures. The primary (only) function of these market actors is to ensure that builders comply with the minimum building codes. Most respondents indicated that they would be willing to work with the builders but that those occasions where a builder would be interested in any advice was rare. There were, of course, those who did not have the time or inclination to do anything but their job of enforcing minimum compliance.

Awareness and Perceptions of Demand for Energy Efficiency

Because of the nature of their profession, building officials, plans examiners, and inspectors tend to be very aware of state and federal energy codes along with the latest available high efficiency technologies and shell measures. The least amount of knowledge lies in the areas of duct testing and sealing methods. Their primary information sources include product literature, professional seminars, training sessions, and what's seen in the field along with other trade literature and organizations such as International Conference of Building Officials (ICBO) and Council of American Building Officials (CABO).

Although 90% of the building officials, plans examiners, and inspectors interviewed had heard about both the PCH and PCH Plus programs, nine out of the 10 knew nothing about the requirements. One inspector was knowledgeable about the programs but this was attributed to their involvement in construction. This respondent even asked if the programs might be extended to homeowners. None of the interviewees had heard of CHEERS or ENERGY STAR[®] homes.

As building officials, plans examiners, and inspectors are so closely involved in the residential marketplace, one might expect to find similar opinions on the demand from homebuyers. All respondents agreed that there was at least some demand from homebuyers for energy saving equipment or features. However, 20% of the respondents thought there

was very little demand, 40% thought there was some demand, and the other 40% thought that there was a lot of demand. The wide spectrum of answers may be due to their lack of involvement directly with the homebuyer. The majority of the responses (70%) indicated that customer demand for energy saving features had increased since 1990. The explanations behind the increase ranged from media driven reasons, promotion by the HVAC contractors, and financial reasons.

Government and Nongovernment Agency Representatives

Both government and nongovernment organizations influence the residential new construction market. In the context of this study, a government agency is one that receives government funding, while a nongovernment agency is a nonprofit organization or one that receives private funding. The government's influence on the RNC market is expressed directly through the required building, energy and appliance code standards. Indirectly, government and nongovernment agencies provide information, training and administration of certain programs designed to promote energy efficient housing and building practices. This Subsection discusses the primary functions these agencies have and their influences on other market actors. Typically, government agencies interact with or influence manufacturers and builders by promulgating the energy efficiency requirements of equipment that is manufactured, as well as administering the residential building energy codes by which all residential buildings must comply. Nongovernment agencies interact with a wide variety of actors by providing informational services and programs to promote the demand of more energy efficient homes.

Primary Functions and Interactions of Government and Nongovernment Agencies in the Residential New Construction Market

Government and nongovernment agencies perform the following functions related to the residential new construction market.

- Enact, publish, and promote building and energy standards,
- Collect, publish and disseminate information related to energy efficient housing,
- Fund and conduct research related to energy efficient housing,
- Implement programs that provide training to builders, contractors, and other related market actors,
- Implement programs that promote the use of energy efficient mortgages and home rating systems, and
- Coordinate and administer associations of professionals.

Each of these functions is explained in more detail below.

Building and Energy Standards. These standards, described in Section 2, represent a minimum level of quality by which builders must comply. In California, documentation showing compliance with Title 24 is required in order for the builder to obtain a building permit. The Energy Efficiency Standards Office at the California Energy Commission (CEC) administers changes to the code in three-year cycles; the latest revision takes effect July 1999. The Office of Codes and Standards at the U.S. Department of Energy (DOE) assists states in updating and implementing their energy codes and promulgates federal building energy efficiency standards. The New Buildings Institute (NBI) is a nonprofit organization that supports the development of codes and standards for improved energy systems and designs in buildings.

Disseminate Information. A number of agencies provide brochures, websites and 800 telephone numbers for the benefit of various market actors. The American Council for an Energy Efficient Economy (ACEEE) is a nonprofit organization that publishes books and studies for energy professionals and consumers. The Alliance to Save Energy (ASE) works with more than 75 corporations and business trade associations to promote cost-effective energy efficiency. One such program is the Efficient Windows Collaborative (EWC) that maintains a very informative website on window technology.

Research. Research on energy efficient technologies is conducted by labs like the Oak Ridge National Laboratory (ORNL) and the Lawrence Berkeley National Laboratory (LBNL). Research at LBNL over the past eight years has resulted in a commercial product to seal ducts from the inside. In addition, researchers at the LBNL developed the technical information necessary to include duct sealing into the Title 24 Energy Code as an optional compliance credit. At ORNL, research has been conducted on gas-fired heat pumps and whole wall rating procedures. The Office of Energy Efficiency and Renewable Energy, operating under the auspices of the DOE, supports private sector research on building systems and materials, particularly focusing on the building envelope and the indoor environment.

Training Programs. Affordable Comfort, Inc. is a training organization that targets builders and contractors. They teach and demonstrate new technologies in building science, and recently their events have focused on pressure balancing. In collaboration with PG&E, they have provided training sessions on duct sealing and testing at the Stockton training center. The Building America Program is a partnership of professionals that is partially funded by the DOE. They use a systems engineering approach and a team of market actors to build residential communities throughout the country that are 30 to 50% more efficient than energy codes require. As of May 1999, they had built over 860 homes, including a community in Southern California. The Energy Efficiency Standards Office at the CEC also

offers training for builders on construction protocols. Part of the training includes field inspections that reveal Title 24 compliance problems and quality issues.

Energy Efficient Mortgages. The ENERGY STAR[®] New Homes Program and the Home Energy Rating System (HERS) were initiated as ways to promote energy efficient mortgages. By providing financing incentives for consumers for purchasing high efficiency homes, the ENERGY STAR[®] New Homes program is designed to stimulate the demand for more efficient housing. The program maintains a very informative website for consumers.

Professional Associations. The National Association of Home Builders (NAHB), The California Association of Building Energy Consultants (CABEC), The California Building Industry Association (CBIA), and the American Association of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) are examples of these organizations. They serve to help educate and train their members, and to lobby for changes to the building and energy codes that benefit their members.

Decision Making and Market Influences

Due to their pervasive nature, these organizations have considerable influence in the industry, albeit they tend to work slowly due to their bureaucratic nature. Typically, they are run by boards or overseen by other agencies, causing the decision-making process to be a time consuming and often complex procedure. With the strength of their large body of members and government funding, however, they have considerable opportunity to influence the market. Changes in the building and energy codes, new products and technologies, and programs that are helping to increase general awareness and change building practices are some of the results these organizations have managed.

4.3 Market Share Data

Overview

To support the assessment of market effects, it is useful to identify and measure a number of market effects indicators. One of these indicators is the market share of relevant technologies. This section describes the development efforts to characterize the market for measures covered by the PCH Program. These measures include:

- Central Air Conditioners,
- High Efficient Windows, and
- Duct Sealing.

The goal of this effort was to develop historical series containing the unit installations of equipment that could be segmented by efficiency level and by geographic region. In

particular, it would be most useful if we could break out historical shares based on the geographical regions covered by the PCH Base²⁴ and Plus²⁵ programs and for California.

We recognized that this was a very ambitious task given the project budget, timeline, and known sources of detailed new construction equipment installation data. Our approach to this task was to identify and review known sources of data, produce historical trends where possible, evaluate gaps in the data, make suggestions on how these gaps could be filled, and recommend ways to develop tracking methods for use in future baseline tracking efforts for the PCH Program. This is a sensible approach given the lack of detailed data on new construction activity in recent years. In particular, as will be noted below, the measure baselines for air conditioners are relatively good for the years before 1994, but nonexistent in more recent years. For windows, a similar problem was encountered. In particular, no recent data are available. Further, in order to develop any indication of the levels of U-values and SHGC in the years from 1990 to 1994 data on frame type, number of panes and glazing type were transformed into U-values and SHGC using rules-of-thumb. In the case of duct sealing we were unable to find any reliable data on measuring duct leakage or attempting to quantify duct sealing practices, other than from the in-depth surveys. We did however infer the share of new homes that have had duct testing.

For air conditioners and high efficiency window data, we suggest collecting data from building departments to fill in the gaps in historical trends. For duct sealing this is a more problematic issue, since the most reliable method to measure duct sealing is through intrusive, high cost diagnostic testing. There appears to be little data on duct testing in the PG&E service territory, particularly for homes not participating in the PG&E duct certification program or other DSM program requiring duct blaster tests.

Suggestions are provided for future tracking initiatives aimed at developing useful measure tracking for the PCH Program. These methods follow the work done by RER in the statewide scoping study in methods to implement measure tracking to support evaluation of market transformation.²⁶ It is our understanding that the residential market tracking study will begin in August 1999, and will be an ongoing effort. Further, we expect high efficiency air conditioners, high efficiency windows, and duct sealing to be measures that will be tracked by CEC weather zone.

²⁴ CEC weather zones 11, 12, and 13.

²⁵ The entire PG&E service territory, which covers CEC weather, zones 1, 1, 3, 4, 5, 11, 12, and 13.

²⁶ Regional Economic Research, Inc., Efficiency Market Share Needs Assessment and Feasibility Scoping Study, prepared for PG&E and CBEE, May, 1999.

Data Sources

Primary Data Sources

Although a number of data sources were reviewed, the data sources considered useful for developing measure baselines are all studies completed by the California Energy Commission. These studies are mainly concerned with the level of compliance and overall impact of the Title 24 standards. These multi-year projects have a wealth of on-site data useful for developing measure baselines. These studies include the following.

- California Energy Commission, *Post-Occupancy Residential Survey*, conducted by NEOS, Contract # 400-94-015, February 1997.
 - This study collected data on over 400 homes built during the 1990-1994 period throughout all climate zones in California via on-site visits. Of these 400 surveys, 159 homes are located in the PG&E service area.
- California Energy Commission, *Energy Characteristics, Code Compliance and Occupancy of California 1993 Title 24 Houses*, California DSM Measurement Advisory Committee. P400-91-031CN. Berkeley Solar Group, Oakland, CA. 1995.
 - This study involved primary data collection for 1,200 in CEC climate zones 10, 12, 13, and 14. Further onsite data collection of duct leakage and metering was conducted for a subset of 100 of these homes.
- California Energy Commission, *Occupancy Patterns & Energy Consumption in New California Houses (1984-1988)*, P400-90-009. Berkeley Solar Group and Xenergy, Oakland, CA. 1990.
 - This study entailed primary data collection of a nested sample of 2,845 mail surveys, 299 on site surveys, and 40 on-site monitoring. A second phase was added to include more on-site monitoring to assist in space cooling calculations. The databases received from this study included detailed measure data on ceiling R-values and furnaces.
- California Energy Commission. *1994-1995 Monitoring Final Report*. P400-93-022. Valley Energy Consultants, Sacramento, CA. 1995.
 - A monitoring program conducted by the CEC to determine the compliance and enforcement problems associated with the Title 24 standards. This study covers residential and commercial sites
- Customer Opinion Research, *Market Transformation: Residential Windows*, prepared for Pacific Gas & Electric Company, San Francisco, CA. 1998.
 - The study focuses on the new construction and window replacement/remodeling market. This study provides a comprehensive look at the windows market in the PG&E service territory and throughout California for 1997. There is considerable data on market profiles for the windows market including window sales by frame type, number of windows sold and break outs by new construction versus retrofit market. Although there is no

data on U-values and or solar heat gain coefficients, this study provides useful data that should be reviewed in conjunction with the development of window baselines.

- Customer Opinion Research, *Residential Windows “Mini-Study,”* prepared for Pacific Gas & Electric Company. San Francisco, CA. 1997.
 - This study is one of several “mini-studies” of market transformation related activities at PG&E. It is a situational study of the residential windows market. Although we were unable to obtain any efficiency level data from the study records, the study included a rule of thumb transformation table that produces a U-value and solar heat gain coefficient based on the frame and glazing type. These assumptions were used to translate some of the CEC data on window frame and glazing types into U-values and solar heat gain coefficients.

Omitted Data Sources

Several sources were also reviewed that ultimately were considered not to be useful in developing measure baselines. Each of these sources is listed below, along with the reason for its omission. As explained, most of these data sources simply did not contain the level of detail relating to measure efficiencies required developing the baselines. Further, some of the sources listed below did not contain any data for the measures of interest.

- XENERGY, 1990 Residential Appliance Saturation Survey Pacific Gas & Electric Company. Prepared or Pacific Gas & Electric Company, Oakland, CA. 1992.
 - PG&E conducts a biennial Residential Appliance Saturation Survey to plan for the energy needs of its residential customers. The study results contain data on residential appliances, characteristics of the residential population, characteristics of dwelling units, and related patterns of electricity and natural gas consumption. Insofar as this is a mail survey, it lacks the level of detail required to develop measure specific efficiency baselines.
- Skumatz Economics Research Associates, Pacific Gas & Electric Company PY94 Residential New Construction Retention Study, Seattle, WA. 1999.
 - It collects data on the fraction of installed measures that are still in place and operating in order to produce a revised estimate of PY94 effective useful lifetimes (EULs) of the measures. The level of detail in the study does not support energy efficiency baselines.
- Barakat & Chamberlin, Inc. Compilation of Energy Efficiency Measure Saturation Data for the California Conservation Inventory Group. Prepared for Southern California Edison Company. January 1995.
 - Insufficient detailed information on measure efficiency levels for use in developing measure baselines.
- XENERGY, Compilation and Analysis of Currently Available Baseline Data on California Energy-Efficient Markets, prepared for the California Board of Energy Efficiency, 1999.

- This study contains a review of currently available data on baseline data from all types of utility, government, commercial, and private sources. We reviewed the study and interviewed the authors of the study to gauge the availability, reliability, and quality of available baseline data relevant for this study.
- While this study identifies studies from the literature, it was not designed to collect and catalogue data on baseline efficiencies.

Measure Baselines

Based on the available data, a historical series of efficiency levels of installed equipment in new residential construction was used to characterize the market for each of the relevant efficiency measures. These historical data are referred to as *measure baselines*. In this context, these baselines refer to historical average values, rather than to values that would have been experienced in the absence of these RNC programs.

Air Conditioners

The PCH Program required that particular set of measures be installed in a home including high efficiency air conditioning. A qualified unit was required to be a conventional single-speed or two-speed air conditioner. In areas where natural gas was unavailable, air-to-air heat pumps were allowed. Each installed CAC unit needed to be properly sized for the home and exceed the rating used in the Title 24 compliance document by a Seasonal Energy Efficiency Ratio (SEER) of at least 1.5.

The incentive levels varied between \$225 and \$400 depending on the SEER rating of the installed air conditioning unit. Incentives were paid for only one unit per home; if multiple units were installed, the incentive was based on the one with the lowest SEER rating.

Central air conditioning systems can be heat pumps or they can be combined with a furnace. There are two basic types of central air conditioning units used for residential applications; a split system or single package. Split systems, which are the most typical in single-family home applications, the condenser and compressor, are located outside the residence away from the heat exchanger, fan, and/or furnace components. Single package systems are units in which all components (heating equipment, compressor, condenser, heat exchanger, fans, etc.) are combined in one package.

Efficiency Rating. The efficiency ratings for air conditioning are based on testing procedures conducted by the Department of Energy. The procedures attempt to simulate a system's typical seasonal energy use. The rating is expressed as the ratio of total seasonal cooling output in kBtu to the total electrical input in kWh and is known as the Seasonal Energy Efficiency Ratio (SEER). The higher the SEER level, the more efficient the system. The Heating Seasonal Performance Factor (HSPF) is the heating equivalent of the SEER and

indicates the seasonal heating efficiency of a heat pump. The HSPF is expressed as the ratio of the total seasonal *heating* output in kBtu to the total electrical input in kWh.

Efficiency Standards. National efficiency standards for central air conditioning are covered by the National Appliance Energy Conservation Act (NAECA). Single package central air conditioning (CAC) units manufactured after January 1, 1993 have a minimum 9.7 SEER rating, and in addition, a CAC/HP must have a minimum 6.6 HSPF (Heating Seasonal Performance Factor) rating. Split system central air conditioning (CAC) units manufactured after January 1, 1992 have a minimum 10 SEER rating, and in addition, a CAC/HP must have a minimum 6.6 HSPF rating. The CEC standards are consistent with the national standards and at this time there is no scheduled date for updating these standards.

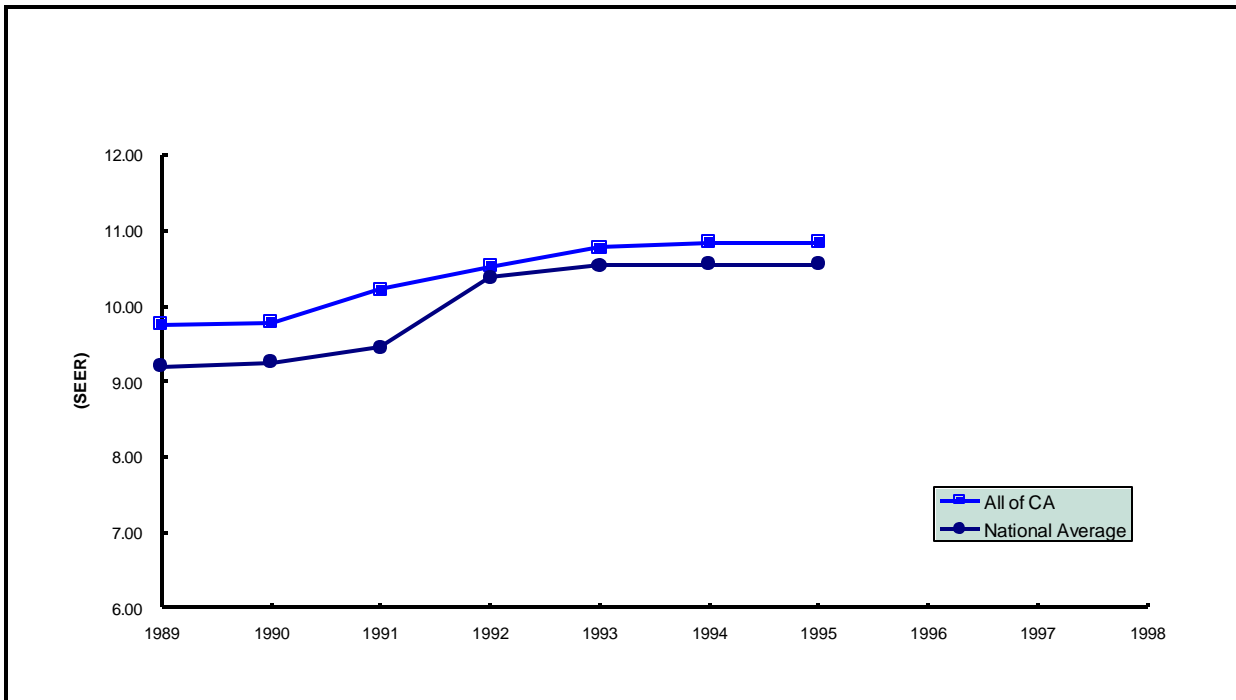
National Shipments. Table 4-17 and Figure 4-8 present a summary of national shipments of unitary air conditioners and shipments weighted average efficiency levels (SEERs), and average SEER values of single family new construction in California. These data provide some insights into the comparison of efficiency levels installed in single family new construction in California compared to average levels shipped from manufacturers. The data reveal that average SEER levels in new construction installations in California have been historically higher than national averages. Note that these shipments data reflects units shipped from manufacturers and not necessarily purchases or installations. However, even if one assumes a lag time of one year, average SEER values installed in California would be above the national average.

Table 4-17: National Shipments and National and California Average SEER of Central Air Conditioners by Year

Year	Shipments	Mean SEER National	Mean SEER California
1989	3,489,000	9.20	9.76
1990	2,920,000	9.26	9.78
1991	3,006,000	9.45	10.22
1992	2,914,000	10.39	10.53
1993	3,188,000	10.54	10.78
1994	3,888,000	10.55	10.85
1995	4,063,000	10.55	10.85

Source: National shipments data and average SEER values (shipments weighted) from Appliance Magazine. California data are based on California Energy Commission, Post-Occupancy Residential Survey, conducted by NEOS, Contract # 400-94-015. February 1997.

Figure 4-8: Comparison of Average SEER Value for Unitary Air Conditioners of National and California New Construction Installations, by Year



California and PG&E Service Territory Efficiency Data . Table 4-18 presents historical data on average SEER values²⁷ of central air conditioning units installed in the California residential single-family new construction market. In particular, average values for all of California, the Central Valley, and the PG&E service territory are presented. As stated above, these historical series are based on data from on-site surveys conducted by the California Energy Commission.

A comparison of average efficiency levels for the PG&E service territory and California are presented in Figure 4-9. This suggests that the PG&E service territory has been on par with California average efficiency level for Central air conditioning.

Figure 4-10 presents a comparison of average efficiencies between the Central Valley and PG&E service territory. Again these two series appear to be almost identical and certainly show the same trend. This is not surprising given the relatively high saturations of residential central air conditioners in the Central Valley compared to the remainder of the PG&E service territory.²⁸

²⁷ The tables also include minimum and maximum SEER values from the sample, standard errors of the sample mean \bar{a} , and the number of observations in the sample.

²⁸ While we did not assemble any final saturations values by mapping divisions to the Central Valley, it is evident from a review of the PG&E 1990 Residential Saturation Survey that Central Valley areas have substantially higher saturations for central air conditioning.

Table 4-18: Average SEER Values by Region and Year

Year	All California	Central Valley	All PG&E
1989	9.76 (0.34) n=8 Min = 9.00 Max = 9.50	9.33 (0.17) n=3 Min = 9.00 Max = 9.50	9.38 (0.13) n=4 Min = 9.00 Max = 9.50
1990	9.78 (0.10) n=76 Min = 9.00 Max = 12.50	9.63 (0.16) n=26 Min = 9.00 Max = 12.00	9.68 (0.13) n=38 Min = 9.00 Max = 12.50
1991	10.22 (0.16) n=49 Min = 9.00 Max = 12.75	10.16 (0.22) n=28 Min = 9.00 Max = 12.75	10.21 (0.20) n=33 Min = 9.00 Max = 12.75
1992	10.53 (0.14) n=51 Min = 9.00 Max = 13.50	10.38 (0.17) n=30 Min = 9.00 Max = 12.50	10.48 (0.15) n=38 Min = 9.00 Max = 12.50
1993	10.78 (0.13) n=60 Min = 9.00 Max = 14.00	11.01 (0.18) n=30 Min = 9.00 Max = 12.30	10.97 (0.18) n=31 Min = 9.00 Max = 12.30
1994	10.85 (0.16) n=28 Min = 10.00 Max = 12.05	10.87 (0.22) n=14 Min = 9.00 Max = 12.00	10.87 (0.22) n=14 Min = 9.00 Max = 12.00
1995	10.85 (0.95) n=81 Min = 10.00 Max = 12.52	11.34 (0.95) n=39 Min = 9.00 Max = 12.52	11.31 (0.96) n=40 Min = 9.00 Max = 12.52

Note: Standard errors are included in parentheses.

Figure 4-9: Comparison of Average SEER – California vs. PG&E Service Territory

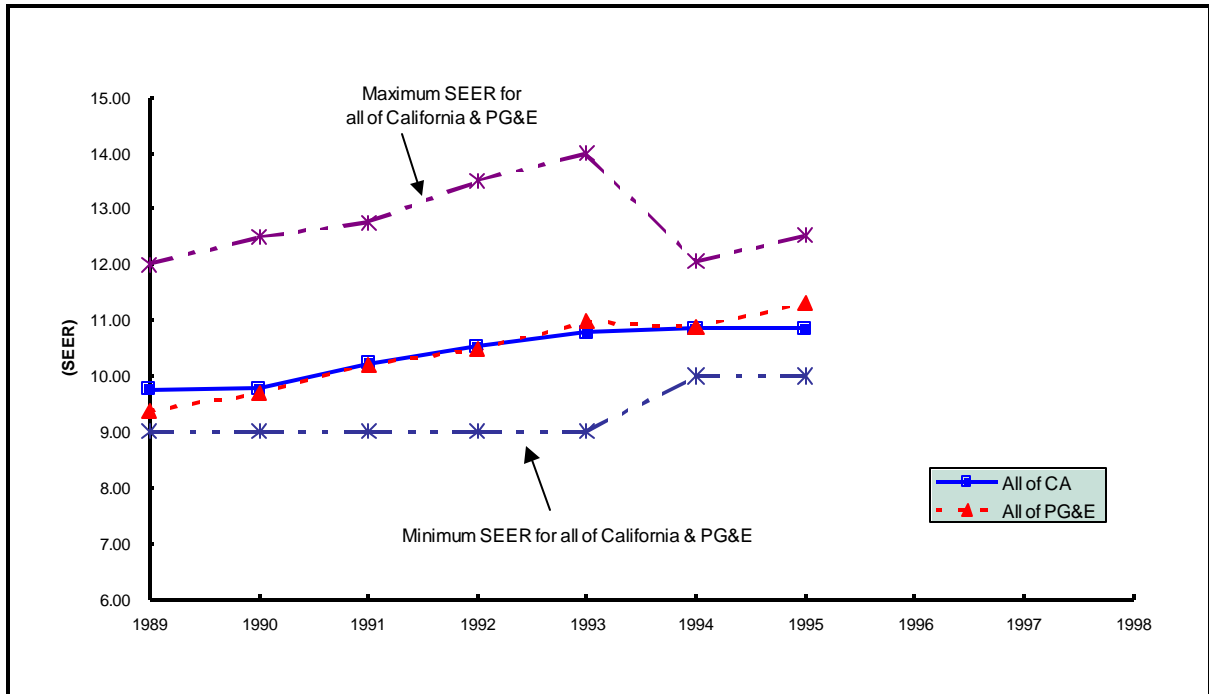
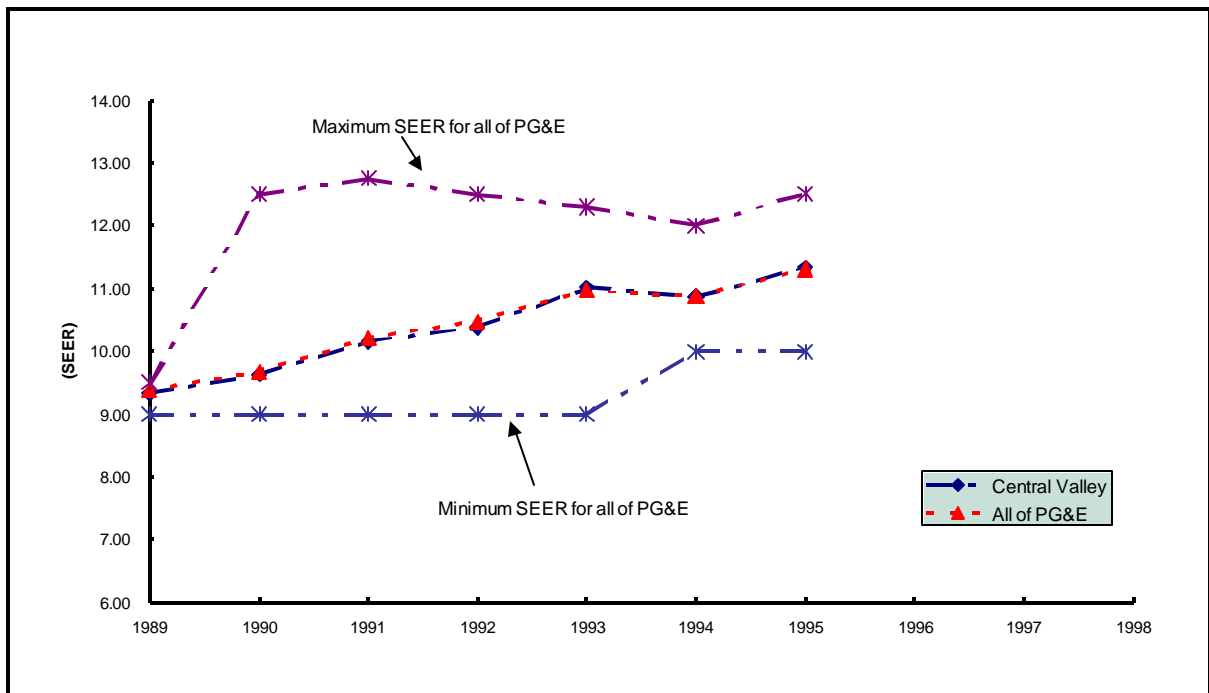


Figure 4-10: Comparison of Average SEER – Central Valley vs. PG&E Service Territory



In-Depth Survey Data. HVAC subcontractors were asked to estimate the market shares of energy efficient heating and cooling equipment during the in-depth survey portion of this study. These questions were designed to look at present levels of efficiency shares as well as changes over time. HVAC contractors were also asked to supply sales or installation records if possible, but all those interviewed declined. As will be shown below, the categories of estimated shares of efficiency levels are based on existing standards and are rather broad to facilitate estimation by the HVAC contractors.

A summary of the reported market shares by efficiency levels from the in-depth surveys is presented in Table 4-17. The market shares reported by HVAXC contractors indicate that a large percent of the installed equipment exceeds the Title 24 minimum 10 SEER. When asked about changes in shares over time, all respondents said these percentages had changed since 1991. However, responses were quite varied as to when and whether these percentages had increased or decreased. Reasons given for increased percentages were state standards, utility programs, demand for comfort and energy efficiency, manufacturer’s rebate, “availability of 14 SEER unit and 10-year compressor warranty.” Reasons given for decreased percentages were a reduction of PG&E sponsored incentives directly targeted at high-efficient units. In fact, almost every contractor talked longingly of the days when PG&E directly rebated high efficiency equipment.²⁹

Table 4-19: Installed Cooling Equipment Efficiency Market Percentages^{1,2}

	£10 SEER	> 10 SEER and £12 SEER	> 12 SEER
SEER (n=5)	46.3%	43.9%	9.7%

Values reported by contractors were weighted according to the number of installations in 1998 as reported by each respondent.

In order to link and compare these market shares to historical shares, the data collected by the California Energy Commission for the Central Valley and the self-reported HVAC contractor data were broken out into consistent market share categories. In particular, Table 4-20 presents the SEER value category break outs by year for central air conditioners installed in new construction in the Central Valley.

²⁹ Further, regarding whether or not the current trend in SEER market percentages would continue if current utility programs were ceased, responses were mixed ranging from expectations that percentages of minimum 10 SEER units would increase, that they were unsure of the impact, or that there would be no impact primarily due to increased consumer/builder awareness and the presence of the national Energy Star program.

Table 4-20: Percent of New Construction Installations of Air Conditioning Units by Efficiency level

Year	£10 SEER	> 10 SEER and £12 SEER	> 12 SEER
1989	100	0	0
1990	84.2	13.2	2.6
1991	57.6	33.3	9.1
1992	57.9	39.5	2.6
1993	22.6	71.0	6.5
1994	21.4	78.6	0
1995	-	-	-
1996	-	-	-
1997	-	-	-
1998	46.3	43.9	9.7

Source: Years 1989 – 1995 are based on data for weather zones 11, 12 and 13 from data collected for the California Energy Commission, Post-Occupancy Residential Survey, conducted by NEOS, Contract # 400-94-015, February 1997. Year 1998 from HVAC contractor interviews where values reported by contractors were weighted according to the number of installations in 1998 as reported by each respondent.

Impact of PCH Program. The assembled data is insufficient to draw any conclusions on the PCH Program impacts on central air conditioners installations. In particular, the historical data is incomplete, and more importantly there is no recent data and there is no period when the program has not been offered. What is even more unfortunate is that there might be some interesting clues as to the effect of the PCG Program if data from the post 1995 years were to be gathered. This would provide insights into the effect of the program given that the structure of the program changed considerably from a generous incentive based program to a more low incentive heavy informational and training approach.

Again, the data we were able to assemble on the pre post 1995 years is a combination of a self-reported year for post 1995 and fairly reliable onsite data collection for pre 1995. However, these results indicate that the share of units above code was considerably higher in 1993 and 1994 as compared to 1998. This could be a reflection of two major changes in the market, the change in the program from an incentive based to informational-based program and the availability of substantial manufacturer rebates during the 1993 and 1994 period.

Windows

The PCH Program included a bonus incentive for homes with windows meeting the ENERGY STAR® Performance Requirements. To qualify for this bonus incentive, installed windows

needed to meet the Southern Region ENERGY STAR[®] Performance Requirements for Solar Heat Gain Coefficient (SHGC) and the Central Region ENERGY STAR[®] Criteria for U-factor. The requirements applied to all fenestration in the house including windows, fixed glass, glass doors, and skylights. Specifically, these requirements are as follows:

- An Solar Heat Gain Coefficient (SHGC) of 0.4 or less,
- A U-factor of 0.4 or less for all fenestration except skylights,
- A U-factor of 0.45 or less for skylights, and
- Certification by the National Fenestration Rating Council in accordance with NFRC 100, 200, 300 and 301.

Production homes were required to meet these levels on all homes within the same development. The bonus incentive varied between \$150 and \$200 depending on the Title 24 compliance U-factor. The program required Title 24 compliance using a U-factor of 0.5 or greater, a shading coefficient of 0.87 or greater, and a SHGC of 0.68 or greater.

Efficiency Rating. There are two major factors to be considered in evaluating window efficiency. The first is the window's U-factor, which is a measure of the window's ability to transmit heat, and the solar heat gain coefficient (SHGC), which is a measure of the window's ability to control heat gain from direct sunlight. Note that the SHGC has replaced the shading coefficient as the measure of heat gain from direct sunlight. As a rule-of-thumb, the SHGC is approximately 1.15 times the shading coefficient.

U-Factor. The window U-factor is a measure of the total fenestration system and represents the heat transfer coefficient in Btu/hr-ft²-°F that includes conductive, convective, and radiative heat transfer. The lower the U-factor, the less energy is transmitted and therefore the more efficient the window. The inverse of the U-value is the R-value, or the measure of resistance to heat transfer. The National Fenestration Rating Council (NFRC) provides a Certified Product Directory that lists U-factors for all NFRC-rated products. A typical U-factor for single pane metal fixed windows is 1.19. This value decreases to 0.72 for double pane windows. Further, these values fall to 1.04 and 0.57 for wood framed windows.³⁰

Solar Heat Gain Coefficient. The SHGC is the measurement used to quantify a fenestration systems ability to control heat gain. The SHGC is a number between 0.0 and 1.0, with a lower number indicating a better product for controlling heat gain. SHGH is particularly important in hot dry climate zones and in areas where there is excess glazing on the east, west or south elevations.

³⁰ *High Performance Windows, Doors & Title 24, Residential*, Windowmaster Products, El Cajon, CA

Efficiency Standards. The CEC Standards mandate window glazing in California.³¹ These standards vary by CEC climate zone and by performance package selected for compliance. The standards are stated as maximum U-values and shading coefficient, together with maximum window area, as a percentage of wall area and maximum and minimum non-south- and south-facing window areas. For instance, in climate zone 11, 12, and 13 (Central Valley) the mandated U-value varies from .40 to .65 and the SHGC coefficient is .40 across the alternative compliance packages.

California and PG&E Service Territory Efficiency Data. Table 4-21 presents data on the average U-values for all of California, the PG&E service territory and for the Central Valley. These data are developed from on-site data collected by the California Energy Commission. The primary data includes information on window frame type, number of panes and glazing type. These characteristics were used to infer U-values based on rule-of-thumb relating these window features to U-values.³² Table 4-22 presents similar information about the SHGC. Again, the primary data collected was for the window shading coefficients. The shading coefficients were translated into SHGC ($SC = 1.15 \times SHGC$). These results indicate no difference between California, the PG&E service territory and the Central Valley. Further, there is no perceptible difference across year 1989-1994.

³¹ *Energy Efficiency Standards for Residential and Nonresidential Buildings*. California Energy Commission. P400-98-001. May 1999

³² See Customer Opinion Research, *Residential Windows "Mini-Study"*, prepared for Pacific Gas & Electric Company. San Francisco, CA. 1997.

Table 4-21: Estimated Average U-Values by Region and Year

Year	All California	All PG&E	Central Valley
1989	.62 (0.030) n=17 Min = .56 Max = 1.10	.60 (0.00) n=5 Min = .60 Max = .60	-
1990	.64 (0.015) n=98 Min = .49 Max = 1.10	.59 (0.003) n=50 Min = .49 Max = .71	.60 (0.00) n=4 Min = .60 Max = .60
1991	.59 (0.003) n=77 Min = .49 Max = .77	.59 (0.004) n=47 Min = .49 Max = .71	.59 (0.004) n=34 Min = .55 Max = .71
1992	.60 (0.004) n=76 Min = .55 Max = .85	.59 (0.006) n=49 Min = .56 Max = .85	.59 (0.007) n=36 Min = .56 Max = .85
1993	.60 (0.006) n=84 Min = .49 Max = 1.10	.60 (0.003) n=45 Min = .56 Max = .69	.59 (0.004) n=33 Min = .56 Max = .71
1994	.63 (0.020) n=45 Min = .51 Max = 1.1	.60 (0.009) n=24 Min = .51 Max = .64	.60 (0.010) n=20 Min = .51 Max = .71
1995	.60 (0.00) n=1 Min = .60 Max = .60	-	-

Note: Standard errors are included in parentheses.

Table 4-22: Estimated Average Solar Heat Gain Coefficient by Region and Year

Year	All California	All PG&E	Central Valley
1989	.71 (0.005) n=17 Min = .69 Max = .78	.72 (0.00) n=5 Min = .72 Max = .72	-
1990	.71 (0.002) n=98 Min = .62 Max = .78	.71 (0.003) n=50 Min = .62 Max = .72	.72 (0.00) n=4 Min = .72 Max = .72
1991	.71 (0.002) n=77 Min = .62 Max = .74	.71 (0.003) n=47 Min = .62 Max = .72	.71 (0.003) n=34 Min = .68 Max = .72
1992	.71 (0.002) n=76 Min = .67 Max = .75	.71 (0.002) n=49 Min = .69 Max = .75	.71 (0.003) n=36 Min = .69 Max = .75
1993	.72 (0.002) n=84 Min = .62 Max = .78	.71 (0.002) n=45 Min = .69 Max = .72	.71 (0.002) n=33 Min = .69 Max = .72
1994	.72 (0.004) n=45 Min = .64 Max = .78	.71 (0.005) n=24 Min = .64 Max = .72	.71 (0.005) n=20 Min = .64 Max = .72
1995	.72 (0.00) n=1 Min = .72 Max = .72	-	-

In-Depth Survey Data. During the in-depth interviews, window contractors³³ were asked to estimate the relative U-value and SHGC shares of installed windows in the single family residential new construction. Table 4-23 presents the estimate of U-value shares for windows installed in 1998. For comparison, Title 24 typically requires a maximum prescriptive U-value of 0.65 for zones 11 through 13.

Table 4-23: Installed Window U-Value Market Percentages

	£ 0.40	> 0.40 & £ 0.60	> 0.60 & £0.80	> 0.80
U-value (n=4)	65.0%	34.0 %	1.0 %	0.0 %

Responses were weighted according to the number of installations in 1998 as reported by each respondent.

In regards to whether or not these statistics have changed since 1991, only one subcontractor indicated that there had been no change, but their reason was that they only manufacture vinyl, double-paned windows. In regards to when the change occurred, only one subcontractor indicated a year – 1994. The primary drivers of this change were cited as being revisions of the state standards but also a demand for comfort. For all subcontractors who responded to these questions, the present market shares were expected to continue unchanged. In contrast to the primary driver of this change being the state standards, consumer demand was expressed as this primary reason for the current U-value shares continuing, even in the absence of high-efficiency window programs. One subcontractor actually stated that they thought the market for high-efficiency windows would actually increase as a result of upcoming changes to Title 24.

Table 4-24 presents the estimates of SHGC values for windows installed in 1998. Comparisons between these values and Title 24 prescriptive values are complicated by the fact that Title 24 standards are specified as glass Shading Coefficients (Sc.) rather than fenestration SHGCs. However, using the estimate of $SC = SHGC \times 1.15$ per the NFRC, Title 24 requires a maximum prescriptive SC of 0.40 which is approximately a SHGC of 0.36 for zones 11 through 13. For reference, SHGC values for a single-paned clear glass window would be about 0.67, a double-paned clear low-e window about 0.50, and a double-paned spectrally selective, very low-e argon-filled window about 0.33.³⁴

³³ All subcontractors also indicated awareness of the National Fenestration Rating Council' s whole U-value rating system and SHGC rating system. This is no doubt linked to their awareness of Title 24 standards, especially the new window labeling requirement (July 1st 1999) which requires NFRC labels for all windows typically used in single-family residential new construction.

³⁴ Reference: Selecting Windows for Energy Efficiency, Home Energy July/August 1995, Jeffrey L. Warner

Table 4-24: Installed Window SHGC Market Percentages

	£ 0.40	> 0.40 & £ 0.65	> 0.65
SHGC (n=4)	15.7 %	65.1 %	19.2 %

Responses were weighted according to the number of installations in 1998 as reported by each respondent.

In regards to whether or not the market shares indicated above had changed since 1991, the responses were indefinite. Two of the contractors indicated they had changed as recently as 1998 due to Title 24 standards, while the other three did not respond or indicated that there had not been any changes. Some of this confusion may be partially the result of the switch from a Shading Coefficient (SC) approach to an SHGC approach that is adopted by the recent revision of the Title 24 standards. The subcontractors most aware of these changes are probably the ones who indicated that these market shares had changed.

Impact of PCH Program. The data available to develop U-value and solar heat gain multiplier measure baselines is problematic. In particular, the data used to construct U-value and SHGC in this study were developed from data on window frame type, number of panes, and type of glazing. Further, this data is incomplete in the most recent three years. Therefore, without further research there is insufficient data to make any inferences about the impact of the PCH Program by reviewing the measure baselines.

Duct Sealing

Duct systems were required to meet PG&E High Efficiency Duct Standards. These standards involve installation and material specifications, and a description was provided to builders upon acceptance into the program. In addition to compliance with local building codes, 1998 *PG&E Duct Installation Standards*, and the 1997 *Uniform Mechanical Code*,³⁵ a number of general guidelines were required to be followed. These were supplied to participants in *Comfort Home High Efficiency Duct Guidelines – Specifications for 1998 Program Installations* and in *Comfort Home High Efficiency Duct Guidelines – Recommended Duct System Installation Guidelines*. To qualify for the incentive payment, a duct blaster test was required to be passed, and a completed form was required to be submitted verifying total duct leakage within program limits.

There is no commonly accepted methodology for measuring duct system efficiency. Accordingly, the specific efficiency parameters to be monitored through developing historical baselines and initiating future tracking are the primary issue with duct sealing. Given the requirements of the program, four alternative indicators should be considered, including 1) *diagnostic testing* to measure the extent of duct leakage, 2) the actual practice or

³⁵ Specifically, within the *Uniform Mechanical Code*, refer to Chapter 6, Duct Systems, and Appendix A, UMC Standard No. 6-3.

service of *duct sealing*, 3) the method of sealing or using duct sealant *products*, and 4) *incidence of duct testing* as a proxy for duct sealing practices and builder and contractor awareness of the importance of duct leakage.

Duct Leakage Rates. The extent of duct leakage can be measured with either a duct blaster test (which pressurizes the duct system) or a duct blaster test in tandem with a blower door test, which pressurizes the building. These tests measure the leakage from the ducts to the conditioned space within the building envelope, or the leakage between the building envelope and the outside. HVAC contractors conduct these tests at the direction of builders in new construction. However, they are not yet commonplace in the absence of financial incentives.

Duct Sealing Practices. Duct sealing methods overlap somewhat with sales of sealant products, as the sealing method employed often infers the use of particular sealant product. While the measure identified for the development of baselines is duct sealing, a number of factors related to the energy efficiency of an air distribution system are important to total duct leakage. These factors, which could be termed “HVAC/mechanical contractor practices” or “air distribution system optimization,” could serve as useful market-effects indicators. Relevant HVAC contractor practices include 1) duct design, such as location of the duct system (e.g., the proportion of the air distribution system located within unconditioned spaces and consideration of airflow patterns), 2) consideration of airflow factors related to doors, flexible ducts, metal ducts, and duct board, 3) duct insulation R-values, and 4) proper duct installation and sealing practices.³⁶ Naturally, data for tracking sealing methods and contractor practices would need to be collected from HVAC/mechanical contractors.

Duct Sealing Materials. Leaking air ducts can be sealed with a variety of methods, including mastics, metal tape (foil back), butyl tape (clear plastic tape), and duct tape, which can be augmented with collars or clamps. Tracking sales of sealant products could serve as a relatively solid indicator of duct efficiency, as sealant products vary in rates of degradation as well as strength. Those that can form tighter seals and/or last longer will contribute to a more energy-efficient duct system. A study conducted by LBNL revealed that some types of duct sealant namely duct tapes, “failed reliably and catastrophically.”³⁷ Clear tapes, foil-backed tapes, mastics, and aerosol sealants were judged as better sealant products. In addition, a recent development in the duct sealing industry is the advent of a sticky vinyl polymer aerosol sealant, developed at the Lawrence Berkeley National Laboratory (LBNL). In

³⁶ An example of duct sealing practices is the use of collars and clamps with tapes or other products that were designed as such.

³⁷ The Air Conditioning, Heating, and Refrigeration News. “Duct Tapes Flunk Berkeley Lab tests.” Vol. 204, No. 18. August 31, 1998.

simplest terms, the sealant is injected into the duct system with a machine similar to a duct blaster. The material automatically deposits and dries at leakage points in the duct work, covering large areas and those that are both small and inaccessible with conventional methods.

Incidence of Duct Leakage Testing. As mentioned above, diagnostic testing remains an uncommon practice in new construction. Therefore an alternative to collecting relatively expensive leakage rate data, one could measure the incidence of duct testing. While changes in the incidence of diagnostic services would not explicitly infer tighter ducts (one cannot assume that testing automatically implies taking action to reduce leakage or the use of better sealant products), such information could serve as an indicator of better duct sealing practices and contractor and consumer awareness, overall. Furthermore, the incidence of duct testing would serve as a useful market-effects indicator of the normal business practices of HVAC/mechanical contractors.

Efficiency Standards. Currently, California's Title 24 energy efficiency standards award performance credit for verified tight ducts. The standards, however, do not currently mandate specific sealing methods, nor do they require duct leakage testing. Recent revisions to Title 24 will require that "all pressure sensitive tapes, mastics, aerosol sealants, or other closure systems must meet applicable UL 181 requirements."³⁸ This requirement pertains to ducts in all building types and will become effective January 1, 1999.

PG&E Service Territory Efficiency Data. The discussion above presented four alternatives for measuring duct sealing baselines. The only historically available information is on the incidence of duct testing. In particular, the incidence of duct testing is highly correlated with participation in the PCH Program. In particular, the in-depth interviews with HVAC contractors revealed that there is little to no duct testing done outside of the program. Further, there was only one HVAC contractor who reported any spillover of duct testing outside the program. These few tests were requested by another builder who was interested in comparing the duct sealing quality in their homes with the Comfort Home participant homes. Therefore, we suggest using program participation as a proxy for duct testing incidence. Table 4-25 presents the number of program participants requiring duct tests, and a comparison with the total number of new housing starts, for the Central Valley, by year. These results suggest that there has been a slight increase in the number of duct tests in the most recent three years of the program. Further, the relatively high participation in 1992 and 1993 might overstate the number of duct tests since duct efficiency was an optional feature of the program in these years. It is also worth noting again that while changes in the incidence of diagnostic services do not explicitly infer tighter ducts (one cannot assume that testing

³⁸ California Energy Commission, *Summary of Changes to the Energy Efficiency Standards*. Sacramento, CA. 1997. The revisions also mandate drawband materials and tightening when used with flexible duct work.

automatically implies taking action to reduce leakage or the use of better sealant products), this information serves as an indicator of better duct sealing practices and contractor and consumer awareness, overall.

Table 4-25: PCH Program Participation Requiring Duct Tests – Central Valley

Year	Committed Comfort Home Participants	New Housing Starts	Percent Duct Tested
1992	29,328	11,018	37%
1993	26,901	11,738	44%
1994	26,368	3,275	12%
1995	22,757	3,023	13%
1996	23,004	6,939	30%
1997	23,353	6,621	28%
1998	28,385	5,635	20%

Note: Duct efficiency was only an optional offering prior to 1994. Therefore, these percentages might be overstated.

In-Depth Survey Data. The HVAC contractors were asked what percentage of their homes is duct tested. All of the contractors interviewed suggested that the only duct testing being undertaken was due to the requirements of the PCH Program. These percentages ranged from 0-15%, depending on the HVAC contractor involvement in the PCH Program.

Impact of PCH Program. The measure baseline data for duct sealing is admittedly sparse. Further, insofar as the program is still being offered it is problematic to attempt to measure market effects through measure baseline indicator data alone.

Gaps Analysis

The purpose of this section is to summarize the availability and quality of the measure baseline assembled in this study. Table 4-26 presents a summary by measure and year of the available data. Included in the table are indicators of the source of the data. In particular, OS indicates that the data was gathered from onsite data, OST indicates that the data was gathered from onsite data but transformed into useful efficiency data, SRD indicates that the data is self-reported from market actor interviews, and PD indicates that the data is from program data.

Table 4-26: Summary of Available Baseline Data for Key Program Measures

Year	CAC	Windows		Duct Sealing		
	SEER	U-Value	SHGC	Sealants	Practices	Diags.
1989	OS	OST	OST	-	-	-
1990	OS	OST	OST	-	-	-
1991	OS	OST	OST	-	-	-
1992	OS	OST	OST	PD	PD	PD
1993	OS	OST	OST	PD	PD	PD
1994	OS	OST	OST	PD	PD	PD
1995	-	OST	OST	PD	PD	PD
1996	-	-	-	PD	PD	PD
1997	-	-	-	PD	PD	PD
1998	SRD	SRD	SRD	PD	PD	PD
199 plus	-	-	-	PD	PD	PD

Note: OS = Onsite data
 OST = Onsite data transformed to efficiency data (e.g. windows frame and glazing type to U-values)
 SRD = Self reported data during market actor interviews
 PD = Data from program database. Contains data for participants only

The following sections provide suggestions on how to fill the gaps in the historical series and initiate future tracking of measure baselines.

Historical Data

Central Air Conditioners and Windows

The historical series for central air conditioners and windows can be augmented with building department data. Documentation certifying compliance with Title 24 energy building regulations must be filed with an enforcing agency for construction activity in all residential and nonresidential buildings requiring a building permit. The enforcing agencies are the city, county, or state agency responsible for issuing building permits. City and county building departments issue the vast majority of building permits.³⁹ Before issuing a permit, building department staff (plans examiners or reviewers) review the Title 24 compliance package and construction plans to ensure that the building specifications meet the Title 24 regulations. At various stages of the construction, field inspectors perform on-site visits to ensure that the equipment and shell measures are installed properly and coincide with those specified on the plans.

A considerable amount of data useful for tracking the market shares of key, energy-using measures is either collected or observed during the certification process performed by

³⁹ There are roughly 500 city and county building departments in California issuing building permits.

building departments. These data sources include compliance documentation, and verification documentation.

- **Compliance Documentation.** During the residential building permit application process, Title 24 compliance documents are filed with the building departments. These documents include, at the least, the CF-1R form for residential buildings. Assembling historical market shares via compliance documentation entails the collection of CF-1R, compliance form data from building departments.
 - **Advantages.** The compliance documentation provides detailed equipment and shell measure data. All building departments presently collect this data.
 - **Disadvantages.** The biggest disadvantage of compliance documentation is the lag time between filing for a building permit and the actual construction. In particular, it is common for changes in equipment to take place, especially in the residential sector, with no change made to the compliance documentation.⁴⁰ The Title 24 regulations state that compliance documentation needs to be redone only if changes in equipment and/or shell measures cause the building to fall out of compliance.
- **Installation Verification Documentation.** For residential buildings, documentation of the installed equipment and shell measures are posted at the job site during construction.⁴¹ These include the CF-6R and IC-1 forms. These forms must be provided to the homeowner and must be made available to the building department if requested.⁴²
 - **Advantages.** The verification data provides detailed data on installed equipment and shell measures. Builders and contractors presently generate this data. There are some historical data available from building departments that presently require filing the verification documentation.
 - **Disadvantages.** The biggest disadvantage of this method is that not all building departments have required that the builders file these forms with the department.

Duct Sealing

PG&E has been very instrumental in developing a recommended duct system installation guidelines for new construction. Included in these guidelines are recommendations for duct installation practices, sealant materials and the for a duct blaster test to be conducted that

⁴⁰ There have been some studies recognizing this difference that have suggested ways to calibrate estimates of efficiencies and size based on secondary data.

⁴¹ See Blueprint #46, Efficiency Standards Office, California Energy Commission, July/August 1993, and Blueprint #55, Efficiency Standards Office, California Energy Commission, Spring 1996, for a discussion of these requirements.

⁴² The CF-1R, MF-1R, CF-6R, and IC-1 forms are required to be included in the Home Owners Manual that is provided to the home owner.

meets some threshold requirement. In addition, and most importantly, these programs require the submission of a detailed duct inspection report. This report provides details on materials used and duct blaster test results. We suggest that these hard copy program records be accessed and input into a database. These data could then be summarized to provide a baseline for duct sealing incidence and provide detailed information on program participant duct sealing.

Framework for Future Research

It is important to develop reliable measure baselines in order to monitor the market effects of programs. The following are some suggestions on how to track shares of program measures.

- ***Duct Sealing***
 - Obtain information regarding duct testing diagnostics and duct sealing practices and materials from the PG&E Duct Certification program data,
 - Obtain information regarding duct sealing practices and materials from the building department data,
 - Implement on-site surveys to record duct sealing practices and materials,
 - Collect information from residential HVAC contractors regarding their duct sealing practices and materials,
 - Collect information from residential builders regarding duct sealing practices and materials, and
 - Conduct diagnostic tests on a sample of homes to determine duct leakage rates.

- ***Central Air Conditioning***
 - Collect compliance, verification, or field inspection data from building departments,
 - Implement on-site surveys to obtain the manufacturer and model number of installed equipment,
 - Collect equipment installation information from residential builders, which should also necessarily include equipment manufacturer and model number,
 - Collect sales data from residential HVAC contractors, which would necessarily include equipment manufacturer and model numbers of all units sold, and
 - Obtain relevant sales data from HVAC equipment distributors in California.

- ***Windows***
 - Obtain U-values, number of panes, and glazing area from building department data,
 - Conduct an on-site survey to collect number of panes, frame type, and glazing size,

- Collect all available window efficiency data from residential builders, and
- Collect all available sales or installation data from residential window contractors.

Each of these methods was described in detail in RER's recently completed scoping study of the feasibility of efficiency market share tracking.⁴³ Further, there is a follow up residential market share tracking study supported by the CBEE and with a statewide focus that is implementing the tracking initiatives developed in the scoping study. This study should be an excellent source for climate zone specific data for the measures covered by the PCH Program.

⁴³ Regional Economic Research, Inc, Efficiency Market Share Needs Assessment and Feasibility Scoping Study, prepared for PG&E and CBEE, May 1999.

5

Market Effects

5.1 Overview

This section presents RER's analysis of effects in the RNC market attributable to the PCH program. For builders and consumers, the key market actors in this market, these effects are analyzed with a econometric modeling approach that controls for differences between the program area and the control area, allowing us to infer the net impacts of the program on market actors' attitudes, perceptions and behaviors. For the remaining market actors, their self-reported ratings of awareness and activity are used to infer relevant market changes. In each case, we consider evidence of market changes. If found, we address the issues of attribution to the program and sustainability.

Subsection 5.2 presents the key market barriers and addresses the issues in market transformation analysis. The remaining sections present the analysis and results of testing market effects hypotheses for specific market actors. These sections are arranged as follows:

- Section 5.3 Builders
- Section 5.4 Architects
- Section 5.5 Sales Agents
- Section 5.6 Lenders
- Section 5.7 Consumers
- Section 5.8 HVAC Manufacturers
- Section 5.9 HVAC Distributors
- Section 5.10 Window Manufacturers
- Section 5.11 Window Distributors
- Section 5.12 HVAC Contractors
- Section 5.13 Window Contractors
- Section 5.14 Title 24 Consultants

5.2 Market Barriers

In general terms, market barriers are defined as factors that prevent the adoption of a socially optimum level of energy efficiency activity in private markets. Previous research has

disclosed a variety of market barriers hindering the adoption of energy efficiency products and services in new construction.¹ The specific market barriers targeted by the PCH Program are the following:²

- Asymmetric information,
- Product unavailability,
- Performance uncertainties,
- Access to financing,
- Split incentives, and
- Organizational practices.

Split incentives arguably constitutes the primary barrier in the residential new construction market, though all of the barriers described above can potentially hinder the choice of energy efficiency in new construction. In addition to these barriers, the impacts of informational search costs, and hassle costs were analyzed.³

These and other barriers in the context of the theory of market failure in residential new construction are reviewed below.

Product Unavailability

Product availability refers to the extent to which high efficiency products are available to downstream market actors. According to Eto, et al. (1996), the availability of DSM products could be limited because manufacturers, distributors, and retailers might perceive relatively high levels of risk associated with the provision of these products. Some risk is inherent in any marketplace and should not be construed as an indication of market failure *per se*. However, unnecessary risk based on misperceptions of product quality, lack of consumer information, or other inadequacies in the market can be seen as a market barrier and a legitimate target for public intervention.

This market barrier is primarily associated with manufacturers and distributors. In general, manufacturers explained that they can and will produce any product demanded by market

¹ See Eto, Joe, Ralph Prael, and Jeff Schlegel, 1996.

² PG&E CPUC Application, October 1, 1997 filing.

³ Environmental impacts associated with energy usage constitute another type of market failure. In the absence of public policy, these environmental effects are externalities in the sense that their costs are not considered in decisions relating to energy usage. While environmental benefits of DSM are considered in societal benefit-cost tests, they are not explicitly taken into account in private decisions with respect to energy investments. It can be argued that these environmental externalities constitute a market barrier, in the sense that they prevent the private market from achieving a socially optimum level of efficiency. On the other hand, the types of utility programs considered in this project do not relate directly to the recognition or mitigation of environmental effects.

actors downstream. Manufacturers and distributors perceive risks in the production or distribution of high efficiency gas equipment if adequate demand for such products is not detected.

Organizational Practices

Organizational practices refer to a company's standard business practices and decision-making strategies, such as the types of products manufactured, or the efficiency levels of equipment typically specified in building plans. Standard organizational practices can be a barrier to the diffusion of energy efficient technologies and are associated with many market actors, including manufacturers, distributors, builders, Title 24 energy consultants, and HVAC contractors.

At the manufacturing level, there could be considerable inertia in decisions to produce new high efficiency technologies as a result of perceived risk or inappropriate practices relating to management rewards and penalties. Further, distributors will not stock high efficiency gas equipment if they do not detect or anticipate sufficient demand for such products. The majority of builders minimize their construction costs subject to compliance of building code standards. Thus, they rarely specify gas equipment or other shell measures that exceed the minimum requirements.

Performance Uncertainties and Perceived Risks

Performance uncertainties and perceived risks refer to how a market actor perceives the performance and quality of equipment and shell measures with which they are unfamiliar. This market barrier is primarily associated with consumers, but can also pertain to equipment specification and purchasing patterns of builders and HVAC and plumbing contractors. For example, customers typically do not understand or are not aware of the energy savings associated with high efficiency equipment and shell measures. Thus, consumers associate a risk to, or are uncertain as to the benefits of such products.

Information Costs

The standard model of competitive markets assumes that all market participants have full information. However, because not all market actors are "experts," information relating to energy efficiency is neither full nor free. Information costs are those incurred by market actors who need to obtain additional information during the decision-making process. It can be costly for these actors to acquire the necessary information and to conduct an appropriate search for alternative products. Information costs often take the form of time and manpower (and sometimes hassles) required for increasing one's knowledge about a particular subject. In the context of this research, information costs affect nearly every demand-side participant in the residential new construction market.

Hassle Costs

Even with full information and clearly identified options, installing high efficiency measures can entail significant hassle costs. These costs can be very real and consist of disruptions of daily routines and use of personal time. Since the market under examination here is the new construction market, hassle costs are primarily associated with changing standard organizational practices to incorporate high efficiency equipment and shell measures. For example, builders who are familiar with specific equipment, or utilize the same building plans for multiple projects, incur a hassle cost when they “change their normal behavior.”

Asymmetric Information

Asymmetric information in the market occurs when market actors who interact have different information or perceptions. In the context of this study, this market barrier is associated with consumers. For example, consumers, by nature, do not have the same information that other market actors have with respect to energy efficiency. This asymmetry affects their decision-making ability and sends signals to other market actors, such as sales agents, that they are not interested in more efficient equipment or shell measures.

Access to Financing

The RFP mentions access to financing as a separate market barrier. For some DSM products, there might be artificial limits on access to funds for energy efficiency investments. For example, builders and developers might face difficulties in receiving financing to upgrade the efficiency levels of HVAC systems, or consumers might not be able to secure adequate financing to purchase a more energy-efficient home.

Misplaced or Split Incentives

The barrier of split incentives refers to the disparity between consumers’ and builders’ incentives in market transaction. As noted by Eto, et al. (1996), energy efficiency decision makers might not be direct beneficiaries of energy savings. Builders might determine shell features and equipment efficiencies, for instance, even though home purchasers enjoy the benefits of higher refrigerator efficiency. If the market does not value the benefits of savings fully (i.e., if home prices cannot be raised to reflect the benefits of investments in efficiency), then the market will tend to yield too low a level of investment in efficiency. In the parlance of welfare economics, some or all of the benefit is *nonappropriable* by the decision maker.

This is a classic case of an ownership externality, and is almost surely a major element of market failure in residential new construction markets. This market barrier exists, at least in part, due to the inherent structure of the residential new construction market – the relationship between the builder and the consumer, in particular. Mitigation of this market barrier should take advantage of intermediaries between the builder and consumer to (1)

ensure that builders receive the correct market signals with respect to consumer values for energy efficiency and (2) to educate consumers about the benefits of more energy-efficient homes. As explained in Section 4, sales agents serve as the (only) intermediary between builders and consumers and are a likely candidate to be targeted by future RNC programs.

Market Barrier Summary

Three aspects of these barriers are important to keep in mind:

- First, these barriers are clearly interdependent and to some extent overlapping. In a few cases, they might not even be distinguishable from each other. For instance, the split incentive barrier is clearly exacerbated by customers' lack of awareness of the energy savings associated with efficiency measures, and this lack of awareness is strongly related to both performance uncertainties and bounded rationality.
- Second, most of the barriers can be characterized as costs (information costs, decision costs, etc.) or risk perceptions. The mere existence of costs or risks in a marketplace does not necessarily signal market failure or indicate the need for policy. If these costs or risks are misperceived or unnecessary, however, appropriate policies might help to improve market performance.
- Third, the reduction of market barriers does not necessarily yield market transformation in the sense in which that term is used in policy discussions surrounding energy efficiency markets. In this context, market transformation implies the use of policies and programs to secure long lasting reductions in these barriers. While some kinds of program features might diminish barriers for the duration of these programs, it is important to recognize that such features actually cause more or less permanent improvements in market performance.

These barriers were described and hypotheses relating to the potential impacts of specific program intervention strategies on these barriers were formulated.⁴ Data collected for this study were used to test these hypotheses in the market-effects assessment portion of the project. Table 5-1 presents the applicable market barriers for each market actor.

⁴ Preliminary hypotheses were presented in the survey questionnaire design portion of the research plan, by market actor.

Table 5-1: Barriers and Market Actors

Actor	Asymmetric Information	Product Unavailability	Performance Uncertainty	Access To Financing	Split Incentives	Business Practices	Information Search Cost *	Hassle Cost *
Manufacturers		X				X		
Distributors		X				X		
HVAC Contractors	X		X			X	X	X
Window Contractors	X	X	X			X	X	
Architects						X	X	
Title 24 Consultants	X					X		
Builders			X	X	X	X	X	X
Sales Agents	X		X		X		X	
Lenders	X			X		X	X	
Consumers	X		X	X	X		X	

* Indicates additional barriers we examined in this study; they were not identified in the PG&E program filing.

5.3 Builder/Developer Market Effects Hypotheses

Overview

Builders are the market actors most directly targeted by the PCH Program. Consequently, interventions need to influence builders’ attitudes, perceptions, and behaviors if the PCH Program is to accomplish its market transformation objectives. In this section, a series of hypotheses relating to the impacts of the PCH Program on builders and developers are tested.

Hypothesized Market Effects

The PCH Program is designed to address several key barriers directly affecting builders’ choices of energy efficiency. These barriers include performance uncertainties of both builders and homebuyers, split incentives relating to the benefits and costs of energy efficiency, organizational practices that discourage the choice of energy efficiency, limited information, and high information search costs relating to energy efficiency measures. The specific hypotheses relating to the mitigation of these barriers are the following.

- The PCH Program provided training and educational services, thus increasing awareness of energy efficiency on the parts of builders and the market actors who influence their decisions, as well as decreasing search and hassle costs associated with the selection of energy efficient equipment and shell measures.

- The PCH Program provided incentives for builders to build homes that exceeded Title 24 and provided opportunities for builders to gain experience in the construction of those homes. This experience led builders to change their business practices relating to the design and construction of their homes.
- The PCH Program provided builders with opportunities to experience increased marketability of a Comfort Home or ENERGY STAR[®] Home, thus decreasing the barrier of split incentives and increasing the likelihood that builders will offer more energy efficient homes in the future.

Research of the market effects relating to these barriers reveals that builders in the PG&E area are more aware of duct testing and that this is likely attributable to the PCH Program. Furthermore, there is some evidence that the PCH Program has also lessened information and hassle costs for PG&E builders and that these effects are likely to be sustainable. In addition, there is some evidence that PG&E builders have changed their building practices as a result of participating in the PCH Program; however, other than the practices of duct sealing and testing, these changes are not likely to persist in the absence of the PCH Program. We find no evidence of a market effect for the barrier of split incentives.

The general approach, overview of modeling, summary of market conditions and builder characteristics, and hypotheses testing are presenting below.

General Approach

The tests of hypotheses relating to market effects are based on the analysis of the builder/developer survey efforts described earlier in Section 3. Builder surveys were conducted in two areas: the PG&E service area (with a fairly strong focus on the Central Valley) and a comparison area consisting of various regions of the country. These surveys will be used to determine if the PCH Program has had a perceptible influence on builders' attitudes, perceptions, and behaviors relating to energy efficiency. Three kinds of evidence will be used to test these hypotheses:

- **Self-Reported Impacts.** The review of program impacts self-reported by developers in the PG&E service territory will offer some evidence with respect to the market effects caused by the PCH Program.
- **Simple Comparisons Across Groups.** As is traditional in market effects studies, the comparison of survey responses from builders in the PCH Program area (the PG&E service area) and the comparison area will help to provide some insights with respect to market effects attributable to the PCH Program.
- **Modeling Approach.** The simple comparison of responses of builders inside and outside the PG&E service area is a traditional approach to the assessment of market effects. However, such comparisons could be distorted by other differences between the PG&E service area and the comparison area. As a result,

an econometric modeling approach will be used to control for these other differences between the PCH Program area and the regions of the comparison area, and to allow us to infer the net impacts of the PCH Program on key aspects of builders' attitudes, perceptions and behaviors. The specific modeling approach is discussed below.

Overview of Modeling Approach

The modeling approach used to control for differences across regions is straightforward. For each of the responses used in the assessment of market effects, we specify a general relationship of the form:

$$Response_{rb} = g_r(CA_b, HMBUILT_b, TRACTHM_b, CDDNORM_b, HDDNORM_b, NEWCONPI_b, STANDARD_b)$$

where

b represents a builder,

r reflects a specific response,

CA is a binary indicator that takes on a value of 1 for PG&E builders and 0 for others,

HMBUILT is the number of homes built in 1998,

TRACTHM is the percent of 1998 homes that were tract homes,

HDDNORM and *CDDNORM* are normal heating and cooling degree days, respectively,

NEWCONPI is a binary indicator of the presence of a utility new construction program in the builder's area (other than PG&E), and

STANDARD reflects the presence of local or state standards.

Because the model includes variables other than *CHP*, it controls for differences across regions. The derivative of the response with respect to *CHP* can then be considered the impact of being a California builder (exposed to the Comfort Home Program), controlling for these other factors. This derivative is included in the tables below as an adjusted difference in the responses of California and non-California builders. It should be noted that the construction of the model yields an estimate of the difference between the PG&E service area and the comparison areas controlling for (taking away) the impacts of other utility programs. In essence, the adjusted difference reflects a no-program baseline for the assessment of market effects.

Summary of Key Market Conditions and Builder Characteristics

Before beginning the assessment of market effects, it is useful to review the differences across regions. Table 5-2 provides weighted means of some key variables for builders in the

PG&E service area and the overall comparison area.⁵ As shown, the average sizes of the builders in the two areas are very similar. However, builders in the comparison area tend to have lower percentages of tract homes, experience more severe weather conditions, and face lower energy prices. Further, not all comparison area builders face standards or utility programs. These differences, of course, are the reasons it is useful to use a modeling approach to control for such factors.

Table 5-2: Summary of Builder Characteristics and Market Features

Characteristic	PG&E	Comparison Area
Number of Homes Built in 1998	237	218
Percentage of Tract Homes	99.7%	58.9%
Normal Heating Degree Days	3,163	2,492
Normal Cooling Degree Days	1,238	2,250
Residential Energy Price	.1192	.0791
Have State or Local Standards	100%	69.7%
Have Utility New Construction Program	100%	61.3%

Builders: Hypothesis One

The PCH Program provided training and educational services, thus increasing awareness of energy efficiency on the parts of builders and the market actors who influence their decisions, as well as decreasing search and hassle costs associated with the selection of energy efficient equipment and shell measures.

Evidence of Market Changes

Evidence with respect to this hypothesis is presented in Table 5-3 and Table 5-4. Both tables present the weighted mean responses for PG&E builders and for builders in the comparison area. Also shown are the simple differences between PG&E builder responses and responses from the counterparts in the comparison area. Standard errors are provided in parentheses, and significance is indicated by asterisks. Finally, we present an adjusted difference for each indicator. This is an estimate of the difference between PG&E builders and comparison area builders controlling for other differences between the builders and the markets in which they compete. As explained above, these adjusted differences were derived from statistical models relating builder responses to a series of factors including the presence of the PG&E Comfort Home Program as well as weather conditions, energy prices, the presence of energy efficiency standards, and the presence of other utility programs.

⁵ The mean for the variable *HMBUILT* is unweighted. All others are weighted by *HMBUILT*.

As shown in Table 5-3, PG&E builders are *less* aware of all but two of the listed energy efficiency measures than their counterparts in the comparison area. The only exceptions are duct testing and duct sealing, which have been a fairly strong focus of PG&E programs in recent years. Using the simple differences between PG&E builders and builders in the comparison area as an indicator, the differences are statistically significant for all of the measures except duct sealing. However, using the adjusted differences, which are based on the model that controls for other differences across areas, only two differences are significant. It appears that, given market conditions and builder features, California builders are significantly less aware of high performance windows and more aware of duct testing than builders in the comparison area.

Table 5-3: Very Aware of Latest Energy Saving Technologies

Technology	PG&E Builders	Comparison Area Builders	Simple Difference	Adjusted Difference
High Efficiency AC	.308** (.086)	.633** (.068)	-.325** (.110)	-.121 (.273)
High Efficiency Gas Furnaces	.308** (.086)	.561** (.070)	-.253** (.111)	-.121 (.117)
High Performance Windows	.384** (.090)	.657** (.067)	-.273** (.112)	-.214* (.112)
Insulation	.373** (.097)	.741** (.062)	-.368** (.115)	-.186 (.130)
Duct Testing	.383** (.095)	.172** (.053)	.211* (.109)	.494** (.220)
Duct Sealing	.383** (.095)	.252** (.061)	.131 (.113)	.084 (.212)

* Significantly different from zero at 90% confidence level

** Significant different from zero at 95% confidence level

t-values are included in parentheses.

Evidence for testing this hypothesis is also gathered from builders' perceptions of whether or not lack of information on hassle costs are important impediments to energy efficiency. Table 5-4 indicates the importance of various reasons for not exceeding minimum energy efficiency code requirements. As shown, very few PG&E builders indicate that either lack of information or hassle costs are important. Indeed, the proportions indicating that these issues are important is not significantly different from zero. Moreover, PG&E builders place significantly less importance on these issues than comparison area builders. On the other hand, PG&E builder place very strong importance on both cost and difficulties in financing. The importance they accord to these barriers is significantly higher than for comparison area builders, according to both the simple differences as well as the model results.

Table 5-4: Importance of Reasons for Not Exceeding Minimum Energy Efficiency Code Requirements

Reason	PG&E Builders	Comparison Area Builders	Simple Difference	Adjusted Difference
Cost	.855** (.068)	.633** (.070)	.222** (.098)	.514** (.128)
Lack of information on energy efficiency measures	.071 (.051)	.218** (.070)	-.147* (.079)	-.163* (.089)
Lack of availability of energy efficiency measures	.005 (.013)	.022 (.060)	-.017 (.025)	.008 (.039)
Difficulty in choosing among alternatives	.102 (.062)	.157** (.053)	-.055 (.081)	()
Hassle	.007 (.018)	.322** (.067)	-.315** (.069)	-.622** (.101)
Difficulties in financing	.341** (.150)	.020 (.146)	.321** (.151)	.330** (.115)

* Significantly different from zero at 90% confidence level

** Significant different from zero at 95% confidence level

t-values are included in parentheses.

Important or very important = 1.

Attribution to PCH Program

The relatively high awareness of duct testing in the PG&E service area is more than likely attributable to the PCH Program. In fact, several builders indicated that their first exposure to testing was through the PCH Program. The lower attention to windows cannot be attributed to the PCH Program, except in the sense that it may suggest that the attention to windows should increase. While window measures are covered by the PCH Program, very few participating builders incorporated them into their offerings.

The relative unimportance of lack of information and hassle costs as impediments to high efficiency installations is probably also at least partly attributable to the PCH Program, since its design focuses strongly on providing information about covered measures. The relative high importance of cost and difficulties in financing may be related to the PCH Program in two ways. First, to the extent that the PCH Program removes information barriers, builders probably focus more strongly on cost. Second, PCH Program incentives have been lowered in recent years (a move that is consistent with attempts to transform the market in other ways), and PG&E builders appear to be reacting to this change. Nonetheless, it seems clear that costs are critical to PG&E builders. As discussed later, this condition is important because many builders are convinced that these costs cannot be passed on to customers in the form of higher home prices.

Sustainability

Changes in awareness, by definition, should have some sustainability. Moreover, if the PCH Program has diminished the importance of lack of information and hassle costs, this should persist as well.

Summary

- Market Effect:** Yes
- Strength of Effect:** Moderate
- Attribution to PCH Program:** Yes
- Sustainable:** Yes

Builders: Hypothesis Two

The PCH Program provided incentives for builders to build homes that exceeded Title 24 and provided opportunities for builders to gain experience in the construction of those homes. This experience led builders to change their business practices relating to the design and construction of their homes.

Evidence of Market Changes

Table 5-5 summarizes responses from *participating* builders relating to building practices. The results shown here suggest that roughly 41% of the participating builders have made changes in their building practices because of the PCH Program. They also reveal that over half of the contractors they use have changed some practices. In general, these practices relate to the installation of measures and the marketing of efficient homes.

Table 5-5: Changes in Building Practices (Participants Only)

Practice	Proportion
Have made changes in building practices as result of participating in the PCH and/or Plus Program	.412** (.105)
Have your continued or will continue practices without the PCH Program	.240* (.142)
Contractors have made changes in building practices as result of participating in the PCH and/or Plus Program	.546** (.114)
Contractors have continued or will continue practices without the PCH Program	.439* (.248)
Would continue to participate in the PCH Program without incentives	.408** (.113)

* Significantly different from zero at 90% confidence level

** Significant different from zero at 95% confidence level

As shown in Table 5-6, comparisons of PG&E builders with builders from the comparison area present a mixed picture. As shown, comparison area builders report higher proportions of single family homes that exceed code, and are more likely to have increased the proportion of their homes exceeding code since 1991. However, note that the adjusted differences between PG&E builders and comparison area builders on these two questions are not significant. That is, when we control for weather conditions, energy prices, household features, and other factors, these differences are insignificant. Moreover, it should be noted that California Title 24 standards are relatively stringent, and that this may account for the appearance of a better performance on the part of comparison area builders.

Table 5-6: Building Practices (All Builders)

Practice	PG&E Builders	Comparison Area Builders	Simple Difference	Adjusted Difference
Proportion of single-family homes that exceed energy efficiency code (Title 24) standards in 1998	.472** (.085)	.622** (.072)	-.150 (.111)	-.166 (.159)
Report that proportion exceeding code has increased since 1991	.186** (.089)	.463** (.084)	-.277** (.127)	-.118 (.140)
Of those that exceeded code (Title 24) in 1998, proportion that were tract homes	.995** (.013)	.747** (.075)	.248** (.076)	.159* (.090)
Will company continue to build homes that (intentionally) exceed code (Title 24)?	.996** (.016)	.788** (.073)	.208** (.075)	.282** (.096)

* Significantly different from zero at 90% confidence level

** Significant different from zero at 95% confidence level

Builders in the PG&E service area report that a higher percentage of efficient homes are tract homes; indeed, they indicate that virtually all of their efficient homes are tract homes, whereas comparison area builders are considerably more likely to be active in custom home markets.

Attribution to PCH Program

Some PG&E builders attribute their changes in building practices to participation in the PCH Program, and over half suggest that their contractors have also changed some practices as a result of the PCH Program. Thus, there is some evidence that the market changes identified above are attributable to the PCH Program.

Sustainability

Sustainability seems to be a strong issue here. As shown in Table 5-6, virtually all of the builders in the PG&E area indicate that they will continue to build homes that intentionally exceed Title 24. However, this response could be tainted by confusion between “meeting” and “exceeding” code. While our interviewers attempted to stress this difference in the interviews, there are some indications that some respondents may still have interpreted this question as dealing with code compliance.

The responses in Table 5-5 are probably more indicative of sustainability of Program impacts. As shown, less than one-quarter of the surveyed PG&E builders indicated that they would continue the practices induced by the PCH Program in its absence. Moreover, only 44% of those whose contractors have changed practices expect that these changes would be sustained in the absence of the PCH Program. One change that appears to have some persistence is duct testing/sealing. One builder reported that using “PG&E ducts” was “the best thing we’ve ever done.”

Interestingly, only 40% of participating builders said they would continue in the PCH Program if incentives were dropped. It appears that changes induced by the PCH Program have been the result of incentives, and the disappearance of the PCH Program or even the discontinuation of incentives would reverse the market effects induced by the PCH Program. This point is reinforced by the strong importance that builders in the PG&E area place on cost as a reason for not building energy efficient homes. Costs are perceived as important, and will continue to deter efficiency until builders are convinced that they can be passed on to home buyers in the form of higher prices or quicker sales.

Summary

Market Effect: Yes

Strength of Effect: Moderate

Attribution to PCH Program: Yes

Sustainability: Not likely

Builders: Hypothesis Three

The PCH Program provided builders with opportunities to experience increased marketability of a Comfort Home or ENERGYSTAR[®] Home, thus decreasing the barrier of split incentives and increasing the likelihood that builders will offer more energy efficient homes in the future.

Evidence of Market Changes

As noted earlier in this report, the barrier of split incentives appears to be the dominant impediment to the adoption of energy efficiency in residential new construction. If the PCH Program has diminished this barrier, we would expect it to improve builders' perceptions of this willingness to pay and/or raise the amount consumers are willing to pay for efficiency through the encouragement of better builder marketing practices.

Table 5-7 summarizes the key responses relating to this barrier. As indicated, PG&E builders tend to be *less* optimistic about customers' demand for energy efficiency than their counterparts in the comparison area. For instance, only 67% of builders in the PG&E area feel that there is some or a lot of demand for energy saving equipment or features. In contrast, 94% of all comparison area builders perceive a lot of demand for high efficiency equipment or features in new homes. Both the simple difference and the adjusted difference in this response are highly significant. While roughly 80% of builders feel that demand for efficiency has increased since 1991, this percentage is no higher than reported by comparison area builders. Builders are virtually unanimous that homebuyers simply expect new homes to be energy efficient (presumably because they satisfy code), and do not recognize differences in efficiency.

Table 5-7: Builder Perceptions of the Demand for Energy Efficiency

Perception	PG&E Builders	Comparison Area Builders	Simple Difference	Adjusted Difference
Homebuyer Demand for Energy Saving Equipment or Features (1 = Some or A Lot; 0= Very Little, None)	.668** (.091)	.944** (.032)	-.276** (.096)	-.257** (.091)
Customer demand for energy saving features has increased since 1991 (1 = Yes, 0 = No)	.800** (.077)	.833** (.053)	-.033 (.093)	-.048 (.097)
Homebuyers expect new homes to be energy efficient (1 = Yes, 0 = No)	.999** (.005)	.997** (.008)	.002 (.009)	.032 (.030)
If you were to build a home that exceeded code by 10%, what proportion of the incremental cost would homebuyers be willing to pay? (%)	.314** (.101)	.534** (.080)	-.220* (.129)	-.254* (.137)
Market homes that exceed code (Title 24) differently than market homes that just meet minimum requirements (1 = Yes, 0 = No)	.423** (.113)	.273** (.080)	.150 (.138)	.077 (.180)

* Significantly different from zero at 90% confidence level

** Significant different from zero at 95% confidence level

Even more telling is the fact that PG&E builders, on average, feel that consumers are willing to pay for only 31% of the total cost of energy efficiency improvements. This value is low in absolute terms, and compares unfavorably with the value reported by comparison area builders. This may account for the fact that only 42% of builders who offer energy efficient homes indicate that they market them differently than other homes. Those who do so report that they emphasize comfort and savings, and that they use PCH Program materials in marketing. There is some evidence that the PCH Program has stimulated changes in marketing strategies, insofar as a higher percentage of PG&E builders report using different marketing strategies than comparison area builders; however, this difference is not significant.

Program Attribution

The PCH Program does not seem to have convinced builders that homebuyers have a high demand for efficiency. There is little question that the PCH Program has induced some changes in the marketing of efficient homes, but these practices are not widespread.

Sustainability

Sustainability is not a strong issue here, since the impacts of the PCH Program in this area do not seem to have been strong. Some program-induced changes in marketing emphases have occurred, and some PG&E builders report that they will continue to market homes on the basis of energy efficiency.

Summary

Market Effect: None

Strength of Effect: n/a

Attribution to PCH Program: n/a

Sustainable: n/a

5.4 Architect Market Effects Hypothesis

The 1998 PCH Program offered technical assistance and product information to architects who assisted builders in the design of homes. Architects often work directly with builders in the designing of residential homes. Thus, they may influence the choices builders make regarding the types of energy efficient measures included in their plans.

Key barriers addressed by the PCH Program assumed to effect architects include organizational practices and information search costs. The following hypotheses are designed to address the impacts from the PCH Program on these two market barriers. In particular, program attribution and the sustainability of any identified market effects will be analyzed.

- By providing opportunities for architects to work with builders on homes with increased energy efficiency requirements, the PCH Program increased the awareness of these actors. This increased awareness leads to lower information costs and improved access to information.
- The PCH Program encouraged builders to install more efficient energy measures and provided education and training to architects on new technologies and installation practices. This led to changes in architects' business practices.

The results indicate that there are little to no sustainable market effects in the form of increased awareness attributable to the PCH Program among architects. Architects tend to be aware of the latest technologies and obtain the majority of their technical information from resources other than program participation. However, there appears to be weak support for sustainable changes in business practices attributable to the PCH Program. This finding is based upon one interview respondent who reported basing plans on PCH Program

specifications. This respondent explained that homes built to PCH specifications were highly marketable and builders took advantage of this marketability, even without formal participation in the PCH Program.

Architects: Hypothesis One

By providing opportunities for architects to work with builders on homes with increased energy efficiency requirements, the PCH Program increased the awareness of these actors. This increased awareness led to lower information costs and improved access to information.

This hypothesis was tested by examining the self-reported awareness of architects, identifying the sources of this information, and comparing differences between these factors for architects who are aware of the PCH Program and those who are not.

Evidence of Market Changes

Due to the nature of their profession, architects are aware of the design-related specifications of a new home. Therefore, one would expect them to be aware of technologies incorporated into the plans during the design stage, and not necessarily aware of technologies used during construction or other phases of production. The data used for testing this hypothesis consists of self-reported ratings of awareness of the latest available technologies obtained during the in-depth interviews.

Specifically, architects were asked how aware they are of the latest available energy saving technologies during the in-depth interviews. As shown in Table 5-8, on average architects consider themselves very aware of high efficiency air conditioning, windows and insulation. They consider themselves less aware of gas furnaces, and barely aware of duct testing and duct sealing methods. These findings are consistent with what one would expect, since architects tend to be more involved with the design of the house rather than HVAC duct installation methods and diagnostic testing.

Table 5-8: Average Awareness of Latest Energy-Efficient Technologies

	High Eff. AC	Gas Furnaces	High Eff. Windows	Insulation	Duct Testing Methods	Duct Sealing Methods
Average Self-Reported Awareness	3.23 (0.21) n = 10	2.64 (0.65) n = 10	3.79 (0.33) n = 10	3.71 (0.34) n = 9	1.71 (0.32) n = 10	1.65 (0.33) n = 10

Each respondent rated their own awareness, with a one 1 meaning “not at all aware,” a 3 meaning “somewhat aware”, and a 5 indicating “very aware.”

Means are weighted according to the self-reported number of homes designed in 1998.

Standard errors are presented in parentheses.

Attribution to PCH Program

In order to ascertain whether or not architect awareness is due to the PCH Program, architects must first be aware of the PCH Program and needed to have cited the PCH Program as an information source for new technologies. First, the vast majority of architects (nine out of ten) reported being aware of the PCH Program. However, none of the respondents mentioned utility programs or PG&E as information sources directly. Typical responses included manufacturers, building departments, trade magazines and conferences, Title 24 consultants, and builders, with no obvious differences between program-aware and program-unaware respondents.⁶

Evidence of Sustainability

Insofar as there is no evidence that the PCH Program heightens architects' awareness of the latest technologies, a discussion about the sustainability of the market effect is not relevant.

Summary

The PCH has no influence on architects' awareness levels.

Market Effect: None

Strength of Effect: n/a

Attribution to PCH Program: n/a

Sustainable: n/a

Architects: Hypothesis Two

The PCH Program encouraged builders to install more efficient energy measures and provided education and training to architects on new technologies and installation practices. This led to changes in architects' business practices.

This hypothesis was tested by examining market changes related to business practices, that occurred during the PCH Program years (since 1991), changes in the proportion of homes architects designed in 1998 that exceeded Title 24, and if any such changes are directly attributable to the PCH Program.

Evidence of Market Changes

Here, the market effects relating to standard business practices refer to changes in how architects design homes, and if the relative percentage of homes that exceed Title 24

⁶ While there appears to be no connection between the PCH Program and architects' information sources, it is reasonable that they would seek information about the PCH Program and the related technologies from their builder and Title 24 consultant clientele.

requirements has changed over the past several years. One of the ten architects interviewed for this study reported changes in their business practices. Specifically, he reported basing plans on PCH specifications. This respondent explained that PCH specifications were highly marketable and builders took advantage of this marketability, even without formally participating in the PCH Program. Two architects also mentioned the builders they worked with made changes to their building practices as a result of the PCH. One is building to Comfort Home specifications even though he is not actually participating in the PCH Program, and the other is installing higher efficiency insulation.

All of the architects interviewed reported no changes over the past eight years in the proportion of homes that exceed Title 24. One stated that the *methods* they used to exceed Title 24 had changed, and this was due to changes in the energy efficiency code, rather than the PCH Program.

Attribution to PCH Program

Based on the information presented above, and the fact that most architects are, in fact, aware of the PCH Program, there is weak evidence to support a market effect relating to changes in architects' standard practices. In particular, we note the following:

- One of ten architects interviewed reported changing his business practices because of the PCH Program. While this is strong evidence that the PCH Program has made a change in the market, the results are arguably weakened due to the low sample size.
- Four of the ten architects in the sample reported that they design homes that exceed the energy code; none reported a change in these proportions over the past eight years. There is no evidence of change in this practice, and thus no attribution to the PCH Program for this particular practice.

Evidence of Sustainability

The one respondent who reported changing his practices as a result of the PCH Program also claimed that he would continue this without the PCH Program. Interestingly, the builders he draws plans for are not actually participating in the PCH Program; rather, they are employing what they consider a competitive strategy. Therefore, the sustainability of this negligible change depends on the marketability of high efficiency homes, and not directly on the continuance of the PCH Program.

Summary

There is a weak effect on this barrier due to the PCH Program. Further, assuming that architects will continue to see the marketability of new homes that are designed to PCH specifications, this effect should persist after the PCH Program is discontinued.

Market Effect: Yes

Strength of Effect: Weak

Attribution to PCH Program: Yes

Sustainable: Yes

5.5 Sales Agent Market Effects Hypotheses

Builders' sales agents act as an intermediary between the builder and the homebuyer and can directly influence consumers' decisions. As the direct sales contact for the consumer, they provide the homebuyer with information on the builder, the features of the home, financing opportunities, and other information that could influence the homebuyer's choices. Questions asked of sales agents in the in-depth interviews were designed partly to test specific hypotheses about relative market barriers.

Market barriers related to sales agents include asymmetric information, information search costs, and split incentives. The specific hypotheses to be tested in this study are the following.

- By providing opportunities for sales agents to work with builders on homes with increased energy efficiency requirements, the PCH Program increased the awareness of these actors. This increased awareness led to lower information costs and improved access to information.
- By encouraging builders to install more efficient energy measures, the PCH Program provided increased opportunities for sales agents to promote and sell homes that exceed Title 24. Consequently, sales agents experienced consumer demand for these homes and gained enhanced perceptions of the marketability of energy efficient homes, thereby decreasing the barrier of split incentives.

Research on these barriers reveals no evidence to indicate a market effect attributable to the PCH Program for the barriers of asymmetric information, information search costs and split incentives. In particular, agents with program experience are no more aware of energy-saving features or of energy efficient mortgages than are agents with no program experience. Some evidence was found that program agents are more aware of Title 24, but this is weakened by the small sample size involved. Similarly, agents with program experience perceived no more demand from customers for energy-saving features than agents with no experience with the PCH Program. Likewise, program agents did not perceive energy efficiency as any more marketable as a new home feature than did non-program agents.

Sales Agents: Hypothesis One

By providing opportunities for sales agents to work with builders on homes with increased energy efficiency requirements, the PCH Program increased the awareness of these actors. This increased awareness leads to lower information costs and improved access to information.

This hypothesis was tested by assessing whether sales agents who have sold homes under the PCH are more aware of the benefits of homes with high efficiency features than are sales agents who have not worked under the PCH Program.

Evidence of Market Changes

Sales agents would need to have sold homes under the PCH Program in order for there to be evidence of increased awareness attributable to the PCH Program. Presumably, they would get this information from the builder or from program information supplied to them by PG&E.

Of the 20 sales agents interviewed for this study, 14 were aware of the Comfort Home program. One of these was also aware of the ENERGY STAR[®] New Homes program. Of the agents aware of the Comfort Home program, none are currently selling homes under the PCH Program. However, three agents have sold program homes in previous years.

Awareness of Title 24. Table 5-9 presents evidence of sales agents' awareness of the Title 24 energy code. As shown, 100% of sales agents who have sold homes under the PCH Program claimed awareness of the energy code. The proportion is 94% for agents without program experience. Surprisingly, agents who have sold homes under the PCH Program reported a lower proportion of sales of high efficiency homes than did agents without program experience. However, it is necessary to keep in mind the small sample size related to this result.

Table 5-9: Sales Agents' Awareness of Energy Codes

	Awareness of Title 24
Sales agents that have sold PCH homes	1.00 (0.0) n = 3
Sales agents who have not sold PCH homes	0.94 (0.1) n = 17
All respondents	0.95 (0.1) n = 20

Responses are weighted means; weight variable is the number of homes sold in 1998.

Standard errors are shown in parentheses.

Response is a binary variable with a 1 indicating the respondent is aware.

Awareness of Energy-Saving Features in New Homes. Table 5-10 summarizes sales agent awareness of the latest available energy-saving features in new homes. As shown, agents with program experience rated themselves more aware of high efficiency windows than did agents with no program experience. For high efficiency air conditioning and gas furnaces, however, they rated themselves less aware. The result for duct systems is that both groups rated themselves equally, once the results were weighted by number of homes sold.

Table 5-10: Sales Agents' Awareness of Energy-saving Features

	High Eff. AC	High Eff. Gas Furnaces	Efficient Duct Systems	High Eff. Windows
Sales agents that have sold program homes (n = 3)	3.0 (0.0)	3.5 (0.6)	3.5 (0.6)	5.0 (0.0)
Sales agents who have not sold program homes (n = 17)	4.3 (0.4)	3.9 (0.4)	3.5 (0.4)	3.9 (0.3)
All respondents (n = 20)	4.2 (0.3)	3.9 (0.3)	3.5 (0.4)	4.0 (0.3)

Responses are weighted means; weight variable is the number of homes sold in 1998.

Standard errors are shown in parentheses.

When asked the source of their information on energy saving features in new homes, 12 of the 20 agents interviewed identified builders or contractors as their primary source of

information. Of the three agents with experience selling program homes, one also reported receiving construction training and doing walk-throughs with the building supervisor.⁷

Awareness of Energy Efficient Mortgages. As shown in Table 5-11, about 70% of sales agents interviewed are aware of energy efficient mortgages (EEMs). The proportion is more than twice as high for sales agents who have not sold program homes as it is for agents with program experience. In addition, of those agents who are aware of EEMs, more than 75% have sold homes that qualify for these mortgages. Interestingly, none of the sales agents with program experience had done so.

Table 5-11: Sales Agents' Awareness of Energy Efficient Mortgages^{1,2}

	Awareness of EEMs*	% of Homes Sold That Qualify for EEM
Sales agents that have sold program homes	0.3 (0.3) n = 3	0.0% (0.0) n = 1
Sales agents who have not sold program homes	0.7 (0.1) n = 17	78.9% (14.3) n = 9
All respondents	0.7 (0.1) n = 20	76.6% (14.1) n = 10

Responses are weighted means; weight variable is the number of homes sold in 1998.

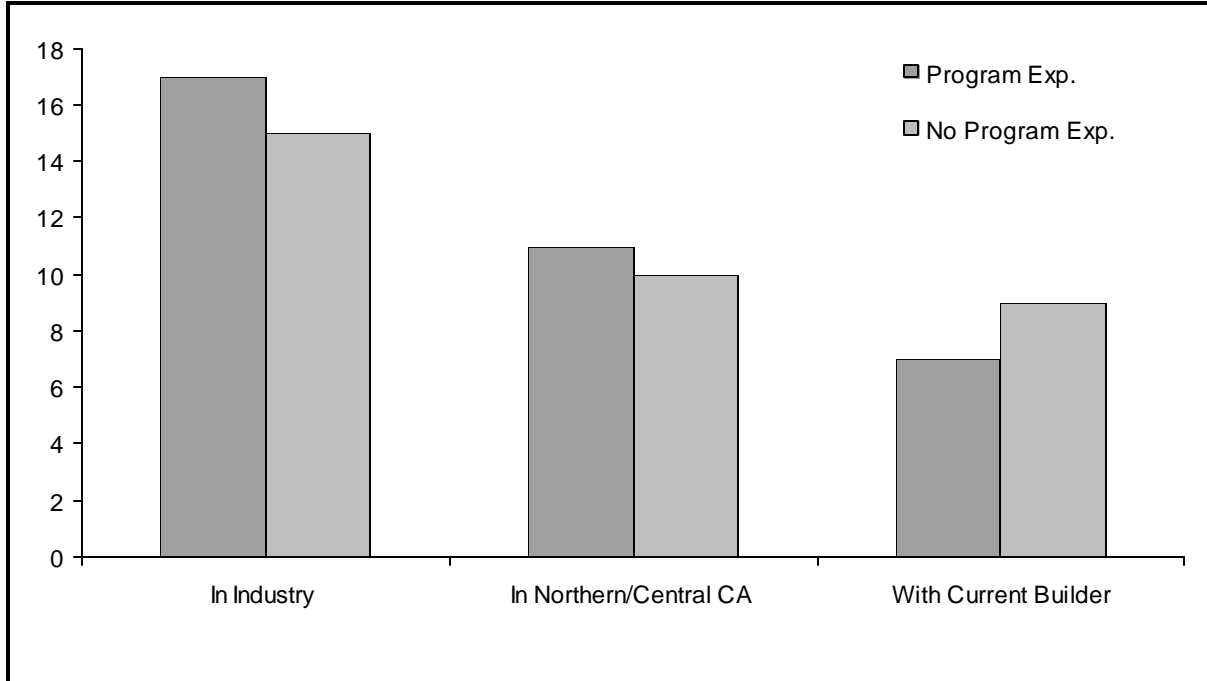
Standard errors are shown in parentheses.

* This response is a binary variable with a 1 indicating the respondent is aware.

At first glance, one may wonder if these awareness levels are related to time in the industry or experience selling new homes in California. Figure 5-1 compares years of experience for sales agents interviewed. Self-reported years in the real estate industry, years working in that industry in northern and central California, and years working for their current builder are shown for sales agents with and without PCH Program experience. As shown, the distribution is similar with program sales agents having slightly more industry experience than non-program agents.

⁷ The second of the three identified subcontractors as a primary source of information and the third did not know.

Figure 5-1: Sales Agent Experience in Years



The evidence presented above indicates that sales agents with experience selling program homes are no more aware than sales agents in general.

- Table 5-9 presents evidence sales agents who have sold program homes are more aware of the Title 24 energy code than are agents without program experience. However, the small sample sizes weaken this evidence.
- Table 5-10 presents evidence that sales agents who have sold program homes are no more aware of energy efficient technologies than are agents with no program experience. High efficiency windows is the exception here; there is some evidence that program agents are more aware of this technology than are non-program agents. However, the small sample sizes must be considered.
- Table 5-11 presents evidence that program sales agents are no more aware of energy efficient mortgages than are non-program sales agents.
- Table 5-11 also presents evidence that program sales agents sell fewer homes that qualify for these mortgages than do non-program agents.
- Evidence presented in Figure 5-1 indicates there are no significant differences in years of experience among the two groups of agents. Therefore, their respective awareness levels are not solely attributable to years of experience.

Attribution to PCH Program

As discussed above, there is no evidence of a market effect attributable to the PCH Program.

Evidence of Sustainability

As there is no evidence to attribute a market effect to the PCH Program, the issue of sustainability is irrelevant.

Summary

Market Effect: None

Strength of Effect: n/a

Attribution to PCH Program: n/a

Sustainable: n/a

Sales Agents: Hypothesis Two

By encouraging builders to install more efficient energy measures, the PCH Program provided increased opportunities for sales agents to promote and sell homes that exceed Title 24. As a result, sales agents experienced consumer demand for these homes and gained enhanced perceptions of the marketability of energy efficient homes, thereby decreasing the barrier of split incentives.

This hypothesis was tested by examining sales agents' perceptions of consumer demand for high efficiency features in new homes. In addition, agents' perceptions of the marketability of energy efficient features in new homes were considered. Specifically, perceptions of agents with program experience were compared to those of agents with no program experience.

Evidence of Market Changes

Sales agents working with builders in the PCH Program would need to perceive a higher demand from consumers for high efficiency features in new homes than do non-program agents in order for the PCH Program to have caused a market effect. In addition, sales agents with experience selling Comfort Homes would need to perceive an increased marketability for these homes as compared to sales agents with no program experience.

Perceptions of Consumer Demand. Sales agents were asked how much demand they perceived for features that exceed minimum energy efficiency standards. As shown in Table 5-12, sales agents who have sold program homes perceive no more demand from consumers for energy-saving home features than do agents with no program experience.

Table 5-12: Sales Agents' Perceptions of Consumer Demand

	Consumer Demand
Sales agents that have sold program homes	0.8 (0.6) n = 3
Sales agents who have not sold program homes	1.1 (0.3) n = 16
All respondents	1.1 (0.3) n = 19

Responses are weighted means; weight variable is the number of homes sold in 1998.

Standard errors are shown in parentheses.

Responses are rated on a scale of 0 to 3 where 0 indicates none, 1 indicates very little, a 2 indicates some, and 3 indicates a lot.

Perceptions of Marketability. Sales agents on the average perceive energy efficiency as a marketable feature, but less so than other features such as price, location, style, floor plan and square footage. Table 5-13 presents the results of sales agents' responses to ranking the marketability various home features. As shown, agents who have sold program homes ranked energy efficiency the lowest. For agents with no program experience, energy efficiency was ranked slightly higher than floor plan, equal with square footage, and lower than price, location, and style.

Table 5-13: Sales Agents' Perceptions of Marketability of Home Features

	Price	Location	Energy Efficiency	Style	Floor Plan	Square Footage
Sales agents that have sold PCH homes (n = 3)	5.7 (0.3)	4.7 (0.3)	2.2 (1.1)	3.6 (1.1)	4.5 (0.4)	4.7 (0.3)
Sales agents who have not sold PCH homes (n = 17)	4.8 (0.2)	4.8 (0.2)	4.1 (0.2)	4.2 (0.2)	3.7 (0.2)	4.1 (0.2)
All respondents (n = 20)	4.8 (0.1)	4.8 (0.1)	3.9 (0.2)	4.1 (0.2)	3.8 (0.2)	4.2 (0.2)

Responses are weighted means; weight variable is the number of homes sold in 1998.

Standard errors are shown in parentheses.

Responses are rated on a scale of 1 to 5, where 1 is not important and 5 is very important.

The evidence presented above indicates that sales agents with experience selling program homes perceive no more customer demand for energy-saving features than do agents in general. Furthermore, program agents do not perceive energy efficiency as any more marketable than do agents with no program experience.

- Table 5-12 presents evidence that sales agents with program experience rate customer demand for energy-saving features lower than do agents who have not sold program homes.
- Table 5-13 presents evidence that sales agents with program experience rate the marketability of energy efficiency lower than do agents who have not sold program homes.

Therefore, we find no evidence to support hypothesis two and conclude there is no market effect relating to this barrier.

Attribution to PCH Program

As discussed above, there is no evidence of a market effect attributable to the PCH Program.

Evidence of Sustainability

As there is no evidence to attribute a market effect to the PCH Program, the issue of sustainability is irrelevant.

Summary

Market Effect: None

Strength of Effect: n/a

Attribution to PCH Program: n/a

Sustainable: n/a

5.6 Lender Market Effects Hypothesis

Lenders provide financing for consumers to purchase their home. In some cases, they may work closely with a particular builder; in fact, some builder/developers own their own mortgage company. In other cases, they may be contacted by the consumer. Questions asked of lenders in the in-depth interviews were designed partly to test specific hypotheses about relative market barriers.

Market barriers related to lenders include asymmetric information, information search costs, financing, and business practices. The specific hypotheses to be tested in this study include:

- By providing information to consumers about financing opportunities and by recruiting lenders to participate with consumers of Comfort Homes, the PCH Program decreased information search costs and diminished the barrier of asymmetric information.
- By providing opportunities for consumers to meet eligibility requirements for energy efficient mortgages (EEMs), the PCH Program increased the likelihood that lenders will offer more EEMs. This experience reduced the access to financing barrier.
- By providing opportunities for lenders to work with builders under the PCH Program and experience the marketability of a PCH home and an EEM, the PCH Program encouraged lenders to change their business practices.

One difficulty in researching market effects among lenders is to include a mix of lenders and lending companies who are and are not writing energy efficient mortgages. An effort was made in this study to do so by including in the sample companies known to offer this service; however, no particular lender was targeted. For example, a major lending institution identified as a national lender for the ENERGY STAR[®] program was included in the in-depth interviews. It was found that the lender interviewed at this company claimed to have never heard of these kinds of mortgages although he had worked in the industry, in California, and at his company for 13 years. This situation indicates a lack of internal communication and training among large financial institutions, and perhaps a lack of support of EEMs in general in the industry.⁸

There is some confusion in the market as to what these mortgages are called. In particular, none of the lenders interviewed was aware of the terms energy efficient mortgage or ENERGY STAR[®] mortgage. Rather, they knew of these only as FHA mortgage upgrades. When consumers were questioned about special mortgages that help buyers purchase energy efficient homes, roughly half the consumers who knew about these mortgages did not know what they were called. The other half knew them as energy efficient mortgages (n = 30), ENERGY STAR[®] mortgages (n = 14), FHA (n = 1), RGE (n = 1), low income (n = 1), or “PG&E ones” (n = 1).

Research on these barriers reveals that lenders are typically unaware and inexperienced with mortgages for energy efficient homes. Specifically, none of the lenders interviewed is

⁸ Some of the in-depth interviews with other market actors revealed similar comments. For example, one respondent from a nonprofit organization relayed her own experience in being unable to find a willing lender and commented that lenders did not want to write energy efficient mortgages because of the additional time involved. Another director of a nonprofit agency commented that lenders in general had not come forth with preferred financing products for energy efficient homes as expected. Furthermore, an organization in California commented that most of the EEMs currently being written in the state are for existing housing rather than new construction.

currently writing such mortgages and only one had done so in the past. Further, the lenders that are aware of energy efficient mortgages know them as FHA upgrades, indicating their information source is something other than the PG&E or ENERGY STAR[®] programs. No evidence was found for market effects attributable to the PCH Program related to these market actors.

Note that the responses are unweighted as most lenders interviewed declined to provide complete information on the number of loans they had written.

Lenders: Hypothesis One

By providing information to consumers about financing opportunities and by recruiting lenders to participate with consumers of Comfort Homes, the PCH Program decreased information search costs and diminished the barrier of asymmetric information.

This hypothesis was tested by examining if lenders who have worked with builders in the Comfort Home program are more aware of energy efficient mortgages. In addition, consumers who purchase and live in homes built under the PCH Program were questioned concerning their awareness of mortgages with special incentives for energy efficient features. Of the ten lenders interviewed, eight wrote mortgages for homebuyers; the remaining two deal only with construction financing for builders.

Evidence of Market Changes

Lenders would need to have worked with builders in the PCH Program or consumers buying program homes in order for there to be evidence of increased awareness attributable to the PCH Program. Similarly, consumers in program homes would need to show more awareness of such loans. Presumably, they would get this information from the sales agent or lender, or from program information supplied to them by the sales agent or by PG&E.

Of the lenders interviewed for this study, four are aware of the Comfort Home or PCH Program. Of the lenders interviewed who write mortgage loans for homebuyers, two are aware of the PCH Program. One of the PCH Program-aware respondents and two of the PCH Program-unaware respondents had heard of energy efficient mortgages, making up an overall average of 38% of the sample.⁹ None of the lenders interviewed is currently offering energy efficient mortgages. One of the PCH Program-unaware lenders had offered them in the past but discontinued that practice.

⁹ Lenders were asked “have you heard of mortgages available to help buyers purchase homes that exceed energy efficiency standards?”

Table 5-14 presents awareness levels of lenders as measured in the in-depth interviews for this study. As shown, 50% of lenders who are working with program builders are aware of energy efficient mortgages. Although, this is a higher proportion than shown for lenders without program experience, the results are weakened by the low sample size. In addition, when asked if their company presently offers these mortgages or has offered them in the past, none of the PCH Program lenders responded affirmatively. These results indicate a lack of awareness on the part of these lenders.

Table 5-14: Lenders' Awareness of Energy Efficient Mortgages (EEMs)

	Aware of EEMs	Company Offers EEMs
Lenders with program experience	50% (0.35) n = 2	0% (0.00) n = 1
Lenders without program experience	33% (0.09) n = 6	50% (0.35) n = 2
All respondents	38% (0.06) n = 8	33% (0.19) n = 3

Total respondents = 8, as 2 did not write mortgages for homebuyers.
Standard errors are in parentheses.

Consumers were also questioned regarding their awareness of energy efficient mortgages.¹⁰ As shown in Table 5-15, 21% of consumers in the PG&E area are aware of such mortgages. A slightly higher proportion of consumers in non-program homes is aware of the mortgages than are consumers in program homes.

¹⁰ Consumers were asked "are you aware of special mortgages available to help buyers purchase energy efficient homes?"

Table 5-15: Consumers' Awareness of Energy Efficient Mortgages (EEMs)

	Aware of EEMs
Respondents in program homes	19% (0.03) n = 243
Respondents in non-program homes	21% (0.03) n = 224
All respondents	20% (0.02) n = 467

Responses are weighted; weights are described in Section 3.

All respondents are those surveyed in the PG&E area who own their home.

The evidence presented above does not adequately support the hypothesis. Specifically, we note the following:

- Table 5-14 presents evidence that half of the lenders with program experience are aware of energy efficient mortgages; however, none are currently offering them. These results indicate a low level of awareness of EEMs in the industry.
- Again from Table 5-14, while 50% of the PCH Program lenders claimed awareness of energy efficient mortgages, the small sample size severely weakens this statistic.
- Although an effort was made to interview lenders at firms known to offer energy efficient mortgages, it did not produce the expected results. Specifically, a lender interviewed at a firm known to offer ENERGY STAR[®] mortgages nationwide claimed unawareness. This result indicates an institutional problem: large financial institutions may sign up as participating lenders with programs without internally communicating this or training their lenders to promote it.
- Table 5-15 presents evidence that consumers living in program homes are no more aware of EEMs than consumers in non-program homes. In fact, non-program home consumers are slightly more aware of energy efficient financing than are program home consumers.

Therefore, we find no evidence to support hypothesis one and conclude there is no market effect on this barrier.

Attribution to PCH Program

As there is no evidence of a market effect, the issue of attribution is irrelevant.

Evidence of Sustainability

As there is no evidence to attribute a market effect to the PCH Program, the issue of sustainability is irrelevant.

Summary

Market Effect: None

Strength of Effect: n/a

Attribution to PCH Program: n/a

Sustainable: n/a

Lenders: Hypothesis Two

By providing opportunities for consumers to meet eligibility requirements for energy efficient mortgages (EEMs), the PCH Program increased the likelihood that lenders will offer more EEMS. This experience reduced the access to financing barrier.

This hypothesis was tested by examining whether program lenders are writing more energy efficient mortgages than are non-program lenders. Similarly, consumers were asked about their experience with energy efficient mortgages and comparisons between consumers in program homes and other PG&E customers were made.

Evidence of Market Changes

Program lenders would need to show an increased likelihood of writing energy efficient mortgages in order for there to be an effect on this barrier attributable to the PCH Program. Evidence was presented in Table 5-14 above that indicated program lenders are no more active in writing energy efficient mortgages for homebuyers than are non-program lenders. In fact, none of the lenders interviewed is currently writing these mortgages, and only one lender, with no program experience, had written them in the past.

Consumers who claimed awareness of energy efficient mortgages were further questioned as to their use of them. Of those aware of the mortgages, roughly 14% had financed their current home with one. Interestingly, although a similar proportion of consumers in program and non-program homes was aware of the mortgages, a higher percentage of non-program home consumers took advantage of them. Table 5-16 presents the results.

Table 5-16: Consumers' Experience with EEMs

	Aware of EEMs	Financed current home with EEM	Would have purchased home w/o EEM
Respondents in program homes	19% (0.03) n = 243	9% (0.04) n = 47	50% (0.29) n = 4
Respondents in non-program homes	21% (0.03) n = 224	14% (0.05) n = 43	20% (0.20) n = 5
All respondents	21% (0.02) n = 467	14% (0.04) n = 90	22% (0.15) n = 9

Responses are weighted; weights are described in Section 3.

All respondents are those surveyed in the PG&E area who own their home.

Standard errors are in parentheses.

Of those consumers who financed their home with an energy efficient mortgage, their recognition of the mortgage name was as follows: of the four consumers in program homes, one identified his mortgage as an ENERGY STAR[®] mortgage; the remaining three did not know the name. Of the six consumers in non-program homes, three identified their mortgages as energy efficient mortgages, one as an ENERGY STAR[®] mortgage, one as different from these but unidentified, and one did not answer.

Consumers who financed their home with an energy efficient mortgage were also asked if they would have purchased their home without it. While half of the consumers living in program homes responded affirmatively, only 20% of the remaining consumers did so.

The evidence presented above indicates no effect on lenders' or consumers' financing preferences. Specifically, we note the following.

- Table 5-14 presents evidence that program lenders are no more likely to write energy efficient mortgages than are non-program lenders. In fact, none of the lenders interviewed is currently writing such mortgages.
- Table 5-16 presents evidence that consumers living in program homes are no more likely to take advantage of energy efficient mortgages than are other PG&E customers. In fact, consumers outside of the PCH Program are more likely to purchase energy efficient mortgages.

- For half the consumers living in program homes who did take advantage of the preferred financing, it was not a factor in their decision to purchase the home. This was true of only 20% of other PG&E customers, indicating that the PCH Program has not contributed to the demand for energy efficient mortgages.

Therefore, we find no evidence to support hypothesis one and conclude there is no market effect on this barrier.

Attribution to PCH Program

As there is no evidence of a market effect, the issue of attribution is irrelevant.

Evidence of Sustainability

As there is no evidence to attribute a market effect to the PCH Program, the issue of sustainability is irrelevant.

Summary

Market Effect: None

Strength of Effect: n/a

Attribution to PCH Program: n/a

Sustainable: n/a

Lenders: Hypothesis Three

By providing opportunities for lenders to work with builders under the PCH Program and experience the marketability of a PCH home and an EEM, the PCH Program encouraged lenders to change their business practices.

This hypothesis was tested by examining changes in lenders' business practices and the relation of these changes to the PCH Program.

Evidence of Market Changes

Lenders working with program builders would need to have changed their business practices in some way related to information they received about the PCH Program.

Two of the ten lenders interviewed reported working with a builder under the PCH Program. Of these, one reported that favorable incentives were offered to homebuyers under this program, and he identified the incentive as a \$400 rebate. When asked if they had changed any of their business practices as a result of being involved with the PCH Program, both lenders reported that they had not. The results are not surprising, considering none of the

lenders interviewed are currently writing energy efficient mortgages and only one had any past experience with them.

Therefore, no evidence was found to support this hypothesis. In particular, only two of the lenders interviewed had worked with a program builder, and neither of these lenders had written energy efficient mortgages. Moreover, both lenders claimed that they had made no changes to their lending practices because of the PCH Program.

Attribution to PCH Program

As there is no evidence of a market effect, the issue of attribution is irrelevant.

Evidence of Sustainability

As there is no evidence to attribute a market effect to the PCH Program, the issue of sustainability is irrelevant.

Summary

Market Effect: None

Strength of Effect: n/a

Attribution to PCH Program: n/a

Sustainable: n/a

5.7 Consumer Market Effects Hypotheses

Overview

Customers living in Comfort Homes are the ultimate purchasers and users of the energy efficiency measures installed in new construction. In most general terms, the PCH Program could transform customer behavior in two ways. First, the PCH Program increases the availability of efficient homes and gives customers a wider range of efficiency options. While customers typically have no direct influence on the installation of these measures, they do choose to purchase these measures indirectly through their purchase of the homes in question. To the extent that the marketing of Comfort Homes increases awareness of efficiency options, it contributes to the transformation of customer behavior. Second, even if customers purchase Comfort Homes unwittingly, their customer experience with higher levels of efficiency may affect their future efficiency choices. This section advances and tests several specific hypotheses with respect to the PCH Program impacts on the behavior of residential customers.

Hypothesized Market Effects

Consumers may not make efficient choices regarding energy measures in their new home due to a number of market barriers. Of the barriers targeted under this study, those affecting consumers include asymmetric information, performance uncertainties, access to financing, and split incentives. An additional relevant barrier is information search costs. An objective of the PCH Program was to mitigate some of these barriers by increasing consumers' awareness levels and knowledge about efficiency choices. In what follows, we specify and test a series of specific hypotheses relating to the market effects of the PCH Program. The specific hypotheses tested include the following:

- Marketing associated with the PCH Program increased consumer awareness of the benefits of energy efficient housing and appliances, thus lowering information costs and diminishing asymmetric information barriers.
- The PCH Program increased consumer awareness of the ENERGY STAR[®] New Home Program. This lowered information costs and diminished asymmetric information barriers.
- Consumers purchasing homes under the PCH Plus Program experienced eligibility for Energy Efficient Mortgages and other financing opportunities. This provided access to financing for purchasing energy-efficient measures and increased awareness of this option.
- By providing opportunities for consumers to experience the performance and operating costs of energy-efficient measures, the PCH Program improved consumers' satisfaction with these products and diminished performance uncertainties and reduced the barrier of split incentives.
- The PCH Program increased consumer awareness of the energy savings associated with energy efficient housing and appliances. As a result, consumers are willing to pay higher prices for these measures.

Research on market effects reveals that the PCH Program has had an effect several barriers. PG&E consumers report higher awareness levels; specifically, they report that energy efficiency has increased in importance and has become a feature they look for when buying a new home. In addition, consumers are slightly more aware of the ENERGY STAR[®] New Homes program and energy efficient mortgages; however, there is no clear evidence to attribute these effects to the PCH Program. Furthermore, the PCH Program has had an effect on product satisfaction, albeit a weak one. No evidence was found of an effect on the barrier of split incentives.

The general approach, modeling approach, background information, and results are presented below.

Approach

The tests of hypotheses relating to customer effects are based on the analysis of the customer survey efforts described earlier in Section 3. As noted there, customer surveys were conducted for three groups:

- Customers living in homes built under the Comfort Home program,
- Customers living in nonparticipant homes in the PG&E service area, and
- Customers living in new homes in a comparison area consisting of other regions of the country.

Analyses of responses from these three groups will be used to determine if the PCH Program has had a perceptible influence on homebuyers' attitudes, perceptions, and behaviors relating to energy efficiency. Three kinds of evidence will be used to test these hypotheses:

- **Self-Reported Impacts.** The review of program impacts self-reported by customers living in Comfort Homes will offer some evidence with respect to the market effects caused by the PCH Program.
- **Simple Comparisons Across Groups.** It is traditional in impact analyses and market effects studies to use the comparison of survey responses by participants and nonparticipants to provide some insights relating to program impacts. For some indicators, this is a legitimate approach; for others, it is not. If the indicator reflects the results of experience with the home, and if there is some way to control for initial (pre-participation) differences, comparing indicators of intended future behavior may yield some information with respect to the impact of the PCH Program. However, if the indicator reflects general attitudes or perceptions (as most do), comparing participants and nonparticipants may yield very misleading inferences. The reason for this is that participants and nonparticipants self-select themselves into or out of the PCH Program. Thus, comparisons are plagued by self-selection bias. While there are ways of attempting to control for self-selection bias, these approaches are not particularly effective.¹¹ A second problem with direct participant/nonparticipant comparisons is a specific issue that arose in the course of this particular analysis. While the 1998 PCH Program had over 5,000 committed homes, relatively few homes were occupied in time to be covered by the study. Because the available frame covers a limited number of developments, the sample drawn from it may not be representative of the overall 1998 Program. Yet a third problem is that programs like Comfort Home also affect the perceptions and attitudes of nonparticipants, and this spillover effect is obscured by simple comparisons of this sort. There is, of course, an alternative way of testing the market effects of the PCH Program,

¹¹ We made some preliminary attempts to use double and single Mills Ratios to mitigate self-selection bias, but were not very successful. The correlation between the participating variable and the Mills Ratio was so high that the participating variable was never significant.

and that is to compare customers in the PG&E service area to those in the comparison area. This type of comparison is unaffected by self selection, and fully reflects spillover as well as direct effects. Clearly, it is more in the spirit of market transformation analysis. If the PG&E Program truly induced market effects, these should show up in comparisons of PG&E customers and comparison areas. While we will post results of participants and nonparticipants, our tests of hypotheses will focus primarily on comparisons across areas.

- **Modeling Approach.** Of course, even simple comparisons of PG&E customers with customers from a comparison area could be confounded by other differences between the PG&E service area and the control area. As a result of these drawbacks an econometric modeling approach will be used to infer the impacts of the PCH Program on key aspects of customer attitudes, perceptions and behaviors. The modeling approach, which was also used for the analysis of builder/developer impacts, is described briefly below.

Modeling Approach

The modeling approach used to control for differences across regions is very similar to the one used for builders/developers. For each of the responses used in the assessment of market effects, we specify a general relationship of the form:

$$Response_{rh} = g_r(CA_h, EDUYEARS_h, CENTKWH_h, PEOPLE_h, CDDNORM_h, HDDNORM_h, NEWCONPI_h, STANDARD_b)$$

where

h represents a household,

r reflects a specific response,

CA is a binary indicator that takes on a value of 1 for PG&E customers and 0 for others,

$EDUYEARS$ is the number of years of education of the head of household,

$CENTKWH$ is residential electricity price,

$PEOPLE$ is the household size,

$HDDNORM$ and $CDDNORM$ are normal heating and cooling degree days, respectively,

$NEWCONPI$ is a binary indicator of the presence of a utility new construction program in the customer's area (other than PG&E), and

$STANDARD$ reflects the presence of local or state standards.

Because the model includes variables other than CHP , it controls for differences across regions. The derivative of the response with respect to CHP can then be considered the

impact of being a California customer (exposed to the PCH Program), controlling for these other factors. This derivative is included in the tables below as an adjusted difference in the responses of California and non-California customers. It should be noted that the construction of the model yields an estimate of the difference between the PG&E service area and the comparison areas controlling for (taking away) the impacts of other utility programs. In essence, the adjusted difference reflects a no-program baseline for the assessment of market effects.

Background Information

Table 5-17 contains a summary of the key features of PG&E participants, PG&E nonparticipants, and comparison area customers. This information is relevant to the interpretation of simple differences in responses.

Table 5-17: Customer Characteristics

Characteristic	PG&E Participants	PG&E Nonpartic.	All PG&E Customers	Comparison Area
Income	\$59,610	\$55,136	\$55,336	\$60,854
Household Size	3.020	3.400	3.378	2.975
Age of Head of Household	48.3	41.4	41.8	42.7
Education in Years	15.4	15.0	15.0	15.5
Average Energy Price	\$0.119	\$0.119	\$0.119	\$0.080
Normal Heating Degree Days	3,065	2,794	3,065	2,794
Normal Cooling Degree Days	972	2,191	972	2,191
Face Local or State Standards	1.000	.900	1.000	.900
Face New Const. Programs	1.000	.511	1.000	.511

Consumers: Hypothesis One

Marketing associated with the PCH Program increased consumer awareness of the benefits of energy efficient housing and appliances, thus lowering information costs and diminishing asymmetric information barriers.

Evidence of Market Changes

If this hypothesis is true, we would expect PG&E customers to be more aware of energy efficiency options and benefits than their counterparts in the comparison area (controlling for cross-area differences and removing the impacts of other programs from comparison area responses). We would also expect that customers' perceptions of the importance of energy efficiency to have increased in recent years. Table 5-18 offers some evidence with respect to these potential effects.

As shown in Table 5-18, PG&E residential customers are significantly more aware of energy efficiency standards than customers in the comparison area.¹² PG&E customers are also significantly more aware of energy efficient mortgages, even though this overall awareness level is also quite low.

Over 90% of all PG&E customers rate energy efficiency as being important or very important, but this percentage is no different than for customers from the comparison area. On the other hand, PG&E customers are more likely to indicate that energy efficiency was important or very important in the purchase of their current home. Moreover, PG&E customers tend to be significantly more likely to feel that energy efficiency has become more important over the past four years than their counterparts in other areas.

¹² Note that responses to all questions concerning awareness of standards or programs were tabulated only for areas where such standards or programs exist.

Table 5-18: Information Relating to Consumer Hypotheses

Indicator	PG&E Service Area			Comparison Area	Simple Difference	Adjusted Difference
	Partici-pants	Non-partic.	All PG&E			
Aware of energy efficiency standards relating to appliances, windows and insulation levels	.931 (.018)	.952 (.014)	0.951 (0.011)	0.854 (0.027)	.097* (.029)	
Aware of minimum energy efficiency standards for air conditioners)	.889 (.026)	.667 (.026)	0.678 (0.027)	0.713 (0.038)	-.035 (.046)	
Aware of differences in windows	.829 (.025)	.778 (.028)	0.781 (0.020)	0.809 (0.026)	-.028 (.033)	
Aware of ENERGY STAR [®] Program	.052 (.014)	.160 (.023)	0.154 (0.016)	0.089 (0.018)	.066* (.024)	
Awareness of energy efficient mortgages	.194 (.025)	.205 (.027)	0.205 (0.019)	0.138 (0.021)	.067* (.028)	
Energy efficiency is important or very important	.930 (.016)	.908 (.018)	0.909 (0.013)	0.892 (0.019)	.017 (.023)	
Energy efficiency has become more important over the past four years	.380 (.031)	.432 (.031)	0.429 (0.022)	0.324 (0.029)	.105* (.036)	
Energy efficiency has become more important over the past seven years	.410 (.032)	.546 (.032)	0.539 (0.022)	0.380 (0.030)	.159* (.037)	
Energy efficiency of this home was important or very important in the decision to buy or rent it	.692 (.030)	.712 (.028)	0.711 (0.020)	0.654 (0.030)	.057 (.036)	

* Significantly different from zero at 90% confidence level

** Significant different from zero at 95% confidence level

Attribution to PCH Program

The differences between PG&E customers and other customers with respect to perceptions on the importance of energy efficiency and the change in this importance over the past few years suggest that the PCH Program has had an impact on consumers’ awareness of the benefits of energy efficiency.

Sustainability

Changes in awareness are by their very nature somewhat sustainable.

Summary

Market Effect: Yes
Strength of Effect: Strong
Attribution to PCH Program: Yes
Sustainable: Yes

Consumers: Hypothesis Two

The PCH Program increased consumer awareness of the ENERGY STAR[®] New Home Program. This lowered information costs and diminished asymmetric information barriers.

Evidence of Market Changes

If this hypothesis is correct, we would expect that PG&E customers are more aware of the ENERGY STAR[®] Program than customers in other areas. As shown in Table 5-18, they are indeed more aware of the ENERGY STAR[®] Program than comparison area customers, although overall awareness of this program is very low across all groups. Oddly enough, customers living in Comfort Homes are less aware of ENERGY STAR[®] than PG&E nonparticipants. This difference may trace to the makeup of the participant group, which tends to be considerably older than the other groups covered by the analysis.

Attribution to PCH Program

It is unclear whether the difference in awareness of ENERGY STAR[®] is the result of the Comfort Home Program or promotions by ENERGY STAR[®]. In any event, the difference, while significant, is still fairly small.

Sustainability

Again, changes in awareness are generally sustainable.

Summary

Market Effect: Yes
Strength of Effect: Weak
Attribution to PCH Program: No
Sustainable: n/a

Consumers: Hypothesis Three

Consumers purchasing homes under the PCH Plus Program experienced eligibility for energy efficient mortgages and other financing opportunities. This provided access to financing for purchasing energy-efficient measures and increased awareness of this option.

Evidence of Market Changes

Some support for this hypothesis is found. As shown in Table 5-18, PG&E customers are significantly more aware of energy efficient mortgages than customers in the comparison area. However, awareness is still small in absolute terms.

Attribution to PCH Program

It is unclear whether this difference may be attributable to PCH Program efforts. It is possible the influence is program related, especially considering the Comfort Home Plus option. However, the change is small and we find no clear evidence to attribute it to the PCH Program.

Sustainability

This effect is sustainable, but continued efforts to build awareness are still necessary.

Summary

Market Effect: Yes

Strength of Effect: Weak

Attribution to PCH Program: No

Sustainable: n/a

Consumers: Hypothesis Four

By providing opportunities for consumers to experience the performance and operating costs of energy-efficient measures, the PCH Program improved consumers' satisfaction with these products and diminished performance uncertainties and reduced the barrier of split incentives.

Evidence of Market Change

This is an absolutely critical hypothesis, insofar as split incentives seems to be the key barrier facing this market. If this hypothesis is true, participants should be aware that they are in an energy efficient home, should be satisfied with the performance of the home, and should be relatively likely to consider energy efficiency an important factor for the purchase of their next home. According to the results presented in Table 5-19, the support for this hypothesis is limited.

First, we note that 82% of all participants indicated that they were aware that their home was energy-efficient when they bought it. However, we are somewhat skeptical of this result insofar as there is some confusion about the meaning of energy efficiency. Many customers appear to equate energy efficiency with meeting, as opposed to exceeding, codes. Evidence to this effect is provided by the fact that only 53% of all participants are aware that their

Comfort Home exceeds code requirements. A similar percentage is aware that their air conditioner exceeds standards. This is a higher percentage than is typical in new home programs, so PG&E (and builders to some extent) has apparently done a good job of informing the purchasers of Comfort Homes that they are living in an efficient home. Nonetheless, the fact that almost half of the participants are unaware of their home's properties limits the effectiveness of the PCH Program in transforming the market.

Table 5-19: Evidence for Consumer Hypothesis Four

Indicator	PG&E Service Area			Comparison Area	Simple Difference	Adjusted Difference
	Partici-pants	Non-partic.	All PG&E			
My home exceeds energy efficiency standards on appliances, windows and insulation levels	.531 (.038)	.347 (.035)	0.357 (0.025)	0.477 (0.042)	-.120* (.049)	
Was aware that this home qualified as an energy-efficient home when purchased it (participants only)	0.819 (0.025)	NA	NA	NA	NA	NA
My air conditioner exceeds energy efficiency standards (participants only)	.544 (.045)	NA	NA	NA	NA	NA
Satisfied with performance of air conditioner	.970 (.011)	.862 (.024)	0.870 (0.016)	0.960 (0.013)	-.090* (.021)	
If replacing present air conditioner, would replace it with a model with equal or higher efficiency (participants only)	.990 (.008)	NA	NA	NA	NA	NA
Given experience with energy efficient home, energy efficiency will be important or very important in purchase of next home (participants only)	.930 (.018)	NA	NA	NA	NA	NA
If looking for a new home, would look for one with energy efficiency measures	.900 (.019)	.900 (.019)	0.900 (0.014)	0.794 (0.025)	.106* (.029)	

* Significantly different from zero at 90% confidence level

** Significant different from zero at 95% confidence level

Significantly, 90% of all participants report that, as a result of their experience with their Comfort Home, energy efficiency will be important or very important in the purchase of their next home. Roughly 90% of all participants also report that they would look for a home with energy efficiency measures if they were in the market. It is also encouraging that virtually all participants are satisfied with their air conditioner and would replace it with a unit of equal or greater efficiency.

Attribution to PCH Program

While participants are generally positive about their experience with their Comfort Home, and a high percentage express the intent to seek energy efficiency in future decisions, the comparisons of PG&E customers (both participants and nonparticipants) with comparison area customers yields mixed results. PG&E customers as a whole are significantly less satisfied with their air conditioners than comparison area customers, although participants are more satisfied than either nonparticipants or comparison area customers. The one evidence of attribution is that both groups of PG&E customers are reportedly more likely to look for energy efficiency in their next home than customers in other areas. This is fairly weak evidence, but somewhat encouraging.

Sustainability

The enhanced intention to seek out energy efficiency in subsequent purchases is at least somewhat sustainable. Of course, intentions can change as market conditions vary or recollections of the experience with energy efficiency fade.

Summary

Market Effect: Yes

Strength of Effect: Weak

Attribution to PCH Program: Yes

Sustainable: Yes

Consumers: Hypothesis Five

The PCH Program increased consumer awareness of the energy savings associated with energy efficient housing and appliances. As a result, consumers are willing to pay higher prices for these measures.

Evidence of Market Change

This hypothesis is similar to Hypothesis Four, except that it tends to be a bit more concrete. While Hypothesis Four related to satisfaction and intentions to look for energy efficiency, Hypothesis Five poses the ultimate question: Is the PCH Program making customers more

willing to pay for the incremental costs of energy efficiency? Table 5-20 contains our evidence with respect to this question.

The first two questions have already been discussed under Hypothesis Four. Again, we note that PG&E customers are significantly more likely to look for a home with energy efficiency measures than comparison area customers. However, only 70% of these customers (and only 68% of the customers in Comfort Homes) would be willing to pay *any* more for an efficient home if it yielded savings of \$10 per month. Of those who would be willing to pay more, reports of the premium they would be willing to pay vary widely. These premiums vary from a few dollars to \$50,000, suggesting that many respondents had no idea how to value a monthly saving in terms of purchase price. Strangely, participants express considerably less willingness to pay a premium than PG&E nonparticipants. Again, this could be because of differences in the characteristics of PG&E participants and nonparticipants, but it is nonetheless odd. Even though PG&E customers as a whole express a higher average premium than comparison area customers, the adjusted difference is actually reversed. That is, if we control for differences across areas, PG&E customers are actually willing to pay a smaller premium than customers in other areas.¹³

Attribution to PCH Program

The PCH Program does not seem to have increased customers' willingness to pay a premium for energy efficient homes.

Sustainability

Since there is no evidence of an impact, sustainability is not an issue.

Summary

Market Effect: No

Strength of Effect: n/a

Attribution to PCH Program: n/a

Sustainable: n/a

¹³ This results stems from the fact that PG&E's residential energy price is higher than all but one of the service areas covered by the comparison group. Since willingness to pay a premium was strongly correlated with energy prices, controlling for this difference had a strong impact on the adjusted difference.

Table 5-20: Evidence for Consumer Hypothesis Five

Indicator	PG&E Service Area			Comparison Area	Simple Difference	Adjusted Difference
	Partici-pants	Non-partic.	All PG&E			
Given experience with energy efficient home, energy efficiency will be important or very important in purchase of next home ⁴	.930 (.018)	NA	NA	NA	NA	NA
If looking for a new home, would look for one with energy efficiency measures	.900 (.019)	.900 (.019)	0.900 (0.014)	0.794 (0.025)	.106* (.029)	
If I could upgrade the efficiency of a new home and save \$10/month, I would be willing to pay more for the home	.682 (.030)	.698 (.031)	0.697 (0.021)	0.503 (0.031)	.194* (.037)	
Assuming I could finance at least part of the cost, I would be willing to pay a premium of \$ ____ on the sales price of the home	\$927 (234)	\$1,883 (305)	\$1,849 (238)	\$1,313 (228)	\$536 (329)	

* Significantly different from zero at 90% confidence level

** Significant different from zero at 95% confidence level

5.8 HVAC Manufacturer Market Effects Hypotheses

High efficiency air conditioning units were a direct requirement of the PCH Base program. In addition, these and/or high efficiency gas furnaces could be installed to meet the PCH Plus Program requirements. The manufacturers of these units have a direct influence on product availability and pricing. As explained in Section 4, HVAC equipment manufacturers are the ultimate suppliers in the HVAC equipment market and sell most units for residential new construction directly to HVAC distributors or contractors. Equipment manufacturers also serve as one of the primary sources of information for distributors, contractors, and builders.

Market barriers related to HVAC manufacturers relate to product unavailability and business practices. One element of the 1998 PCH Program was to work with manufacturers to increase the supply of energy efficient products. The specific hypotheses to be tested in this study include:

- By requiring the installation of a specific set of measures in Comfort Homes, the PCH Program increased demand for these products. The PCH Program also worked with manufacturers to increase the supply of energy efficient products and

with consumers to increase their awareness, resulting in manufacturers' perceiving less risk in making these products available.

- By stimulating increased supply of high efficiency products, the PCH Program caused manufacturers to change their business practices relating to product design, distribution, marketing, and other activities.

Research reveals evidence of market effects in the form of increases in the percentage of high efficiency HVAC units shipped to Central and Northern California. This evidence is fairly strong for central air conditioners, but weak for gas furnaces. Other changes in the HVAC equipment market include some changes in inventory and distribution practices. Though most manufacturers agreed that rebates strongly influence the percentage of high efficiency units that are shipped nationwide, these apparent market effects were not attributed specifically to the PCH Program. Moreover, there was consensus among manufacturers that demand for high efficiency equipment will decrease (from "slightly" to "dramatically") when programs promoting the units are discontinued. Thus, at this point, evidence from manufacturers suggests that the sustainability of any detectable market effects will be weak at best.

HVAC Manufacturer: Hypothesis One

By requiring the installation of a specific set of measures in Comfort Homes, the PCH Program increased demand for these products. The PCH Program also worked with manufacturers to increase the supply of energy efficient products and with consumers to increase their awareness, resulting in manufacturers' perceiving less risk in making these products available.

This hypothesis was tested by examining changes in efficiency level mixes of HVAC equipment throughout the PCH Program years (since 1991), manufacturer awareness of the PCH Program, and how discontinuation of programs would impact efficiency level mixes, as reported by equipment manufacturers during the in-depth interviews. The evidence of market effects, attribution to the 1998 PCH Program, and the evidence of or potential for sustainability of any such effects are presented below.

Evidence of Market Change

Manufacturers needed to have indicated changes in efficiency level mixes of gas furnaces and/or central air conditioners in order for there to be evidence of increased availability of high efficiency HVAC equipment. All but one of the manufacturers interviewed for this research reported an increase in the percentage of high efficiency air conditioning units shipped to Central and Northern California over the past several years. Interestingly, manufacturers differed with respect to the percentage of high efficiency units shipped to this region relative to all units shipped. Half of the respondents explained that the efficiency level mixes of

national shipments are representative of the California market, while others indicated quite the opposite. In particular, one company indicated that a higher percentage of 10 SEER units are shipped to the region relative to national shipments, and another stated a higher percentage of 12 SEER units are shipped to Central and Northern California.

In contrast, the gas furnace market has not exhibited quite the fluctuation in efficiencies that has been observed in the air conditioner market in recent years. In fact, less than half of the respondents indicated an increase in the percentage of high efficiency furnaces shipped to the study region over the past several years. The cost of fuel and low heating loads relative to other areas in the country are the primary reasons for stable efficiency levels of furnaces.

Attribution to PCH Program

In order for the above market effects to be attributable to the PCH Program, manufacturers not only need to be aware of the PCH Program, but they also must attribute any changes in efficiency level mixes to the PCH Program. During the in-depth interviews, respondents were queried about primary influence on HVAC equipment efficiency levels *prior to* any mention of the PCH or utility programs, in general. Manufactures were later asked directly if any aforementioned changes in efficiencies of shipments were due to the PCH.

All of the manufacturers were aware of programs designed to increase the efficiency levels of HVAC equipment installed in new homes that are sponsored by government agencies, nonprofit organizations, and utilities. Moreover, research indicates that utility rebates undeniably influence efficiency level mixes of HVAC equipment. In fact, half of the manufacturers interviewed for this study indicated that rebates are the primary reason for changes in product efficiency mixes over the past several years, particularly so for air conditioning equipment. Other reasons for changes include product and technological innovation, changes in demand, customer awareness, and changes in federal minimum efficiency standards.

While the above evidence suggests that changes in the availability of high efficiency HVAC equipment are at least partly attributable to rebates offered through utility programs, in general, there are no indications that such market effects are due specifically to the PCH Program. First, most of the respondents were not aware at all of the PCH Base or Plus Programs; only one of the manufacturers interviewed for this study was aware, though “not well.” Even though all manufacturers are aware of “programs,” one explained that equipment dealers and distributors are more likely and need to be familiar of specific programs to remain competitive. Manufacturers, themselves, are too far distanced from end users in the distribution channel to realize program impacts, much less be familiar with specific programs. Despite this apparent lack of knowledge of specific utility programs, all manufacturers were familiar with the ENERGY STAR[®] New Homes Program.

Second, none of the manufacturers cited the PCH Program or energy efficiency programs, in general, as primary influences on decisions to manufacture HVAC equipment that exceeds federal minimum efficiency standards. Rather, competition among the major manufacturers seemed to dominate such decisions. However, a few respondents did mention meeting market demand as a primary influence, which could indirectly be linked to energy efficiency programs.

Third, none of the HVAC equipment manufacturers interviewed for this study indicated that either the PCH Base or Plus Programs, or the ENERGY STAR[®] New Homes Program was responsible for any changes in product shipment characteristics.

Sustainability

In order for the above market effects (i.e., increases in percentages of air conditioners shipped that are high efficiency), to be sustainable, any changes in efficiency level mixes need to be supported in the future. Evidence suggests that any increases in percentages of high efficiency units are likely to subside when rebates are discontinued. In fact, the majority of manufacturers indicated that increases in shipments of high efficiency air conditioners will not continue without utility promotion or increased federal energy efficiency mandates. This is not surprising, given that manufacturers seemed to focus on or be familiar only with rebate offerings and not information components of programs; informational components are more likely to induce long lasting effects than rebates. Some manufacturers estimated that demand for high efficiency units would drop 10% to 50% if rebates are not offered. One manufacturer also explained that deregulation of the electric power industry and the promise of lower energy costs has introduced another barrier to the adoption of high efficiency HVAC equipment.

It is important to keep in mind several issues relating to the sustainability of market effects. First, at this point manufacturers could not attribute increased percentages of high efficiency HVAC equipment shipped to the study area to the PCH Program. Because such market effects could not be directly attributable to the PCH Program, examining their sustainability is not valuable with respect to assessing the successfulness of the PCH Program. Second, the manufacturers interviewed were very aware of rebates offered through energy efficiency programs, but none mentioned education and information campaigns. So, even though they are aware of programs, manufacturers do not seem to be familiar with specific intervention strategies and their effects in the marketplace other than rebates. Third, sustainability refers to market effects that have outlived the PCH. Given that the PCH Program is still in operation, one can only *predict* the permanence of changes induced by the PCH Program.

Summary

Market Effect: Yes

Strength of Effect: Moderate

Attribution to PCH Program: No

Sustainable: n/a

HVAC Manufacturer: Hypothesis Two

By stimulating increased supply of high efficiency products, the PCH Program caused manufacturers to change their business practices relating to product design, distribution, marketing, and other activities.

This hypothesis was tested by examining self-reported changes in stocking and distribution practices, research and development investments, manufacturing processes, and other activities adopted by HVAC equipment manufacturers. The evidence of market effects, attribution to the 1998 PCH Program, and the evidence of or potential for sustainability of any such effects are presented below.

Evidence of Market Change

Manufacturers needed to have indicated changes in one or more of a variety of business practices in order for there to be evidence of market effects of this nature. Inventory and distribution practices, research and development, and sources of information relating to efficiency standards and energy efficiency programs through the nation were considered.

Inventory and Distribution Practices. As explained in Section 4, manufacturers differ with respect to the levels of inventory they maintain. Some keep very little inventory and operate primarily on a “build-to-order” basis, while others inventory enough units to fill orders for a specified period in the future. Three of the five manufacturers interviewed for this study reported changes in inventory practices in recent years. All of the changes in inventory practices reported reflect the fact that many HVAC equipment manufacturers are reducing inventory levels in efforts to reduce costs and improve overall efficiency of the company. Changes in distribution practices reported by manufacturers are consistent with changes in inventory methods. Though only two out of the five reported changes in distribution, those mentioned related to reducing costs to remain or become more competitive in the market. In particular, one manufacturer is using fewer small distributors and prefers working with larger companies than in the past. The other company used to own its distribution channels, but is now using only independent distributors. Both companies reported that these changes were initiated in the past two years.

Shipments to Study Region. All but one manufacturer reported a change in their share of the Central/Northern California market. For the most part, company shipments to the

region have increased. Increased market volume in the study area are due to product redesign and retooling (which resulted in the production of higher efficiency units), aggressive marketing in Central/Northern California, and changes in distribution practices. One manufacturer reported a decrease in their presence in the region because of changes in their distribution practices.

Research and Development and Changes in Manufacturing Processes. As explained in Section 4, all HVAC equipment manufacturers reported having research and development (R&E) departments, with budgets roughly 5% to 10% of overall operating costs. Two of the five interviewees reported a change in research and development practices in recent years. Even though interview respondents were somewhat reluctant to divulge specifics about information about these changes, one company explained that R&D changes are necessary to remain competitive in the industry. Three of the five companies reported recent innovations in manufacturing, primarily to increase quality of their products, redesign existing HVAC equipment models, or to accommodate changes in federal manufacturing regulations. All of the manufacturers indicated that such changes are continuous and not attributable to any particular external stimuli.

Information Sources. During the in-depth interviews, most of the manufacturers reported trade associations, such as the Gas Appliance Manufacturers Association (GAMA), the Air Conditioning and Refrigeration Institute (ARI), and the Electric and Gas Industry Association (EGIA), distributors, contractors, and government agencies. The only change reported was the creation of a position in 1992 to specifically stay abreast of energy efficiency standards and program requirements throughout the nation.

Attribution to PCH Program

In order for the above market effects to be attributable to the PCH Program, manufacturers not only need to be aware of the PCH Program, but they also must attribute any of the changes described above to the PCH Program. As mentioned above, even though all of the manufacturers were aware of energy efficiency programs, in general, most of the respondents were not aware at all of the PCH Base or Plus Programs. One of the two companies that had heard of the PCH Program did, in fact attribute some organizational changes to energy efficiency programs, in general, but not directly to the PCH Program. This respondent explained that sales and distribution at the local level in California does effect on manufacturing practices because of the size of the California market. As such, they need to consider this market when they plan for designing/redesigning products. However, the respondent also explained that, because utility rebates might or might not exist in the long term, programs may or may not be direct facilitators of change. In particular, redesigning products requires a long term planning horizon, and because rebates might not be available in

the future, manufacturers might not consider programs when considering changing business practices.

Sustainability

Although the market effects described above could not be attributed directly to energy efficiency programs, or the PCH Program specifically, evidence from the interviews with manufacturers suggests that most if not all reported changes will continue in the future. For example, manufacturers consider product development (redesign, retooling, new product development) as part of the natural evolution of the manufacturing industry necessary for a company to remain a formidable competitor.

Summary

Market Effect: Yes

Strength of Effect: Weak

Attribution to PCH Program: No

Sustainable: n/a

5.9 HVAC Distributor Market Effects Hypotheses

HVAC equipment distributors are equipment supply-side market actors that primarily serve as intermediaries between equipment manufacturers and HVAC contractors. As explained in Section 4, the role of the distributor is generally limited to sales of heating and cooling equipment and air distribution system related materials.

This study hypothesizes that the market barriers reduced by the PCH that relate specifically to HVAC equipment distributors include product unavailability and organizational and business practices. The hypothesized market effects are specified below.

- The 1998 PCH reduced or eliminated the product unavailability market barrier. Increased downstream demand for high efficiency air conditioners and enhanced air duct products and sealing practices due to the PCH encouraged HVAC equipment distributors to permanently increase their inventories of high efficiency products.
- The PCH reduced the organizational and business practices market barrier. Recognizing the marketability of high efficiency equipment, the PCH induced permanent changes in marketing and promotional practices of HVAC equipment distributors.

Research reveals evidence of market effects in the form of increases in the percentage of high efficiency HVAC units sold by distributors in Central and Northern California. While

interview respondents agreed that they sell a greater percentage of high efficiency HVAC units now than in the past, few could claim that energy efficiency program incited such changes. The strongest influences on efficiency mixes of HVAC equipment are energy efficiency standards, quality of the equipment, though one company did increase stock of high efficiency units to accommodate contractor orders under energy efficiency programs. Regardless of the cause, most distributors also agreed that the proportion of high efficiency equipment is likely remain stable or increase in the future.

HVAC Distributor: Hypothesis One

The PCH reduced/eliminated the product unavailability market barrier. Increased downstream demand for high efficiency air conditioners and enhanced air duct products and sealing practices due to the Comfort Home Program encourages HVAC equipment distributors to permanently increase their inventories of high efficiency products.

This hypothesis was tested by examining changes in efficiency level mixes of HVAC equipment sold throughout the PCH Program years (since 1991), distributor awareness of the PCH Program, and how discontinuation of programs would impact efficiency level mixes, as reported by equipment distributors during the in-depth interviews. The evidence of market effects, attribution to the 1998 PCH Program, and the evidence of or potential for sustainability of any such effects are presented below.

Evidence of Market Change

HVAC equipment distributors needed to have indicated changes in efficiency level mixes of gas furnaces and/or central air conditioners in order for there to evidence of increased availability of high efficiency HVAC equipment. Two of the five distributors interviewed for this study reported an increase in the percentage of central air conditioners of 10 SEER or greater in recent years. In addition, two distributors (one of which has a significant share of the California market) are also selling more a greater proportion of gas furnaces above 88% AFUE. Incidentally, more than half of the respondents indicated an increase in market share of the Central and Northern California region.

Attribution to PCH Program

In order for the increases in percentage of high efficiency units sold by distributors to be attributable to the PCH Program, distributors not only need to be aware of the PCH Program, but they also must attribute any changes in efficiency level mixes to the PCH Program. During the in-depth interviews, respondents were queried about primary influence on decisions to sell HVAC equipment that exceeds minimum standards *prior to* any mention of the PCH or utility programs, in general. They were later asked directly if any aforementioned changes in were specifically due to the PCH Program.

Prior to any mention of energy efficiency programs, distributors mentioned a variety of influences on their decisions to sell equipment that exceeds minimum efficiency standards. In particular, quality of the unit, better manufacturer warranties, reliability, name recognition, customer demand, and manufacturer advertising all have some influence on the types of units that distributors stock and sell to contractors and builders. One respondent mentioned PG&E rebate programs. Two distributors also explained that Title 24 efficiency standards and rebate programs offered by PG&E and Sears facilitated increases in the percentage of high efficiency units sold in recent years.

Four of the five distributors are aware of programs designed to increase the efficiency levels of HVAC equipment installed in new homes that are sponsored by government agencies, nonprofit organizations, and utilities. (The “unaware” distributor is a relatively small independent company.) All four distributors are aware of ENERGY STAR[®] programs, three of which are also aware of the PCH Base Program. With respect to the extent to which the energy efficiency programs induced the above market effects, one distributor did, in fact, claim that they increased in their inventory of high efficiency air conditioners to ensure they could accommodate orders by contractors – but this distributor did not specify the PCH Program or ENERGY STAR[®] in this claim. None of the remaining companies claimed the PCH Program induced changes in the availability of high efficiency air conditioners or gas furnaces.

Sustainability

Evidence of the sustainability of increased availability of high efficiency HVAC equipment varies, though most distributors agreed that the percentage of units exceed minimum standards will continue to increase in the future. Because most distributors could not attribute changes in efficiency level mixes directly to the PCH or energy efficiency programs in general, most agreed that cessation of the PCH Programs would not significantly affect the availability of high efficiency HVAC units. One distributor thought that the percentage of 12 and 13 SEER units would decrease slightly, while one explained that percentages of high efficiency units would not drop, but would not grow either.

Summary

Market Effect: Yes

Strength of Effect: Weak

Attribution to PCH Program: Yes

Sustainable: Possibly

HVAC Distributor: Hypothesis Two

The PCH reduced the organizational and business practices market barrier. Recognizing the marketability of high efficiency equipment, the PCH induced permanent changes in marketing and promotional practices of HVAC equipment distributors.

This hypothesis was tested by examining self-reported changes in stocking and distribution practices, marketing and promotional practices, and other activities adopted by HVAC equipment distributors. The evidence of market effects, attribution to the 1998 PCH Program, and the evidence of or potential for sustainability of any such effects is presented below.

Evidence of Market Change

Distributors needed to have indicated changes in one or more of a variety of business practices in order for there to be evidence of market effects of this nature. Inventory and distribution practices, sales and marketing, and sources of information relating to efficiency standards and energy efficiency programs were considered.

Inventory and Distribution Practices. All of the distributors interviewed for this study maintain a certain level of inventory to accommodate sales for a specified period in the future. Two of the five companies indicated a change in inventory practices in recent years. One company now keeps higher levels of stock (if the customer cannot see the units, they are less likely to buy them), while the other is ever decreasing its inventory to reduce costs.

Sales and Marketing. Distributors differed in their marketing techniques of high efficiency air conditioners and gas furnaces. While some see the need to stress energy savings of high efficiency units to its customers, others do not market these units any differently than equipment that just meets the minimum standards. Interestingly, one distributor offers promotions to contractors who purchase high efficiency units, claiming that doing so is the only way to sell the units.

Information Sources. Distributors utilize a variety of sources to keep abreast of available technologies, energy standards and energy efficiency program requirements throughout the nation. Those mentioned during the interviews include industry publications, manufacturers, trade organizations, product catalogs, and word of mouth. None of the distributors interviewed for this research reported any changes in how they obtain information in recent years.

Attribution to PCH Program

As mentioned above, the majority of HVAC equipment distributors are aware of energy efficiency programs in general, and most are aware of both the ENERGY STAR[®] and PCH

Program. Two of the five distributors interviewed for this study reported changes in their sales, marketing, or distribution practices changes as a result of any energy efficiency programs. Neither company, however, attributed changes to the PCH Program directly, though one did mention specific programs or program administrators (i.e., PG&E Express Efficiency, SMUD).

Sustainability

Though distributors did not attribute any of the changes in inventory and distribution practices directly to the PCH Program, it is useful to learn that these changes are likely to continue because they were initiated primarily as cost saving strategies.

Summary

Market Effect: No

Strength of Effect: n/a

Attribution to PCH Program: n/a

Sustainable: n/a

5.10 Window Manufacturer Market Effects Hypotheses

High efficiency windows are essential to the 1998 PCH Base and Plus programs. To receive the optional windows incentive in the Base Program, builders had to meet window requirements relating to both solar heat gain coefficients (SHGCs) and U-values, as well as NFRC certification. Participation in the Plus Program was based on meeting the ENERGY STAR[®] New Home building performance level; the installation of high efficiency windows helped to satisfy this requirement.¹⁴

The market barriers associated with window manufacturers are product unavailability and business practices. The specific hypotheses to be tested in this study are the following.

- By requiring the installation of a specific set of measures in Comfort Homes, the PCH Program increased demand for these products. The PCH Program also worked with manufacturers to increase the supply of energy efficient products and with consumers to increase their awareness, resulting in manufacturers' perceiving less risk in making these products available.
- By stimulating increased supply of high efficiency products, the PCH Program caused manufacturers to change their business practices relating to product design, sales, and distribution.

¹⁴ Window standards in California are relatively complex, as Title 24 standards and ENERGY STAR[®] New Home specifications vary by climate zone. The California Window Initiative (CWI) is also recommending standards relating to U-values, solar heat gain, and visual transmissivity.

The research conducted for this study reveals evidence of market effects in the form of increases in the proportion of high performance windows. Window manufacturers attributed these changes to state standards, technological advancement, demand for further sound reduction, and general recognition of and demand for energy efficiency. Efficiency programs – the ENERGY STAR[®] programs in particular – had some influence in manufacturers broadening product lines and changing product designs for program eligibility. Some manufacturers also instituted changes in inventory and manufacturing practices in efforts to decrease production and operating costs that were not facilitated by market intervention strategies. Because the changes identified are viewed as industry and technological advancement, window manufacturers anticipate that they will be sustained and continue in the future irrespective of energy efficiency program offerings.

Window Manufacturer: Hypothesis One

By requiring the installation of a specific set of measures in Comfort Homes, the PCH Program increased demand for these products. The PCH Program also worked with manufacturers to increase the supply of energy efficient products and with consumers to increase their awareness, resulting in manufacturers' perceiving less risk in making these products available.

This hypothesis was tested by examining changes in the relative distribution of performance indicators of windows sold by manufacturers throughout the PCH Program years (since 1991). The indicators examined here include U-factors, SHGC, and the number of panes in the window assembly. Other pertinent evidence includes manufacturer awareness of the PCH Program, and how discontinuation of programs would affect the relative distribution of performance indicators, as reported by window manufacturers during the in-depth interviews. The evidence of market effects, attribution to the 1998 PCH Base and Plus Programs, and the evidence of or potential for sustainability of any such effects are presented below.

Evidence of Market Change

Manufacturers needed to have indicated changes in the distribution of U-factors, SHGCs, and/or number of panes of the windows sold since 1991 in order for there to be evidence of increased availability of high performance windows. Current product availability by performance factor and changes in the availability of product according to these factors is summarized below.¹⁵

¹⁵ As stated in Section 4.2, the California market accounts for about 10% of the national window market. Overall, the distributions of the U-factors and SHGCs of all units shipped were representative of those shipped to Central and Northern California. One fairly small manufacturer with a distribution only in the Northwest indicated that the company ships more windows with lower U-factors and more with lower SHGCs to California.

U-Factors. The majority of windows produced last year had U-factors less than 0.80. In fact, only one fairly small manufacturer reported producing a product with a U-factor greater than 0.80, which are single glazed windows. Two respondents do not produce units with U-factors less than 0.40; the remaining four reported between 50% to 70% of shipments fell in this category. All manufacturers produced units with U-factors between 0.40 and 0.60, with proportions ranging from 20% to 45% of output. Four manufacturers produce units with U-factors between 0.60 and 0.80; proportions ranged between 5% and 80% of output.

Four out of the six manufacturers interviewed for this study reported that they produce a greater proportion of lower U-factor windows since 1991. Two of these companies increased production of units with lower U-factors around 1993 – one because of changes in state standards, and the other because of increased consumer acceptance and recognition of the benefits of vinyl windows. Another explained that technological improvements in 1990 enabled them to produce a cost-effective higher performance product and to eliminate production of all units with U-factors greater than 0.80.

Interestingly, the two that did not report any changes are large manufacturers with national or international distribution. These manufacturers reported producing a relatively high percentage of output with low U-factors (70% and 50% of output with U-factors less than 0.40).

Number of Panes. The majority of windows produced last year were double glazed units. In fact, several of the respondents indicated that double-glazed windows are now the standard in new construction. Five manufacturers still produce single-paned units; proportions of output ranged between 1% and 10%. The majority of output of all companies are double glazed windows – between 65% and 95% of production falls into this category. Five companies manufacturer triple-paned windows, though most percentages are low, between 3% and 5% of output. One large manufacturer reported that 30% of all units produced have three panes. This manufacturer is the only company that produced quadruple-paned windows (roughly 5%).

Increases in the percentages of units with multiple panes are less prominent than those with lower U-factors. Four of the six companies produce a lower percentage of single-paned units, but the reductions are slight (one estimated about 5% less). These changes were attributed to state standards, sound reduction benefits of multiple-paned units, and general recognition of and demand for energy efficiency. Significant increases in the proportion of triple or quadruple glazed units are not likely in the near future because of technological improvements (new frame materials and designs, low emissivity coatings, low conductance gas fills, improved spacers, and solar control coatings) that are making double glazed units equally as efficient.

SHGC. It is first important to note that two of the six manufacturers do not use the NFRC's SHGC rating system. These companies are small manufacturers with regional scope of distribution. The remaining four manufacturers reported that between 15% and 80% of their output had a SHGC less than 0.40, and between 10% and 50% had a SHGC between 0.40 and 0.65. One does not produce any units with a SHGC greater than 0.65.

Three of the four manufacturers that use the SHGC rating system reported significant changes in the distribution of output by SHGC; all now produce more units with lower SHGCs than in the past. Two specifically attributed changes to incentive programs and Title 24 standards, and the other to the availability of new technologies, such as low emissivity coatings. One of the largest manufacturers produced a window low emissivity glazing with a SHGC of 0.48, but this window did not qualify for a former PG&E incentive program. To comply with program requirements, they shifted some production to selective low emissivity glazing to further reduce SHGCs.

Attribution to PCH Program

In order for the above market effects to be directly attributable to the PCH Program, window manufacturers not only need to be aware of the PCH Program, but they also must attribute any changes in efficiency level mixes to the PCH Program. During the in-depth interviews, respondents were queried about reasons for changes in the distribution of window performance factors *prior to* any mention of the PCH or utility programs, in general. Manufacturers were later asked directly if any aforementioned changes in efficiencies of shipments were due to the PCH.

All of the manufacturers interviewed for this study are aware of programs designed to encourage in the installation of high efficiency windows in new homes that are sponsored by government agencies, nonprofit organizations, and utilities. All six respondents are aware of ENERGY STAR[®] programs, though only half manufacturer windows with the ENERGY STAR[®] label.¹⁶ Five of the six respondents have at least heard of the PCH Base Program, and two are aware of the Plus Program.

Primary influences to the performance levels of windows include market demand, efficiency standards, energy prices, and climate conditions. The manufacturers that reported changes in the proportion of high performance windows (in terms of lower U-factors, number of panes, and/or lower SHGCs) primarily attributed changes to state energy efficiency standards,

¹⁶ Two of the three manufacturers estimated that about 50% of the units produced qualify for the ENERGY STAR[®] label. The other company just joined the ENERGY STAR[®] program and could not yet provide an estimate. As mentioned above, the California market accounts for roughly 5% to 10% of units shipped nationwide.

technological advancements, consumer awareness of the benefits of high performance windows, and incentive programs in general. In fact, two respondents explained that they changed produce design to increase window performance and broadened their product lines to ensure that their windows would be eligible for energy efficiency programs.

Only one manufacturer attributed any changes to PG&E efficiency programs prior to the discussion about efficiency programs during the interview. None of the interviewees attributed any changes in window performance directly to the PCH Base or Plus program, though three claimed that the ENERGY STAR[®] program facilitated improvements in window U-factors.

Sustainability

In order for the above market effects (i.e., increases in percentages of units with lower U-factors and SHGC) to be sustainable, any changes need to be supported in the future, after efficiency programs are discontinued. Evidence from the interviews with manufacturers indicates that the relative proportions of high performance windows, in fact, will continue in the future. A few points are worth noting here. First, many of the changes were attributed to technological advancement and state codes, neither of which can or will be reversed in the near future, respectively. Stricter efficiency requirements in other states will also continue the trend. Several manufacturers mentioned that changes will continue because of natural market evolution – progress in the industry cannot or should not be reversed.

Summary

Market Effect: Yes

Strength of Effect: Strong

Attribution to PCH Program: No

Sustainable: n/a

Window Manufacturer: Hypothesis Two

By stimulating increased supply of high efficiency products, the PCH Program caused manufacturers to change their business practices relating to product design, sales, and distribution.

This hypothesis was tested by examining self-reported changes in stocking and distribution practices, research and development investments, manufacturing processes, and other activities adopted by window manufacturers. The evidence of market effects, attribution to the 1998 PCH Base and Plus Programs, and the evidence of or potential for sustainability of any such effects are presented below.

Evidence of Market Change

Manufacturers needed to have indicated changes in one or more of a variety of business practices in order for there to be evidence of market effects of this nature. Inventory and distribution practices, research and development, marketing, and information sources relating to efficiency standards and energy efficiency programs through the nation were considered. Information obtained during the in-depth interviews suggests that standard business and organizational practices have not changed significantly throughout the PCH Program

Inventory and Distribution Practices. As described in Section 4, most window manufacturers maintain low inventory levels and generally have “build-to-order” inventory systems. Two of the manufacturers reported changes in their inventory practices – mainly from keeping high levels of inventory to low levels to decrease operating costs. Window units are typically distributed through independent or factory owned outlets, or directly to window contractors. None of the respondents reported changes in distribution practices.

Research and Development and Changes in Manufacturing Processes. All of the manufacturers have fairly active R&D departments, with investments accounting for 1% to 2% of overall operating costs. Two of the six manufacturers reported increases in R&D in recent years. A large manufacturer explained that R&D activity has increased significantly since 1990 in efforts to develop higher performance, more durable, “fool-proof” products. Another attributed increases in R&D to the NRFC rating system. Several manufacturers have also instituted changes in manufacturing processes, which are generally ongoing improvements to reduce production costs. One company explained that some manufacturing improvements are driven by industry competition and technological advancements.

Attribution to PCH Program

In order for any of the above market effects to be directly attributable to the PCH Program, window manufacturers not only need to be aware of the PCH Program, but they also must attribute any changes in efficiency level mixes to the PCH Program. During the in-depth interviews, respondents asked if any changes in business practices (manufacturing, sales, distribution) resulted from efficiency programs in general. Respondents were then later asked directly if any aforementioned changed practices were due to the PCH.

As mentioned above, all of the manufacturers interviewed for this study are aware of programs in general. All are aware of ENERGY STAR[®], and the majority has at least heard of the PCH Base Program. Despite this awareness, none of the manufacturers attributed changes in inventory or R&D practices specifically to the ENERGY STAR[®] or the PCH Base or Plus Program.

Sustainability

In order for the above market effects (i.e., increases in percentages of units with lower U-factors and SHGC) to be sustainable, any changes need to be supported in the future, after efficiency programs are discontinued. Evidence from the interviews with manufacturers indicates that the changes in business practices identified above will continue in the future, despite the fact that they are not directly due to any efficiency program intervention strategy.

Summary

Market Effect: No

Strength of Effect: n/a

Attribution to PCH Program: n/a

Sustainable: n/a

5.11 Window Distributor Market Effects Hypotheses

The PCH Program offered an optional additional incentive for installing high performance windows. As described in Section 4, window distributors are suppliers in the residential new construction market and act as intermediaries between window manufacturers and window contractors.

The market barriers of product unavailability and business practices relate to window distributors. The following specific hypotheses are to be tested for this study:

- By requiring the installation of a specific set of measures in Comfort Homes, the PCH Program increased demand for these products. This increased demand stimulated the availability of high efficiency products.
- By stimulating increased supply of high efficiency products, the PCH Program induced distributors to revise their organizational practices relating to marketing and promotions.

There is no evidence of market effects relating to increased availability of high efficiency windows or changes in standard inventory, sales, or marketing practices of distributors. This could be because two of the largest distributors in the sample sell exclusively for the same manufacturer, who produces only high efficiency units. Furthermore, because only about 30% percent of windows installed in the study area's residential new construction market are sold through distributors, it is not surprising that their businesses have not been affected by the PCH Program, or energy efficiency programs, in general.

Window Distributor: Hypothesis Two

By requiring the installation of a specific set of measures in Comfort Homes, the PCH Program increased demand for these products. This increased demand stimulated the availability of high efficiency products.

This hypothesis was tested by examining changes in the relative percentages of windows sold by distributors according to key window performance parameters. Windows throughout the PCH Program years (since 1991), distributor awareness of the PCH Program, and how discontinuation of programs would impact mixes, as reported by window distributors during the in-depth interviews. The evidence of market effects, attribution to the 1998 PCH Program, and the evidence of or potential for sustainability of any such effects are presented below.

Evidence of Market Change

Window distributors needed to have indicated changes in the percentage of window sales according to window performance indicators in order for there to be evidence of increased availability of high performance windows. Here, window sales by U-factor, number of panes, and SHGC are investigated.

U-Factors. Of the five window distributors interviewed for this study, three could provide estimates of sales according to U-factors. One indicated that all units sold have U-factors between 0.40 and 0.60, while the other two sell units with U-factors less than 0.40. (Both of these companies distribute exclusively for the same manufacturer). All five reported no changes in the relative percentages of sales by U-factors in recent years. One explained that product improvements are continuous and any resulting changes in performance indicators are due to technological advancements.

Number of Panes. As expected, the majority of units distributed are double-paned (between 80% and 100% of sales) or single-paned (0% to 20%). Most respondents indicated that these proportions have not changed since 1991, though one did report selling a greater percentage of double-paned windows now than in the past.

SHGC. In general, distributors indicated that the proportion of their sales according to SHGC has not changed in recent years. It is important to note, however, that three of the five companies could not comment because they do not keep records with SHGCs.¹⁷ One

¹⁷ One of the five distributors was not aware of the NRFC's SHGC rating system.

distributor explained that the only significant change occurred when the NRFC rating system began, which implicitly encouraged many manufacturers to increase window performance.¹⁸

It is important to note here that two of the five distributors sell the products of one manufacturer exclusively. Both distributors indicated no changes in sales of high performance window primarily because the manufacturer only produces high performance units (i.e., double-pane, U-factors less than 0.40 and SHGC less than 0.65).

Attribution to PCH Program

Because the window distributors did not report any notable changes in the percentage of sales of high performance windows, determination of program attribution is irrelevant.

Regardless, primary influences on distributor decisions to sell high performance units, and their awareness of energy efficiency programs is valuable information.

- The primary influences on decisions to sell high performance units include manufacturers, word of mouth, and customer demand. One company also mentioned the California Window Initiative and “PG&E hype.”
- The majority of distributors aware of energy efficiency programs, in general. Three of the five respondents are aware of the PCH Base or Plus Programs and three are aware of ENERGY STAR[®]. None of the companies was familiar with specific program requirements, though one knew of PG&E rebate programs in general.

Sustainability

Again, because there are no perceptible market effects relating to increases in the availability of high performance windows by distributors, examining sustainability is irrelevant at this point. One company did indicate that the trend toward lower U-factors will continue in the future because of increased awareness of energy efficiency products in general. Also, it is unlikely that the proportion of triple- or quadruple-paned windows will increase because technological advancements. In particular, improvements such as framing materials, insulative gases, and low emissivity coatings make double glazed windows equal to triple or quadruple-paned units in terms of performance.

¹⁸ Two of the interview respondents explained that the majority (roughly 90%) of sales in the study area are casement windows; high performance casements have a SHGC of 0.49, compared to a SHGC of 0.28 for double hung models.

Summary

Market Effect: Yes

Strength of Effect: Strong

Attribution to PCH Program: No

Sustainable: n/a

Window Distributor: Hypothesis Two

By stimulating increased supply of high efficiency products, the PCH Program induced distributors to revise their organizational practices relating to marketing and promotions.

This hypothesis was tested by examining self-reported changes in inventory, marketing and promotional practices, and other normal business activities of window distributors. The evidence of market effects, attribution to the 1998 PCH Program, and the evidence of or potential for sustainability of any such effects is presented below.

Evidence of Market Change

Distributors needed to have indicated changes in one or more of a variety of business practices in order for there to be evidence of market effects of this nature. Inventory and distribution practices, sales and marketing, and sources of information relating to efficiency standards and energy efficiency programs were considered.

Inventory and Distribution Practices. As mentioned in Section 4, distributors vary in the amount of inventory they keep on hand. While some operate on an “as needed” basis, others keep significant levels of inventory to ensure they can accommodate orders from builders and contractors. Though a few indicated that overall sales volumes have increased, none of the window distributors interviewed for this study reported changes in their inventory or distribution practices since 1991. Interestingly, though, a majority of distributors indicated that their market share of the study region has changed in the past few years. In particular, two have experienced enormous growth in the central/northern California market, while two have seen declines in sales to the region. These declines were attributed to the growing prevalence of vinyl windows and market competition.

Sales and Marketing. Distributors differed with respect to how they market high performance windows relative to marketing of standard windows. In general, distributors will emphasize the energy saving characteristics of windows, such as low emissivity glass and argon filled gaps, to their customers. Two companies that sell windows of one manufacturer exclusively explained that their manufacturer only produces high performance windows. These practices were generally the same in the past; distributors have always emphasized particular selling points of their inventory. One distributor explained that they

change their advertising strategies according to manufacturer promotions or energy efficiency program offerings.

Information Sources. Window distributors utilize a variety of information sources to stay current with the latest available technologies, state efficiency standards, and requirements of energy efficiency programs. These sources include manufacturers, trade publications, the California Window Initiative, industry seminars, and downstream market actors. Interview respondents did not identify any changes in how they obtain information in recent years.

Attribution to PCH Program

As noted above, the majority of distributors aware of energy efficiency programs, several respondents are aware of the PCH Base or Plus programs, and ENERGY STAR[®] programs. None of the companies was familiar with specific program requirements, though one knew of PG&E rebate programs in general.

Only two distributors hinted at changing marketing techniques according to special promotions or program offerings. One could attribute such changes directly to the ENERGY STAR[®] program and PG&E rebate programs, but not to the PCH Program specifically. Both companies indirectly attributed changing their standard marketing practices in the sense that programs give the distributors additional sales tools and leverage to sell high performance windows to their customers. One stated that program rebates are the primary selling point.

Sustainability

The slight changes in sales and marketing practices attributed to the ENERGY STAR[®] and energy efficiency programs in general are not expected to be sustained beyond the life of the PCH Program. Essentially, programs provide distributors with an extra marketing edge that will disappear when programs cease.

Summary

Market Effect: Yes

Strength of Effect: Weak

Attribution to PCH Program: No

Sustainable: n/a

5.12 HVAC Contractor Market Effects Hypotheses

As described in Section 4, HVAC contractors have two key functions in the residential new construction market: air distribution system design and HVAC equipment purchases and installation. Some HVAC contractors also perform Title 24 calculations as part of their

services. Contractors work directly with several market actors to complete these functions, including builders, Title 24 consultants, equipment distributors, and sometimes even manufacturers. HVAC contractors typically have considerable input regarding efficiency parameters of HVAC equipment and the design of the air distribution system, and the 1998 PCH Base Program required the installation of high efficiency air conditioning units and enhanced HVAC ducts. The PCH Program also provided training, seminars, and educational materials for builders and their contractors.

This study hypothesizes that the market barriers reduced by the 1998 PCH that relate specifically to HVAC contractors include information costs, hassle costs, asymmetric information, performance uncertainties, and organizational and business practices. The hypothesized market effects are specified below.

- By providing training and information services to builders and HVAC contractors, the PCH decreased information and search costs incurred by these market actors. In doing so, the Comfort Home Program reduced the information costs, hassle costs, asymmetric information, and performance uncertainties market barriers.
- The PCH Program reduced the organizational and business practices market barrier. Increased demand for high efficiency products from consumers and builders encourages HVAC contractors to specify high efficiency air conditioners and to increase quality of air distribution systems. Furthermore, recognizing the marketability of these features, the PCH also induced permanent changes in marketing and promotional practices of HVAC contractors.

Results indicate that some sustainable market effects can be attributed to the PCH Program. Specifically, evidence was found that information and hassle costs have been reduced for contractors. Furthermore, evidence of changed business practices was found that appears to be related to the PCH Program and sustainable.

HVAC Contractor: Hypotheses One

By providing training and information services to builders and HVAC contractors, the Comfort Home Program decreased information and search costs incurred by these market actors. In doing so, the PCH Program reduced the information costs, hassle costs, asymmetric information, and performance uncertainties market barriers.

This hypothesis was tested by examining contractors' participation in utility sponsored training, their sources of information, their awareness of the PCH Program and energy saving technologies, and their ranking of some specific market barriers, as reported during the in-depth interviews.

Evidence of Market Change

Evidence of market effects was determined by examining the primary information sources of HVAC contractors and the relative importance of the lack of information sources as barriers to the installation of high efficiency HVAC systems. As part of the in-depth interviews, HVAC contractors were asked to rate the importance of some specific market barriers on the adoption of energy efficient technologies. The barriers and their ratings are shown in Table 5-21. As shown, the “lack of information on energy efficient measures” is perceived as one of the least important barriers, while cost, product unavailability, and hassle are considered important ones.

Table 5-21: Perceptions of Barriers to High Efficiency HVAC Systems

	Cost	Lack of Info.	Energy Eff. Products Not Avail.	Difficulty in Choosing Among Options	Hassle	Financing
Average Importance of Barrier	4.9 (0.18) n=5	1.5 (0.56) n=5	4.3 (0.64) n=5	3.0 (0.21) n=5	4.2 (0.66) n=5	1.2 (0.24) n=5

Each respondent rated their perception of the importance of each barrier with a one 1 meaning “not at all important,” a 3 meaning “somewhat important”, and a 5 indicating “very important.”

Means were weighted according to the number of installations each respondent reported completing in 1998. Standard errors are included in parentheses.

As all contractors indicated that they attended PG&E sponsored training and hence were aware of the PCH Program, the assumption can reasonably be made that PCH contributed in some way to the low rating of the information barrier. However, as contractors cited many sources for their information on high efficiency equipment and energy-efficiency standards and programs, it is impossible to make a more quantitative estimate of the impact of the PCH Program on information and search costs.

Attribution to PCH Program

Attribution to the PCH Program is direct. As previously mentioned, all contractors had attended PG&E sponsored training sessions. Two of the five contractors also specifically cited PG&E as a source of information on high efficiency equipment and energy-efficiency standards and programs. It was also obvious from the interviews that lessons learned and materials provided by PG&E were utilized to improve duct sealing methods. One contractor specifically cited PG&E’s Duct Installation Standards Manual as an excellent resource that provides “good pictures and useful information that is easy to disseminate.” Despite the direct involvement between PG&E and HVAC contractors, only one contractor mentioned the PCH Program specifically (i.e., the Manual).

Sustainability

Evidence that the effects of disseminated information will continue is derived primarily from comments regarding duct sealing methods and practices. Most contractors mentioned that they have incorporated lessons learned from duct blaster testing into their procedures. In addition, one could assume that once knowledge is gained contractors will continue to apply that knowledge, so expecting these methods to be carried forward is a reasonable assumption.

Summary

Market Effect: Yes

Strength of Effect: Medium

Attribution to PCH Program: Yes

Sustainable: Yes

HVAC Contractor: Hypotheses Two

The Comfort Home Program reduced the organizational and business practices market barrier. Increased demand for high efficiency products from consumers and builders encourages HVAC contractors to specify high efficiency air conditioners and to increase quality of air distribution systems. Furthermore, recognizing the marketability of these features, the PCH Program also induced permanent changes in marketing and promotional practices of HVAC contractors.

This hypothesis was tested by examining HVAC contractor-estimated market shares of high efficiency air conditioners, building practice changes made as a result of PCH, awareness of the latest high efficiency technologies, and participation in utility sponsored training as reported during the in-depth interviews.

Evidence of Market Change

Evidence of the impact of the PCH Program on duct sealing practices and high efficiency air conditioners is directly indicated by a series of questions that were asked of the contractors about changes to their procedures. Regarding duct sealing practices, three of the five contractors specifically stated that PCH was responsible for changes resulting in tighter ducts. Most also indicated that they would continue the sealing practices, but not duct blaster testing, even in the absence of the PCH Program.

For high efficiency air conditioners, the effect of the PCH Program is best reflected by the results from two questions: the self-reported percent of sales for three efficiency categories and a question about how these current trends would change in the absence of the PCH Program. Estimated 1998 market percentages for the three efficiency levels are shown in

Table 5-22, which shows that 53.6% of the air conditioners are high efficiency (>10 SEER) units.

Table 5-22: Installed Cooling Equipment Efficiency Market Percentages ^{1,2}

	£10 SEER	> 10 SEER and £12 SEER	> 12 SEER
Current Market Share (n=5)	46.3%	43.9%	9.7%

1. Values reported by contractors were weighted according to the number of installations in 1998 as reported by each respondent.
2. Note that since 10 SEER is the Title 24 minimum, at least one contractor may have incorrectly counted such units in the 10 to 12 SEER category rather than the 10 SEER or less category.

That this large percent of high efficiency equipment is the result of PCH is implied by statements made by three of the five contractors that reductions in the high efficiency percentages would occur if the PCH Program were terminated. However, there did appear to be some uncertainty about just how much reduction would occur, and none of the contractors stated that the market would return completely to 10 SEER minimum units. In addition, two contractors stated that they were unsure what would happen in the absence of the PCH Program and one of these mentioned the reason for this was that builder and consumer awareness has been increased.

Attribution to PCH Program

HVAC contractors are *very aware* of the latest cooling, heating, duct sealing and duct testing technologies. Most are also at least *somewhat aware* of the latest developments in window and insulation technologies. The subcontractors with the Title 24 consultants on staff are of course *very aware* of all technologies. As all contractors participated in PG&E sponsored training, it can be assumed that PCH contributed somewhat to this high level of technology awareness. This is also more specifically evident in the fact that changes to duct sealing practices were specifically cited as being the result of PCH by three of the contractors.

Sustainability

Regarding duct sealing methods, all contractors indicated that even after discontinuance of the PCH Program they would continue using the sealing methods (excluding duct blaster testing) they had learned and incorporated as a result of PCH. The two largest HVAC contractors reported that they would continue their current business practices, including duct testing, even in the absence of any program because they have “*marketed the benefits of Comfort Home, tight ducts*” and because “*saving energy is #1.*” However, the other HVAC contractors believed that the only changes that would continue are the use of improved duct sealing methods (excluding duct blaster testing) and materials, which will actually be

required in the revised Title 24 standards that are effective July 1, 1999. All contractors also acknowledged the benefits of duct sealing to all involved.

The responses were mixed regarding high efficiency air conditioners. As mentioned previously, three of the five contractors all indicated that, in the absence of the PCH Program, efficiency levels would revert back to the Title 24 minimum 10 SEER. However, the HVAC contractors interviewed also expressed that it was unclear exactly how much this would decrease due to the effects of increased builder and consumer awareness through programs such as PCH and ENERGY STAR®.

Summary

Market Effect: Yes

Strength of Effect: Weak

Attribution to PCH Program: Yes

Sustainable: Yes

5.13 Window Contractors

Window contractors work directly with several market actors including builders, Title 24 consultants, and equipment distributors, and typically have considerable input regarding efficiency parameters of window performance. The PCH Base Program offered an optional incentive, which required the installation of high performance windows that meet the ENERGY STAR® New Home program requirements. The objective of the interviews was to ascertain contractors' attitudes and business practices in conjunction with characterizing the RNC market.

The market barriers of asymmetric information, information search costs, product unavailability, performance uncertainties and business practices relate to this market actor. The specific hypotheses to be tested in this study are the following.

- By providing opportunities for window contractors to work with builders on homes with increased energy efficiency requirements, the PCH Program increased contractor awareness of the costs and benefits of high performance windows. This increased awareness leads to lower information costs and increases the experience and exposure of contractors to these products, thus reducing performance uncertainties.
- By encouraging builders to install more efficient energy measures, the PCH Program provided increased opportunities for contractors to work with builders on homes that exceed Title 24. As a result of this experience, contractors incorporated new product information and builder specifications into their practices, thus changing the way they do business. Furthermore, recognizing the

marketability of these features, contractors also changed their promotional practices.

The information obtained from window contractors reveals no evidence of market effects relating to increased awareness of high performance technologies, lower information costs, or reduced performance uncertainties that can be attributed directly to the PCH Program. While contractors did report changes in the relative proportions of high performance windows installed in the past several years, these changes are primarily due to changes in the state energy efficiency standards and consumer demand for comfort.

Window Contractors: Hypothesis One

By providing opportunities for window contractors to work with builders on homes with increased energy efficiency requirements, the PCH Program increased contractor awareness of the costs and benefits of high performance windows. This increased awareness leads to lower information costs and increases the experience and exposure of contractors to these products, thus reducing performance uncertainties.

This hypothesis was tested by examining window contractor awareness of the latest available performance factors for windows, contractors' primary sources of information, and perceived barriers to the installation of high performance windows in new homes, as reported by the contractors themselves. The evidence of market effects, the extent to which any identified effects are attributable to the PCH Program, and likelihood of sustainability are summarized below.

Evidence of Market Change

The majority of window contractors interviewed for this study (four out of five) considered themselves "very aware" while one reported being "aware" of the latest available high efficiency technologies for windows. Despite this reported high awareness, contractors indicated that lack of information is still a relatively important reason for not installing high efficiency windows, as indicated below in Table 5-23.

Table 5-23: Window Contractor Perceptions of Barriers to High Performance Windows^{1,2,3}

Cost	Lack of Information	Energy Efficient Products Not Avail.	Difficulty in Choosing Among Options	Hassle	Financing
3.8 (0.35) n=5	3.0 (0.23) n=5	1.1 (0.07) n=5	2.4 (0.19) n=5	1.9 (0.19) n=5	1.0 (0.08) n=5

1. Each respondent rated their perception of the importance of each barrier with a one 1 meaning “not at all important,” a 3 meaning “somewhat important”, and a 5 indicating “very important.”
2. Means were weighted according to the number of homes in which the contractor conducted installations in 1998.
3. Standard errors are included in parentheses.

Window contractors rely of a variety of sources for current information about state efficiency standards and energy efficiency program requirements, including various agencies, PG&E, glass manufacturers, corporate, trade magazines, and sales staff and different organization program efforts. None of the window contractors interviewed for this study indicated that their information sources have changed since 1991.

Attribution to PCH Program

All window contractors were generally aware of the existence of energy efficient window programs. All but one contractor also reported being aware of the PCH Program.¹⁹ The number of years that respondents have been aware of the PCH Program range from three to seven years, with a weighted mean of about four years. However, most respondents did not know program details or when the PCH Programs were offered. Three contractors had also heard of ENERGY STAR[®].

Because the majority of window contractors could not attribute any awareness or information sources directly to the PCH Program, and because they still perceive lack of information as a barrier to high performance window installations, it appears that the PCH Program did not increase contractor awareness or reduce performance uncertainties with respect to high performance windows.²⁰

¹⁹ Four are aware of the PCH Base Program, two of the Plus Program, and three are aware of the ENERGY STAR[®] Program.

²⁰ One contractor did, in fact, specifically mention PG&E as an information source on energy efficiency standards and program requirements. This contractor also reported that that incentives to builders offered through the PCH and ENERGY STAR[®] program was directly responsible for changes in their business practices in recent years. However, the interview respondent did not state the individual program that was responsible for changes, nor did they provide details about the changes induced by the PCH Program.

Sustainability

Because there are no market effects attributable to the PCH Program, a discussion pertaining to sustainability is irrelevant.

Summary

Market Effect: No

Strength of Effect: n/a

Attribution to PCH Program: n/a

Sustainable: n/a

Window Contractors: Hypothesis Two

By encouraging builders to install more efficient energy measures, the PCH Program provided increased opportunities for contractors to work with builders on homes that exceed Title 24. As a result of this experience, contractors incorporated new product information and builder specifications into their practices, thus changing the way they do business. Furthermore, recognizing the marketability of these features, contractors also changed their promotional practices.

This hypothesis was tested by examining changes in the proportion of high performance windows installed by contractors, reasons for any such changes, awareness of energy efficiency programs in general, and the PCH and ENERGY STAR[®] programs, and if reported changes are likely to continue after energy efficiency programs are discontinued.

Evidence of Market Change

Evidence of market effects with respect to window contractor practices can be assessed by examining changes in the proportion of high performance windows installed by contractors through the PCH Program years (since 1991). Changes in installations according to U-factors and SHGC are considered here.

U-Factors. As reported by window contractors, an average of 62% of the windows installed last year had U-factors less than 0.40, 35% were between 0.40 and 0.60, 1% between 0.60 and 0.80, and less than 1% had U-factors greater than 0.80. Four of the five indicated a change in these relative proportions since 1991. The factors inducing these changes include consumer demand for comfort and state efficiency standards.

Number of Panes. The contractors interviewed for this study indicated that the majority of windows installed in new construction are double-paned (estimated ranged from 85% to 100%). One contractor reported a changes in the proportion of windows installed (according

to the number of panes) has changed in recent years due to state efficiency standards and consumer demand for comfort.

SHGC. As reported by window contractors, an average of 23% of the windows installed last had a SHGC less than 0.40, 61% with a SHGC between 0.40 and 0.65, and about 12% with a SHGC greater than 0.65. Two contractors reported a change in the relative proportions of installations by SHGC since 1991. Contractors indicated that state energy efficiency standards, consumer demand for comfort, and utility programs were the primary inducements for these changes.

Attribution to PCH Program

In order for the change in proportion of high performance windows (according to SHGC, specifically) to be attributable to the PCH Program, interview respondents needed to be aware of the PCH Program, and needed to mention the PCH Program as a primary influence for change. As indicated above, utility programs were, in fact, mentioned by at least one respondent as a reason for an increase in the percentage of high performance windows (lower SHGCs). Furthermore, all of the contractors interviewed for this study are aware of energy efficiency programs, in general, and most are aware of either the PCH Program or the ENERGY STAR[®] program, or both.

One contractor attributed changes in business practices directly to energy efficiency programs (financial incentives to builders), but could not or would not mention a specific program or utility administrator. Thus, the information obtained during the in-depth interviews suggests that the effect of energy efficiency programs on contractor business practices is minimal, if existent at all.

Sustainability

Because there are no market effects attributable to the PCH Program, a discussion pertaining to sustainability is irrelevant.

Summary

Market Effect: Yes

Strength of Effect: Medium

Attribution to PCH Program: No

Sustainable: n/a

5.14 Title 24 Consultant Market Effects Hypotheses

Title 24 consultants work with builders and architects to ensure compliance with local building codes. Title 24 consultants are typically knowledgeable and influential regarding energy efficient measures, and they may influence builders' and architects' decisions regarding the types of energy efficient measures used in their new homes. Title 24 consultants in the Comfort Home area were interviewed to ascertain their role in the residential new construction market and to test specific hypotheses regarding their function in the market.

Targeted market barriers relating to Title 24 consultants include asymmetric information and organizational practices. Another related barrier is information search costs. The specific hypotheses tested in this study are the following.

- By providing opportunities for consultants to work with builders on homes with increased energy efficiency requirements, the PCH Program increased the awareness of these actors. This increased awareness leads to lower information costs and improved access to information.
- By encouraging builders to install more efficient energy measures, the PCH Program provided increased opportunities for Title 24 consultants to work with builders on homes that exceed Title 24. As a result, Title 24 consultants experienced a changing role in the residential new construction market, thus changing the business practices of these market actors.

The results of these hypotheses indicate that there are no sustainable market effects attributable to the PCH Program for Title 24 consultants. In particular, Title 24 consultants tend to be aware of the latest technologies and obtain the majority of their technical information from resources other than program participation. Further, the only changes in business practices attributable to the PCH Program are directly tied to program requirements (mainly required paperwork and diagnostics). These practices are assumed to cease with the ending of the PCH Program. It is worth noting two reported permanent changes in business practices not attributable to the PCH Program. That is, the offering of an ENERGY STAR[®] turnkey program and HVAC contractors offering Title 24 services for builders installing their equipment.

Title 24 Consultants: Hypothesis One

By providing opportunities for consultants to work with builders on homes with increased energy efficiency requirements, the PCH Program increased the awareness of these actors. This increased awareness leads to lower information costs and improved access to information.

This hypothesis was tested by examining the self-reported awareness of Title 24 consultants, identifying the sources of this information and comparing differences between these factors for Title 24 consultants who are aware of the PCH Program and those who are not aware of the PCH Program.

Evidence of Market Change

Due to the requirements of their profession, Title 24 consultants tend to be very aware of the latest energy technologies. This factor was borne out in the in-depth interviews. Table 5-24 presents the self-reported awareness of Title 24 consultants of the latest energy efficient technologies. As expected, these results indicate a high awareness of all the listed technologies.

Table 5-24: Average Awareness of Latest Energy Efficient Technologies

Gas Furnaces	High Efficiency AC	High Efficiency Windows	Insulation	Duct Testing Methods	Duct Sealing Methods
4.5 (0.47) n=6	4.7 (0.31) n=6	5.0 (0.12) n=6	4.9 (0.23) n=6	4.4 (0.63) n=6	4.4 (0.63) n=6

Each of the six respondent rated their own awareness, with a one 1 meaning “not at all aware,” a 3 meaning “somewhat aware”, and a 5 indicating “very aware.”

Means were weighted according to the number of plans reviewed in 1998, as reported by each respondent. Standard errors are presented in parentheses.

All but one of the Title 24 consultants interviewed have a working knowledge of the PCH, and all of the consultants are aware of the ENERGY STAR[®] Program. The one consultant who is unfamiliar with the PCH Program indicated self-reported awareness levels not significantly different from those who are aware of the PCH Program. Further, all of the consultants interviewed who are aware of the PCH Program have been aware of the PCH Program since 1992. Therefore, we were unable to test whether the length of time that the consultants were aware of the PCH Program impacted their awareness of energy efficient technologies.

The consultants’ source of technical information was also reviewed. This was done to ascertain whether information from the PCH is a major contributing factor to consultants overall awareness of energy efficient measures.²¹ We found that only one of the seven Title 24 consultants interviewed cited PG&E as a major source of information on energy efficient

²¹ In addition, the PCH Program records indicate that a number of Title 24 consultants attended energy efficiency training sessions sponsored by PG&E as part of the PCH Program

technologies.²² However, the consultants interviewed indicated that the vast majority of information they gather on energy efficient equipment and practices come from manufacturers, distributors, sales representatives, trade organizations, and government agencies.

As all consultants reported high awareness coming from non-program sources, we find no strong evidence to support this hypothesis.

Attribution to the PCH Program

As we find no evidence to support this hypothesis, the issue of attribution is irrelevant.

Sustainability

As we find no evidence to support this hypothesis, the issue of sustainability is irrelevant.

Summary

The information collected during the in-depth surveys does not support the hypothesis that the PCH Program had a perceptible impact on the barriers of information search costs and access to information for the Title 24 consultants.

Market Effect: No

Strength of Effect: n/a

Attribution to PCH Program: n/a

Sustainable: n/a

Title 24 Consultants: Hypothesis Two

By encouraging builders to install more efficient energy measures, the PCH Program provided increased opportunities for Title 24 Consultants to work with builders on homes that exceed Title 24. As a result, Title 24 Consultants experienced a changing role in the residential new construction market, thus changing the business practices of these market actors.

This hypothesis was tested by examining the self-reported changes in business practices and whether Title 24 consultants attributed these changes to participation in the PCH Program.

Evidence of Market Change

Four of the seven Title 24 consultants interviewed indicated that they have experienced changes in their building practices, including the following:

²² This Title 24 consultant represented less than 10% of the total number of plans reviewed by the interviewed sample of consultants.

- Offering an ENERGY STAR[®] turnkey program. There is at least one Title 24 consultant now offering a turnkey service to builders that includes completing all of the paperwork, diagnostics and verification fieldwork required to qualify a home as ENERGY STAR[®].
- Completing paperwork for ENERGY STAR[®] and or PCH Programs. According to the consultants interviewed, many of the builders have complained about the volume of required paperwork for the PCH and ENERGY STAR[®] Programs. In response to this, many of the Title 24 consultants have made a standard practice of completing the required paperwork for the builders.
- Providing builders with various energy efficiency options. Two of the interviewees indicated that they now offer many more energy efficiency options to builders than they have in the past. This is in response to the builder wanting to evaluate a number of different cost-effective ways to meet or exceed Title 24 requirements.
- Stopping the practice of explaining the PCH Program. One of the Title 24 consultants has made it standard practice not to mention the existence of the PCH Program unless specifically asked to explain the PCH Program. This is the result of the cutback in available incentives after the 1995 program, increased paperwork, and the perceived lack of interest on the builders' part.

Attribution to the PCH Program

There is evidence that some of these changes are attributable to the PCH Program:

- Completing paperwork for ENERGY STAR[®] and or Comfort Home Programs. This change in business practices is attributable to specific features of the Comfort Home program. The majority of the Title 24 consultants interviewed indicated that the increase in required paperwork and field verification was cited by builders as the major drawback to participation in the PCH Program. In response, three of the seven consultants interviewed have either taken it upon themselves to complete the PCH Program requirements or have been asked by builders to take on this task as part of the energy consulting services. However, as per the PCH Program requirements, the builder ultimately submits all of the paperwork to PG&E.
- Stopping the practice of explaining the PCH Program. This change in business practice is directly attributable to the PCH Program. One of the consultants interviewed suggested that the change in the PCH Program from incentive based to more informational based in 1995 had an impact on how builders value participation in the PCH Program.

There is little or no evidence that the remaining changes are attributable to the PCH Program. In particular,

- Providing builders with various energy efficiency options. In particular, this practice was reported to be related more to Title 24 compliance than to options for building above code.
- Offering an ENERGY STAR[®] turnkey program. This change in business practice is not attributable to the PCH. The Title 24 consulting firm offering this service has done so in response to builders interest in offering the ENERGY STAR[®] New Homes Program and their unwillingness to complete the detailed program requirements.

Sustainability

Given the nature of these business practices changes, it is evident that the changes dealing with the completion of program paperwork will die off with the conclusion of the PCH Program. Further, trivially, the Title 24 firm not discussing PCH Programs with clients will be sustained. The question of sustainability is more interesting regarding the provision of cost-effective energy efficiency options and the turnkey ENERGY STAR[®] program. In both these cases, the consultants interviewed indicated that they see these changes as permanent and thus will continue these practices.

Summary

The information collected during the in-depth surveys suggests that there is some evidence of changes in organizational practices, some attributable to the PCH Program and others not attributable to the PCH Program. However, the data does not support the hypothesis that the changes in organizational practices attributed to the PCH Program can be sustainable.

Market Effect: Yes

Strength of Effect: Moderate

Attribution to PCH Program: Yes

Sustainable: No

6

Summary and Conclusions

6.1 Background and Objectives

This report presents the results of an assessment of the PG&E Comfort Home (PCH) Program. The PCH Program is designed to increase energy efficiency in new homes through both midstream and downstream market transformation. Its midstream element consists of a variety of intervention strategies targeted at residential builders (advertising, training, education, and incentives), while its downstream component entails a comprehensive advertising campaign aimed at increasing homebuyer awareness of the importance of energy efficiency in new home purchase decisions. Two versions of the midstream element were offered in 1998. The Base Program, which was offered in the Central Valley, promotes the use of high efficiency air conditioning, tight duct sealing, natural gas cooking, gas dryer stubs, and high performance windows. The new Comfort Home Plus Program, which is offered system-wide, encourages builders to exceed the Model Energy Code (MEC) by 30%. Incentives cover the cost of the home energy rating required by the program.

The study was designed to achieve two central objectives:

- To characterize the residential new construction market in the PG&E service area, particularly as it relates to the market for energy efficiency, and
- To assess the near-term market effects of the 1998 PG&E Comfort Home (PCH) Program.

The remainder of this section describes the methodology used to meet these objectives, provides an overview of the residential new construction market and its key market actors, and summarizes the results of tests of various hypotheses relating to the near term market effects of the PCH Program.

6.2 Overview of Study Methodology

The methodology consisted of a thorough literature review, the administration of a comprehensive set of surveys and interviews of market actors, the development of market baselines and the assessment of market effects. These elements of the analysis are described very briefly below.

Literature Review. A thorough literature review was conducted to support the market characterization, identify issues, assess methodologies, and collect evidence with respect to market transformation in general and the specific assessment of market transformation in the residential new construction (RNC) market. Data on market activity in the RNC and suppliers' volumes and market shares were also obtained from trade association publications and other available sources to accommodate the analysis. In addition, data on historical efficiency levels and shares of high-efficiency equipment were obtained from a variety of sources, including shipments data, trade publications, Comfort Home program files, and the California Energy Commission's Post-Occupancy Residential Survey project.

Surveys and Interviews. The project team conducted telephone surveys of 760 residential customers, roughly equally split among participants (residents of Comfort Homes), nonparticipants in PG&E's service area, and new home residents in a comparison area consisting of several service areas around the country. The team also conducted in-depth interviews of 31 builders in PG&E's service area and 51 builders in the comparison area. Finally, the team interviewed a wide range of other actors serving the PG&E service area, including window and HVAC manufacturers, distributors, contractors, Title 24 consultants, architects, lenders, sales agents, building inspectors, and government agency representatives.

Baseline Market Characterization. The baseline market characterization was based on a review of program materials, a review of literature relating to the market, surveys of customers, and interviews with a variety of market actors. The characterization includes a full description of the program, a comprehensive market characterization, a description of market barriers, a discussion of indicators that could be used to track market effects, and an analysis of program-related and efficiency-related attitudes and perceptions of key market actors.

Assessment of Market Effects. The assessment of market effects entailed testing a series of distinct hypotheses relating to the potential effects of specific program interventions on key market barriers and the assessment of the sustainability of these effects. These tests were based primarily on the surveys and interviews, and consisted of several kinds of evidence: self reports relating to Program effects by market actors; comparisons of participating and nonparticipating customers, comparisons of customers and builders in the PG&E service area with those sampled in the comparison area; and the application of a set of statistical models designed to control for other differences in market conditions and respondent features across areas.

6.3 The Market for Residential New Construction

6.3.1. Submarkets

The RNC market can be thought of as consisting of the new home market and two ancillary markets: the equipment and shell measure market and the contractor services market. Each of these ancillary markets consists of suppliers and demanders of the product, and each is affected by various government and non-profit agencies.

The New Home Market. The new home market is the dominant sub-market in residential new construction, as the commodity bought and sold is the actual completed home. Builders and those directly involved in the design and construction of the new home (referred to here as the “builder group”) play the dominant supply side role and homebuyers play the demand-side role in the new home market. During the process of producing their product (a new house), builders rely on a number of transactions with other market actors, including contractors, distributors, architects, lenders, and Title 24 consultants.

The Market for Equipment and Shell Measures. The markets for HVAC equipment and windows are of particular relevance here, as these measures were covered by the 1998 PG&E Comfort Home (PCH) Program. In this market, builders (or the builder group) are the primary demand-side actors as they purchase the central air conditioning units, furnaces, and windows to be installed in the new homes. Manufacturers are the ultimate suppliers of these products, though the contractor and/or builder might purchase them through a distributor. Manufacturers also supply information to distributors, contractors, and builders. This information concerning new product development, pricing, service, reliability, and efficiency mixes assists the demand-side actors in making informed decisions.

The Market for Contractor Services. Builders, or the builder group, play a demand-side role and contractors play a supply side role in the market for contractor services. Specifically, builders rely heavily on HVAC contractors to provide HVAC equipment, to install the HVAC system, and, in some cases, to perform diagnostics. Other contractors assisting in the building process include window contractors and Title 24 energy consultants, who work with the builder to ensure compliance with Title 24 and to prepare the required documentation.

Government and Nonprofit Agencies. Government and nonprofit agencies have a broad influence on all market actors. The government influences builders directly through the imposition of minimum energy efficiency standards, and compliance with these standards is recorded by building inspectors. Numerous government and nonprofit organizations exist to support and influence various other market actors by means of research and informational programs, professional associations, and consumer advocacy groups.

6.3.2. Market Actors

The following market actors play significant roles in the new construction and auxiliary markets:

- **Builders.** Builders have the ultimate responsibility for coordinating the other actors and making final decisions with respect to the specification and construction of new homes. Builders include both production builders and customer home builders. Production builders are typically larger corporations with various departments and managers sharing the decision-making responsibilities, while custom builders tend to be smaller companies or individual contractors.
- **Architects.** Builders employ architects to design the home and prepare the building plans for inspection. While most builders hire an outside architect or architectural firm, large national builders typically have an in-house architecture department.
- **Sales Agents.** Builders' sales agents facilitate the sale of the home and are responsible for all transactions between the consumer and the builder or developer.
- **Lenders.** Lenders can provide financing for both consumers and builders. Some lenders specialize in mortgages for new residential construction. These are usually mortgage companies specializing in new housing mortgages, a division of a mortgage company, or a mortgage company owned by a builder.
- **Consumers.** Consumers represent the demand-side of the market for residential new construction. However, as the final end users of these products, they are the ultimate beneficiaries of the utilization of these products.
- **HVAC Equipment Manufacturers.** HVAC equipment manufacturers produce a variety of heating and cooling equipment for the residential sector. They are also a source of information for purchasers of this equipment.
- **Window Manufacturers.** Firms in the industry vary in structure and product line. Many tend to be small firms that sell their product regionally, while the largest window manufacturers distribute their products internationally.
- **HVAC Equipment Distributors.** HVAC equipment distributors function as intermediaries between manufacturers and HVAC contractors.
- **Window Distributors.** Window distributors in the residential new construction industry function as intermediaries between manufacturers and contractors or builders – the link between the window supply and demand markets. Window distributors sell new construction products primarily to builders and contractors, and sell to retail and building supply outlets for replacements and retrofits.
- **HVAC Equipment Contractors.** HVAC contractors are employed by builders to design, select, purchase, and install all HVAC system materials and components.

- **Window Contractors.** Window contractors are typically retained by either builders or window manufacturers to install windows in new homes.
- **Title 24 Consultants.** Title 24 consultants work with builders, architects, and sometimes HVAC contractors to ensure compliance with California's Title 24 energy efficiency standards.
- **Building Inspectors.** Building inspectors are responsible for ensuring that all new residential buildings comply with both state and federal building codes.
- **Government and Nongovernment Agency Representatives.** Both government and nongovernment organizations influence the residential new construction market

6.3.3. Baseline Attitudes and Perceptions

Attitudes and perceptions of all key actors are described in Section 4.

6.3.4. Key Barriers

Most of the specific market barriers targeted through the PCH program were confirmed in the course of the analysis. These barriers include asymmetric information, performance uncertainties, product unavailability, information search costs, hassle costs, organizational practices, access to financing, and split incentives. Split incentives arguably constitute the primary barrier in residential new construction. However, all of the barriers described above can potentially hinder the adoption of energy efficiency in residential new construction.

6.3.5. Market Effects Indicators

Market Shares. To support the assessment of market effects, it is useful to identify and measure a number of market effects indicators, such as the market share of the relevant technologies.. The development of measure baselines was only partly successful. General conclusions follow:

- Measure baselines for air conditioners are relatively good for the years prior to 1994, but nonexistent in more recent years.
- No recent data on window efficiencies are available. Data on frame type, number of panes, and glazing type were transformed into U-values and SHGC for the years from 1990 to 1994
- We were unable to find any reliable data on duct leakage or duct sealing practices, other than from the in-depth surveys. We did however infer the share of new homes that have had duct testing

Section 4 provides suggestions for tracking measure shares for the assessment of the PCH Program.

Other Market Effects Indicators. Other market effects indicators that could be tracked to assess the PCH Program are discussed throughout Sections 4 and 5. They are summarized below:

- **Builders.** Awareness of energy saving technologies, importance of various reasons for not exceeding code, changes in building practices, and perceptions of buyer demand.
- **Architects.** Awareness of energy saving technologies, awareness of Title 24, awareness of the program, changes in business practices, and proportion of homes designed that exceed Title 24.
- **Sales Agents.** Awareness of Title 24, proportion of homes sold that exceed Title 24, awareness of energy saving technologies, awareness of energy efficient mortgages, perceptions of consumer demand, and perceptions of marketability of energy efficiency.
- **Lenders.** Awareness of energy efficient mortgages, proportion of energy efficient mortgages written and changes in business practices.
- **Customers.** Awareness of energy efficiency options, awareness of ENERGY STAR[®] and energy efficient mortgages, the importance of energy efficiency, intentions to opt for energy efficient equipment and homes in the future, and (perhaps most important) willingness to pay for higher levels of efficiency.
- **HVAC Manufacturers.** Changes in efficiency level mixes, awareness of the program, changes in stocking and distribution practices, changes in research and development investments and changes in manufacturing processes.
- **HVAC Distributors.** Changes in efficiency level mixes of HVAC equipment sold, awareness of the program, and changes in the following. inventory and distribution practices, sales and marketing, and sources of information relating to efficiency standards and energy efficiency programs.
- **Window Manufacturers.** Changes in the relative distribution of performance indicators of windows sold including include U-factors, SHGC, and the number of panes in the window assembly; awareness of the program; changes in stocking and distribution practices, research and development investments, and manufacturing processes.
- **Window Distributors.** Changes in efficiency level mixes of windows sold, awareness of the program, and changes in the following. inventory and distribution practices, sales and marketing, and sources of information relating to efficiency standards and energy efficiency programs.
- **HVAC Contractors.** Participation in utility sponsored training, sources of information, awareness of the program and energy saving technologies, ranking of market barriers, estimated market shares of high efficiency air conditioners, and building practice changes.

- **Window Contractors.** Awareness of the latest available performance factors for windows, primary sources of information, perceived barriers to the installation of high performance windows in new homes, changes in the proportion of high performance windows installed by contractors, and awareness of the program.
- **Title 24 Consultants.** Awareness of energy saving technologies, sources of information, awareness of the program, and changes in business practices.

6.4 Tests of Market Effects Hypotheses

The following results emerged from the tests of specific hypotheses relating to the potential short-term market effects of the PCH Program.

6.4.1. Effects on Builders

The analysis suggests the following:

- The PCH Program does seem to have increased builder awareness of duct testing. Moreover, the PCH Program and its predecessors have apparently diminished lack of information and hassle costs to the point where these are no longer perceived as serious barriers.
- While builders appear to have changed construction and marketing practices as a result of the PCH Program, these changes are strongly dependent on the presence of the PCH Program (especially its incentives), and may not be sustained in the absence of the PCH Program. Moreover, only a minority of participants would continue with the PCH Program in the absence of incentives.
- While the PCH Program has offered marketing support for the promotion of Comfort Homes, it has not convinced builders that customers are willing to pay for energy efficiency. On average, PG&E builders estimate that home buyers are willing to pay for only 31% of the cost of improving efficiency in new homes. Changing this fact (whether it is reality or perception) is the key challenge of future programs.

6.4.2. Effects on Architects

The in-depth interviews with architects provided the following insights:

- There are no sustainable market effects in the form of increased awareness attributable to the program among architects. Architects tend to be aware of the latest technologies and obtain the majority of their technical information from resources other than program participation.
- There appears to be weak support for sustainable changes in business practices attributable to the program. This finding is based upon one interview respondent who reported basing plans on PCH program specifications. This respondent explained that homes built to PCH specifications were highly marketable and

builders took advantage of this marketability, even without formal participation in the program.

6.4.3. Effects on Sales Agents

The telephone survey of builder's sales agents revealed the following:

- Sales agents with program experience are no more aware of energy-saving features or of energy efficient mortgages than are agents with no program experience. However, some evidence was found that agents with program experience are more aware of Title 24.
- Similarly, agents with program experience perceived no more demand for energy-saving features from consumers than did agents with no experience with the PCH Program. Likewise, program agents did not perceive energy efficiency as any more marketable as a new home feature than did non-program agents.

6.4.4. Effects on Lenders

Information from the telephone survey of lenders suggests the following.

- In general, lenders are typically unaware and inexperienced with mortgages for energy efficient homes. Specifically, none of the lenders interviewed are currently writing such mortgages and only one had done so in the past.
- The lenders that are aware of energy efficient mortgages know them as FHA upgrades, indicating their information source is something other than the PG&E or ENERGY STAR[®] programs.

6.4.5. Effects on Customers

The program has also targeted customers (new home buyers). Its effects on buyers are summarized below:

- The PCH Program (and others preceding it) seems to have had a modest impact on homebuyers' awareness of the benefits of energy efficiency in principle.
- The PCH Program may have had an impact on customers' awareness of ENERGY STAR[®], but attribution of this effect is problematic and the general level of awareness is still quite low.
- PG&E new home buyers are marginally more aware of the existence of energy efficient mortgages, but the level of awareness is still low.
- PG&E customers are marginally more likely to look for energy efficiency in their next home, but attribution of this tendency to the PCH Program is weak.
- While the PCH Program appears to have given participants positive experiences with energy efficient homes, it does not seem to have significantly changed the

willingness of either participants or other homebuyers in the service area to pay premiums for higher levels of efficiency.

6.4.6. Effects on HVAC Manufacturers

The in-depth interviews with HVAC manufacturers revealed the following:

- There is evidence of evidence of market effects in the form of increases in the percentage of high efficiency HVAC units shipped to Central and Northern California. This evidence is fairly strong for central air conditioners, but weak for gas furnaces.
- Other changes in the HVAC equipment market include some changes in inventory and distribution practices. Though most manufacturers agreed that rebates strongly influence the percentage of high efficiency units that are shipped nationwide, these apparent market effects were not attributed specifically to the PCH program.
- There was consensus among manufacturers that demand for high efficiency equipment will decrease (from “slightly” to “dramatically”) when programs promoting the units are discontinued. Thus, at this point, evidence from manufacturers suggests that the sustainability of any detectable market effects will be weak at best.

6.4.7. Effects on HVAC Distributors

The analyses of information collected from HVAC distributors indicate the following:

- There is evidence of market effects in the form of increases in the percentage of high efficiency HVAC units sold by distributors in central and northern California. While interview respondents agreed that they sell a greater percentage of high efficiency HVAC units now than in the past, few could claim that energy efficiency program incited such changes.
- The strongest influences on efficiency mixes of HVAC equipment are energy efficiency standards, quality of the equipment, though one company did increase stock of high efficiency units to accommodate contractor orders under energy efficiency programs. Regardless of the cause, most distributors also agreed that the proportion of high efficiency equipment is likely remain stable or increase in the future.

6.4.8. Effects on Window Manufacturers

The in-depth interviews with window manufacturers revealed the following results:

- Evidence was found to support market effects in the form of increases in the proportion of high performance windows. These effects, however, are not attributable to the PCH Program. Window manufacturers attributed these changes

to state standards, technological advancement, demand for further sound reduction, and general recognition of and demand for energy efficiency.

- Efficiency programs – the ENERGY STAR[®] programs in particular – had some influence in manufacturers broadening product lines and changing product designs for program eligibility. Some manufacturers also instituted changes in inventory and manufacturing practices in efforts to decrease production and operating costs that were not facilitated by market intervention strategies. Because the changes identified are viewed as industry and technological advancement, window manufacturers anticipate that they will be sustained and continue in the future irrespective of energy efficiency program offerings.

6.4.9. Effects on Window Distributors

The results of the window distributors interview analyses suggest the following:

- There is no evidence of market effects relating to increased availability of high efficiency windows or changes in standard inventory, sales, or marketing practices of distributors. This could be due to the fact that two of the largest distributors in the sample sell exclusively for the same manufacturer, who produces only high efficiency units.
- Because only about 30% percent of windows installed in the residential new construction market in the study area are sold through distributors, it is not surprising that their business has not been affected by the PCH or energy efficiency programs, in general.

6.4.10. Effects on HVAC Contractors

The analyses of information collected from HVAC distributors indicate the following:

- PG&E-sponsored training sessions are well attended by HVAC contractors. Further, contractors indicate that the sessions provide a valuable source of information on high-efficiency equipment and energy-efficiency standards and programs.
- It was also obvious from the interviews that lessons learned and materials provided by PG&E were utilized to improve duct-sealing methods. One contractor specifically cited PG&E's Duct Installation Standards Manual as an excellent resource that provides "*good pictures and useful information that is easy to disseminate.*"
- Most contractors mentioned that they have incorporated lessons learned from duct blaster testing into their procedures. In particular, all contractors indicated that even after discontinuance of the program they would continue using the sealing methods (excluding duct blaster testing) they had learned and incorporated as a result of PCH.

- The majority of HVAC contractors indicated that in the absence of the program, air conditioner efficiency levels would decrease back to the Title 24 minimum 10 SEER.

6.4.11. Effects on Window Contractors

The results of the window contractors interview analyses suggest the following:

- There appears to be no evidence of market effects relating to increase awareness of high performance technologies, lower information costs, and reduced performance uncertainties that can be attributed directly to the PCH Program. While contractors did report changes in the relative proportions of high performance windows installed in the past several years, these changes are primarily due to changes in the state energy efficiency standards and consumer demand for comfort.

6.4.12. Effects on Title 24 Consultants

The analyses of Title 24 consultants' in-depth interviews suggest the following:

- Title 24 consultants tend to be aware of the latest technologies. However, they obtain the majority of their technical information from resources other than through program participation.
- The only reported changes in business practices attributable to the program are directly tied to program requirements (mainly required paperwork and diagnostics). These practices are assumed to cease with the ending of the program. It is worth noting two reported permanent changes in business practices not attributable to the PCH Program. That is, the offering of an ENERGY STAR[®] turn key program and HVAC contractors offering Title 24 services for builders installing their equipment.

Appendix A

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Appendix B

Trade Associations and Related Organizations

Energy Efficiency Related Organizations

Solar Energy Research and Education Foundation (SEREF)

777 North Capitol Street, NE, Suite 805
Washington, D.C. 20002
Tel (202) 289-0049 Fax (202) 289-5354
website: www.crest.org/efficiency/kgs-columns/index.html
Contact: Ken Sheindopf, Executive Director

SEREF has a series of Q&As regarding energy efficiency on their website.

American Council for an Energy-Efficient Economy (ACEEE)

website: aceee.org/

ACEEE (Research Office)
1001 Connecticut Avenue, NW, Suite 801
Washington, D.C., 20036

ACEEE (Publications Office)
2140 Shattuck Avenue, Suite 202
Berkeley, CA 94704-1210

Tel (202) 429-0063 - publications

The ACEEE is a non-profit organization dedicated to advancing energy efficiency as a means of promoting economic development and environmental protection. ACEEE is supported by a variety of foundations, government organizations, research institutes, utilities, and corporations.

ACEEE Publications

- 1996 Summer Study on Energy Efficiency in Buildings
- Energy Efficiency in Buildings: Progress & Promise
- Exemplary Home Builder' s Field Guide
- What Have We Learned from Early Market Transformation Efforts?
- Market Transformation Programs: Past Results and New Initiatives
- Market Transformation Programs: Past Results, Future Directions
- Market Transformation Strategies to Promote End-Use Efficiency
- Energy Savings Estimates from the Energy Efficiency Provisions in the Energy Policy Act of 1992
- Appliance and Equipment Efficiency Standards: Impacts by State
- Appliance and Equipment Efficiency Standards: History, Impacts, Current Status, and Future Directions
- The Future of Appliance Efficiency Standards
- Using Utility DSM Programs to Spur the Development of More Efficient Appliances
- Emerging Technologies to Improve Energy Efficiency in the Residential and Commercial Sectors
- Residential Equipment Efficiency: A State-of-the-Art Review
- Providing Utility Energy Efficiency Programs in an Era of Tight Budgets: Maximizing Long-Term Energy Savings While Minimizing Utility Costs

Association of Energy Services Professionals (AESP)

7040 W. Palmetto Park Rd., Suite 2315
Boca Raton, FL 33433
Tel (407) 361-0023 Fax (407) 361-0027
Contact: Elliot Boardman, Executive Director
website: www.dnai.com/~harrym/

AESP (formerly the Association of Demand-Side Management Professionals), is an association of utility executives, consultants, manufacturers, researchers, regulators, and others who are concerned with promoting energy efficiency and value. AESP is segmented into six primary Topic Committees that include:

- Customer Research and Evaluation
- Energy Services and Technology
- Policy - Chair: Jennifer Peterson (612) 312-5312

Paper / panel session (for Annual Meeting) on "How to Justify Market Transformation to Regulators and Other Decision Makers" (Gabrielle Foulkes)

- Pricing
- Product Development and Marketing - Chair: Nancy Benner (503) 248-4636

Developing a paper (for sale) on the non-energy benefits of energy efficiency, including case studies (Nancy Benner)

- Resource Planning

AESP Publications

- The Annual State of the DSM Industry
- A Compendium of Utility DSM Programs
- A Compendium of Utility DSM Evaluation Projects
- Glossaries of Terms Used in DSM Evaluation and Monitoring
- DSM Planning and Implementation Reference Guide

Alliance to Save Energy

1200 18th Street, NW, Suite 900
Washington, D.C. 20036
Tel (202) 857-0666 Fax (202) 331-9588
website: www.ase.org/

- Energy Efficiency in Buildings (Program Manager: William Prindle)
 - Building Codes Assistance Project - assists states in building code adoption and implementation. Contact: Katherine McQueen
 - Home Energy Rating System, Energy Efficient Mortgages - promotes energy efficient mortgages and standardized energy rating systems. Contact: Malcom Verdict
- Energy Efficiency Industry Support - promotes the emerging energy efficiency industry and gives it a voice in the decision making process. Contact: Joe Loper
- Efficient Windows Collaborative (EWC) – EWC members commit to manufacturing and promoting energy-efficient windows. A website (www.efficientwindows.org/) provides information on the benefits of energy-efficient windows and describes how they work.

ASE Publications

- Better Building Codes for Energy Efficiency (9/91, 72pp., Item 509)
- Gas Retrofit Manual: Auditing Techniques and Efficiency Improvements for Residential Heating Systems (9/86, 194 pp., Item 502)
- 1995 Model Energy Code (MEC-95) - Contact the International Conference of Building Officials, Inc. (ICBO serves as the secretariat for the MEC) at (310) 692-4226
- Builder' s Field Guide - Published by the Bonneville Power Administration. Send postage & handling to Bennie Hill, RMRB, Bonneville Power Administration, P.O. Box 3621, Portland, OR 97208, phone (503) 230-3000
- Moving Customers to Choose Energy Efficiency (7/91, 20pp., Item 603)
- Industry Profile: The High-Efficiency Gas Furnace Industry (3/93, 4pp., Item 1003)

Federal & State Energy Related Organizations

California Energy Commission (CEC)

Publications MS-13

P.O. Box 944295

Sacramento, CA 04244-2950

Tel (800) 772-3000 (in CA)

Tel (916) 654-5106 (outside CA)

website: www.energy.ca.gov/energy/

CEC is made up of three offices: the Efficiency Services Office, the Efficiency Standards Office, and the Efficiency Technology Office

CEC Publications, written material, or other information

- 1996 Energy Efficiency Report
- Energy Publications for the 1995 Energy Efficiency Standards (P400-95-001)
- Energy Specs: Fact Sheet on Efficiency Standards
- Articles and Papers on Efficiency
- Appliances - Efficiency and Use (P400-93-005C)
- Heating and Cooling for Residential Buildings (P400-93-005E)
- Labeling and Certification for Fenestration Products (P400-93-005H)
- Appliance Efficiency Standards (P400-90-029)
- Dir. of Certified Gas Fan-Type Central Furnaces (P400-92-023,)
- Dir. of Water Heaters (P400-93-024)
- Central Gas Furnaces (Models that exceed efficiency standards)
- Database of Appliances that Exceed Efficiency Standards

- Telephone Hotline on Appliance Efficiency Standards
- 1998 Energy Efficiency Standards for Residential and Nonresidential Bldgs.
- Title 24 - Energy Efficiency Standards for Residential and Nonres. Bldgs.
- Home Energy Manual (P400-92-031)

Federal Trade Commission (FTC)

Consumer Response Center
Washington, D.C. 20580
Tel (202) 326-2222
website: www.ftc.gov/

Data available from the FTC website

- EnergyGuide to Home Heating & Cooling
- EnergyGuide to Major Home Appliances

U.S. Department of Commerce (DOC)

Herbert C. Hoover Building
Washington, D.C. 20230
website: www.doc.gov/

Data and web-links available from the DOC website

Economics and Statistics Administration
Tel (202) 482-2235
e-mail: stat-usa@doc.gov

- Bureau of Economic Analysis
- Bureau of the Census
- STAT-USA

International Trade Administration

- Listing of Consumer Goods Industries, with SIC, contact & phone
Appliances, SIC 363, John Harris (202) 482-1178
- Industry Trend Tables which include value of shipments, total employment, production workers, average hourly earnings, capital expenditures, value of imports, & value of exports

Technology Administration

- National Institute of Standards and Technology
- National Technical Information Service

U.S. Department of Energy

website: www.eren.doe.gov/

Energy Efficiency and Renewable Energy Clearinghouse (EREC)
Tel 1-800-363-3732 (for general information)

Office of Energy Efficiency and Renewable Energy

Office of Building Technology, State and Community Programs

- Building Equipment and Appliances
R&D and Market Transformation for efficient appliances, lighting, cooling and heating equipment
- Buildings for the 21st Century
Action Plan Development (12/96 & 3/97 meetings) include:
Residential R&D Summary Action Plan
Goal: Influence the wide implementation of energy efficient technologies & building practices through community scale development by focusing on locally based builders and contractors as agents of change.

Contact: Michael Myers at DOE (Michael.Myers@HQ.DOE.GOV)

Office of Codes and Standards

U.S. Department of Energy
1000 Independence Ave, SW
Washington, D.C. 20585
Tel (202) 586-9127

Consumer Appliance Information

Residential Appliance Specific Information

Building Standards and Guidelines Program (BSGP)

Residential Codes & Products:

The Model Energy Code (MEC), MECcheck compliance materials, free MECcheck downloads, MEC training

BSGP Contacts at DOE:

Margo Appel (202) 586-9495 - State Codes

Stephen Turchen (202) 586-6262 - Residential

BSGP Contacts at PNNL:

Jeffrey A. Johnson (509) 375-4459 - Prog. Mgr.

Eric J. Makela (509) 372-4744 - Outreach

What' s New:

Water Heating Rulemaking Framework (6/11/97) (Adobe download)

OCS provides grants to update state building energy codes (7/15/97)

Fiscal 1998 Priority Setting for Appliance Standards Rulemaking Process (6/30/97)

Energy Information Administration (EIA)

website: www.eia.doe.gov/

EIA Publications

- Historical Natural Gas Annual, 1930 Through 1995 - Contains historical data 1930-1995, and state level information 1967-1995 regarding the supply and disposition of natural gas (downloadable from EIA website, 338pp.)
- Natural Gas Annual 1996: Issues and Trends - Data and information relating to the natural gas industry, covering several topic areas including consumption (downloadable, 171 pp.)
- Natural Gas Annual, 1995 - Contains information relating to supply and consumption of natural gas, including summary tables of supply and disposition from 1991-1995 for each Census Division and State (downloadable, 264 pp.)
- Natural Gas Monthly - several issues available (downloadable)
- Household Energy Consumption and Expenditures, 1993 - Presents information about household end-use energy consumption, based on 1993 RECS study (downloadable, 239 pp.)
- Housing Characteristics, 1993 - Household level data regarding energy consumption, appliances & fuels being used, etc. (downloadable, 380 pp.)
- Measuring Energy Efficiency in the U.S. Economy, A Beginning - Addresses definitional and methodological issues surrounding the measurement of energy efficiency (downloadable, 120 pp.)
- Reducing Home Heating and Cooling Costs, 1994 - Discusses and compares major heating and cooling fuels, as well as systems on the market (downloadable, 36 pp.)
- State Energy Data Report 1994, Consumption Estimates - State and national level energy consumption data for 1960, 1965, and 1970-1994 (downloadable, 532 pp.)

Lawrence Berkeley National Laboratory (LBNL)

website: www.lbl.gov/

Center for Building Science (CBS) - Develops and helps to commercialize energy-efficient technologies and analytical techniques, and documents methods of improving the energy efficiency and indoor environmental quality of residential and commercial buildings

CBS Publications

- The Effect of Efficiency Standards on Water Use and Water Heating Energy Use in the U.S.: A Detailed End-Use Treatment (J.G. Koomey, C. Dunham, and J.D. Lutz)
- Fenestration R&D Newsletter (Wilde, ed.)

CBS Programs

- Building Technologies Program
- Energy Analysis Program
- Indoor Environment Program
Energy Performance of Buildings Group (within CBS's IEP)

The California Institute for Energy Efficiency (CIEE) (at LBNL)
Lawrence Berkeley National Laboratory
Mail Stop 90-3026
1 Cyclotron Road
Berkeley, CA 94720
Tel (510) 486-5380 Fax (510) 486-5929
e-mail: ciee@lbl.gov

CIEE is a partnership of utilities, energy agencies, and research institutions designed to advance energy efficiency nationwide.

Publications available through CIEE

- Alternative Cooling Technologies for California: Social Barriers, Opportunities, and Design Issues (L. Lutzenhiser; Washington State University #UER-289; August 1994; 75 pp.) Loren Lutzenhiser: (509) 335-6707
- Energy Savings Potential for Advanced Thermal Distribution Technology in Residential and Small Commercial Buildings (J. Andrews and M. Modera; LBL-31042; July 1991) LBL EET Indoor Environment Prog., Joyce Cordell: (510) 486-4759 (Many other publications are available through Joyce Cordell that focus on air and thermal distribution and duct systems in residential buildings)

Oak Ridge National Laboratory (ORNL)

P.O. Box 2008, MS 6070
Oak Ridge, TN 37831-6070
website: www.ornl.gov/

ORNL conducts R&D as it relates to both energy production, and end-use technologies. The Building Technology Center (BTC) is responsible for the testing of buildings and equipment. BTC was established by DOE's Office of Building Technologies, and is subdivided into four groups:

Building Envelope Systems and Materials Research

- Heating and Cooling Technology - focuses on field research, design, and testing of heating and cooling systems, refrigeration systems, components, and replacement refrigerants. Contact: Philip D. Fairchild (423) 574-2020
- Existing Buildings Research - focuses on the improvement of energy efficiency and the quality of existing residential, commercial, and industrial buildings. Contact: Ronald Shelton (423) 576-7323
- Technology Transfer

ENERGY STAR[®]

1-888-STAR-YES

websites: www.epa.gov/energystar/
www.energystar.gov/

The Environmental Protection Agency (EPA) administers a variety of ENERGY STAR[®] programs. The ENERGY STAR[®] label has been promoted as an easily identifiable certification of energy efficiency for appliances, windows and buildings.

ENERGY STAR[®] New Homes Program

website: yosemite.epa.gov/appd/eshomes/eshomes.nsf/webdocslookup/FrameBody
e-mail: koteen.japhet@epamail.epa.gov

The ENERGY STAR[®] New Homes Program promotes voluntary partnerships with home builders to construct residences that are 30 percent more energy-efficient than the current Model Energy Code (MEC). Compliance is tested by a Home Energy Rating System (HERS). The main organization in California providing HERS ratings is CHEERS.

Energy Star[®] Windows

website: www.energystar.gov/products/windows/index.html

The ENERGY STAR[®] Windows Program is designed to help consumers identify efficient windows, doors and skylights.

Home Energy Rating Systems Council (HERSC)

1511 K. St. N.W. Suite 600
Washington, D.C. 2005 USA
Tel (202) 638-3700, Fax (202) 393-5043
website: www.hers-council.org/

The HERSC develops the Uniform Accreditation Procedures for home energy rating systems for the purpose of establishing a national uniform rating mechanism. A home meeting the HERS standard (at least 30 percent more energy efficient than a home built to the Model Energy Code) qualifies for an ENERGY STAR[®] certificate. The buyer may also be eligible for an energy efficient mortgage.

The HERSC mission is to increase residential energy efficiency and affordability nationwide by advancing uniform home energy ratings, energy-efficiency financing, education and research through collaborative efforts.

The HERS Council is a nonprofit association promoting residential energy efficiency improvements by linking home energy rating programs with financing for energy-efficient improvements. Council members are drawn from many different groups in the housing and financial community, including banks, environmental groups, government, and product and equipment manufacturers.

Voluntary guidelines to standardize home energy rating methods have been developed by HERS since 1992. They were published by DOE in the Federal Register (7/96) as a Notice of Proposed Rulemaking in which homes would receive an energy performance rating of one to five plus stars. These guidelines were developed to satisfy lender requirements in an effort to stimulate the development of energy efficiency financing products.

HERS Council Publications

- HERS Guidelines for Uniformity: Voluntary Procedures for Home Energy Ratings, v.2.0
- National Directory of HERS Providers (free)
- Uniform Accreditation Procedures for Home Energy Rating systems (free)

Other HERS recommended publications

- Consumer Information on Home Energy Rating systems (free, PG&E, 1996)

California Home Energy Efficiency Rating System (CHEERS)

9400 Oakdale Avenue
Chatsworth, California 91311
(818) 700-3600
(800) 424-3377
FAX (818) 701-2549

CHEERS is a nonprofit organization certifying home energy raters in California in accordance with the recommendations of the HERSC (see above). CHEERS raters perform on-site inspections and provide cost and benefit analysis reports with recommended improvements and participating contractors and lenders.

Standards Related Organizations

Building Codes Assistance Project (BCAP)

1200 18th Street, NW, Suite 900
Washington, D.C. 20036
Tel (202) 530-2200 Fax (202) 331-9588
e-mail: cdamante_bcap@ase.org
website: www.crest.org/efficiency/bcap/

BCAP is a joint effort of the Alliance to Save Energy, the American Council for an Energy Efficient Economy, and the Natural Resources Defense Council. Through their website, they provide updated information on the residential and commercial energy codes adopted or in place by each state. BCAP also provides assistance to construction regulators at the state or local level.

Council of American Building Officials (CABO)

5203 Leesburg Pike
Falls Church, VA 22041
Tel (703) 931-4533

CABO is the publisher of the Model Energy Code (MEC). The MEC is updated annually by the CABO Code Changes Committee, and new editions are published at approximately three-year intervals. Information regarding the MEC can also be found within the DOE's Building Standards and Guidelines Program (BSGP) webpage, at www.energycodes.org/, or by calling 1-800-270-CODE. States that have adopted the MEC are as follows:

- 1992 MEC: AR, IN, IO, NM, TN
- 1993 MEC: DE, KS, MT, ND, OH, UT, VA
- 1995 MEC: GA, MD, MD (early 1997), MA (9/97)

California Association of Building Energy Consultants (CABEC)

website: <http://www.cabec.org/html/index.html>

CABEC is a nonprofit organization that provides certification and training to professionals involved in compliance work with Title 24. Its members include energy consultants, architects, engineers, utility companies, and vendors of energy conservation products and services. CABEC offers a Certified Energy Analyst Program that requires work experience, training, and testing. In addition, all CABEC members subscribe to a code of ethics.

California Building Officials (CALBO)

2215 21st ST.
Sacramento, CA. 95818

CALBO a nonprofit organization that promotes issues in building construction. CALBO provides seminars and other educational opportunities for its members. Through its training institute, it certifies energy plans examiners. Many of these individuals also work as Title 24 energy consultants. The organization does not know how many of its certified energy plans examiners are also Title 24 energy consultants.

American National Standards Institute (ANSI)

11 West 42nd Street
New York, New York 10036
Tel: (212) 642.4900
Fax: (212) 398.0023
website: web.ansi.org/public/about.html

ANSI facilitates the development of standards by promoting consensus among qualified groups internationally.

Building Related Organizations

National Association of Home Builders (NAHB)

1201 15th Street, NW
Washington, D.C. 20005
Tel (800) 368-5242
website: www.nahb.com/

Data available from the NAHB website

- Popular Remodeling Projects - What They Cost and What You Will Recoup
- Residential Remodeling Expenditures - 1978-1995

Energy Efficient Building Association (EEBA)

2950 Metro Drive, Suite 108
Minneapolis, MN 55425
Tel (612) 841-9940 Fax (612) 851-9507
website: www.eeba.org/

EEBA is an international non-profit group that is dedicated to fostering energy efficient design and construction, and environmentally responsible development practices that provide quality living environments.

EEBA 1997 Publications Catalog

- Journal of the Energy Efficient Building Association
- EEBA Builder Field Guide (Author: Joe Lstiburek, 1997)
- Builders Foundation Handbook (Authors: Carmody, Christian, & Labs, 1991)
- Housing Energy Design (Canadian Home Builders Assn.)
- EEBA Conference Proceedings (1994, 12th Annual, Dallas, TX) - Includes research paper “Bringing Energy-Efficient Construction to the Tract Developer” by Bob Kelly

Building Industry Association (BIA)

website: <http://www.biasup.org/>

The Building Industry Association (BIA) members include builders, general contractors and developers, subcontractors and service providers. Members network, advocate legislative issues, and publish educational materials.

New Buildings Institute

11626 Fair Oaks Blvd. Suite 302
Fair Oaks, CA 95628
(916) 966-9916
(916) 962-0101 fax
Codes & Standards Office
PO Box 653
White Salmon, WA 98672
(509) 493-4468
(916) 493-4078 fax
website: www.newbuildings.org/

The New Buildings Institute promotes energy efficiency in buildings and supports the development of codes and standards.

Window Related Organizations

National Fenestration Rating Council (NFRC)

1300 Spring Street, Suite 120
Silver Spring, MD 02091
Tel (301) 589-NFRC, Fax (301) 588-0854
website: www.nfrc.org/
e-mail: NFRCUSA@aol.com

NFRC Mission & Goals: To establish a fair, accurate and credible energy performance rating system for fenestration products, and to coordinate certification and labeling activities to ensure their uniform application.

NFRC Committees: 1996

Public Relations Committee
Rating Codes and Standards Committee
Technical Committee
Accreditation Policy Committee
Certification Policy Committee
Technical Interpretations Policy Committee

NFRC Publications

- NFRC Update Newsletter (bimonthly)
- NFRC Certified Products Directory - Contains descriptive information and thermal transmission data (U-values) for over 20,000 certified products

- NFRC 100-91 - Procedure for determining fenestration product thermal properties (U-values only)
- NFRC 200 - Procedure for determining solar heat gain coefficients at normal incidence
- NFRC 300 - Procedures for determining solar optical properties for simple fenestration products
- NFRC 301 - Standard test method for emittance of specular surfaces using spectrometric measurements
- NFRC 400 - Procedures for determining fenestration product air leakage

American Architectural Manufacturers Association (AAMA)

1827 Walden Office Square, Suite 104
Schaumburg, IL 60173-4628
Tel (847) 303-5664 Fax (847) 303-5774
website: www.AAMANET.org/

AAMA Publications

- WSG.1-95 Window Selection Guide
- AAMA MIR-1 Industry Statistical Review and Forecast
- DSR-96 Combined Study of the Residential and Nonresidential Markets for Windows, Doors, and Skylights
- CPD-1 Certified Products Directory
- GSW Consumer brochure describing AAMA Certification Program and Label
- AAMA 1003-88 Voluntary Standard for Interior Insulating Windows
- AAMA 1503.1-88 Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
- AAMA 1504-97 Rev. Voluntary Standard for Thermal Performance of Windows, Doors and Glazed Wall Sections
- AAMA 502-90 Voluntary Specification for Field Testing of Windows and Sliding Glass Doors
- AAMA 910-93 Voluntary “Life Cycle,” Specifications and Test Methods for Architectural Grade Windows and Sliding Glass Doors
- AAMA/NWWDA 101/I.S.2-97 Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors
- ANSI/AAMA 1002.10-93 Voluntary Specifications for Insulating Storm Products for Windows and Sliding Glass Doors
- ANSI/AAMA 101-93 Voluntary Specifications for Aluminum and Poly (Vinyl Chloride)(PVC) Prime Windows and Glass Doors
- B-EW-03 Energy Efficient Windows
- B-W-10 Windows

- Volume I: Aluminum and Vinyl (PVC) Windows (part of a four-volume reference set compiled by the AAMA Technical Information Center)

National Wood Window and Door Association (NWWDA)

1400 East Touchy Avenue, Suite 470
Des Plaines, IL 60018
Tel (800) 223-2301 Fax (847) 299-1286
website: www.nwwda.org/

NWWDA is an industry trade organization that represents over 130 manufacturers of wood windows and doors in the U.S. and Canada

NWWDA Publications

- NFRC Certified Products Directory
- Annual Statistical Review - Annual study which includes projections of the markets for the windows, doors, and skylights
- Specifiers Guide to Wood Windows and Doors - A compendium of NWWDA standards and informational literature
- Wood Window Units - Performance requirements for wood windows)

National Sash and Door Jobbers Association (NSDJA)

10225 Robert Trent Jones Pkwy.
New Port Richey, FL 34655-4649

The National Sash and Door Jobbers Association (NSDJA) is the national trade association for window and door distributors. In the trade, a distributor is known as a “jobber.” This association has the jobbers as its members, and product manufacturers as associate members.

Equipment Related Organizations

Gas Appliance Manufacturers Association (GAMA)

1901 N. Moore Street
Arlington, VA 22209
Tel (703) 525-9565 Fax (703) 525-0718
website: www.gamanet.org/
e-mail: gamainfo@gamanet.org

GAMA Product Divisions include 16 different groups including a Furnace division (Division Chairman: Robert E.G. Ractliffe, President & CEO, Nordyne, Inc.), and a Water Heater

division (Division Chairman: A. Robert Carnevale, President & CEO, Bradford White Corporation). GAMA compiles numerous statistical reports each month from shipment data supplied directly by manufacturers who participate. Depending on the Product Division, these reports vary in the amount of detail that they contain. Statistical data maintains the confidentiality of members, and the non-disclosure of individual company data. Detailed reports are available only to the manufacturers that participate in the individual programs. General statistical information is available to the public through GAMA publications, including “Statistical Highlights,” published monthly.

Other GAMA Publications

- Consumers Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment (April 1996)

American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE)

website: <http://www.ashrae.org/>

ASHRAE’s primary function is to write standards to establish practices for the HVAC industry worldwide. ASHRAE’s focus is more on overall system design at the engineering level. ASHRAE has approximately 50,000 members.

Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

1020 12th Street, Suite 101
Sacramento, CA 95814

The SMACNA is a trade organization. The California chapter, CAL SMACNA, has over 600 contractors as members. CAL SMCNA provides legislative and regulatory advocacy and develops qualitative standards for the construction industry.

Natural Gas Related Organizations

American Gas Association (AGA)

Publications Department
1515 Wilson Blvd.
Arlington, VA 22209
Tel (703) 841-8400
website: www.aga.com/

AGA Studies and Publications

- IB 1996-04: Residential House Heating Conversions to Natural Gas: Trends and Prospects - This study reviews trends over the past two decades, and explores the prospects for future success.

Gas Research Institute (GRI)

1350 Bayshore Highway
Suite 440
Burlingame CA 94010

GRI is the natural gas industry's management organization for research, development, and commercialization of new gas technologies. GRI operates GRI/NET, the on-line Gas Research Institute Information Service (at www.gri.org/). While this service has some areas that are accessible to non-members, much of the useful information is contained in the "members-only" section of the web page. While GRI plans to soon begin subscription charges for GRI/NET members, there is currently no membership fee. The GRI/NET Help Desk can be reached at (773) 399-5415. GRI is comprised of ten business units which include (among others), "Residential End-Use," and "Strategy & Planning."

Other Organizations

American Institute of Architects (AIA)

1303 J Street
Suite 200
Sacramento, CA 95814

AIA members subscribe to a code of ethics and participate in professional development activities. In San Diego, approximately 35% of architects are AIA members. In other areas of the country, the proportion is higher at 50% to 80%.

Society of American Registered Architects (SARA)

website: <http://sara-national.org/>

Membership in SARA is lower than AIA and its services consist mostly of referrals and competitions.

Appendix C

Survey Instruments and Interview Guides

HVAC Manufacturers

The target was to complete a total of five interviews with HVAC manufacturers. Subsection C.1 details the sampling procedures and interviewing protocols for interviewing HVAC manufacturers. Subsection C.2 presents the completed sample size and provides a list of the interview respondents.

As manufacturers of HVAC equipment, these market actors are responsible for the availability and pricing of high efficiency heating and cooling equipment. In deciding what high performance products to offer, they may work with government agencies, builders, distributors, contractors, and other market actors. The primary objective of interviewing manufacturers was to identify characteristics of the regional residential market for these products and the roles of market actors.

C.1 Sample and Interview Protocol for HVAC Manufacturers

Sampling. The target was to complete five interviews with HVAC manufacturers. There are a small number of HVAC manufacturers nationwide; therefore, the sample included as many of the manufacturers as could be identified.

Protocol. A contact was removed from the sample after five unsuccessful contacts/recruit attempts.

C.2 Completed Interview Sample for HVAC Manufacturers

Interviews were completed with five HVAC manufacturers from a total of roughly eight that were contacted, yielding a response rate of 63%.¹ Table C-1 lists the manufacturer's business name and the respondent's title for the HVAC manufacturers that completed interviews.

¹ For this and the remaining response rates reported herein except for consumers, the total number of individuals contacted excludes those with whom the correct respondent was never reached and those not qualified to participate.

Table C-1: Completed Interview Sample for HVAC Manufacturer

Business Name	Respondent's Title
Amana	Regional Sales Manager
York International	Product Marketing
Goodman Manufacturing	Chief Design Engineer
International Comfort Products	Product Marketing Manager
Carrier Corporation	Corporate Utility Liaison

Interview Guide for HVAC Equipment Manufacturer

Research Objective. High efficiency air conditioning units were a direct requirement of the PCH Base program. In addition, these and/or high efficiency furnaces may have been used to meet the PCH Plus Program requirements. The manufacturers of these units have a direct influence on product availability and pricing. In addition, they may work directly with various market actors or work through distributors and contractors. The objectives of interviewing HVAC manufacturers are to identify characteristics of the regional residential market for these products, assess operating procedures, and discern capital/R&D investments. Further, the interview is designed to aid in the assessment of a market baseline of perceptions, attitudes and behavior.

Introduction

Hello. My name is _____. I'm calling on behalf of PG&E, a large utility located in Northern California. May I please speak to _____?

Hello. My name is _____. I'm calling on behalf of PG&E. We are conducting a study to better understand the market for HVAC equipment in new homes in Northern/Central California. We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: continue

If No: thank and terminate

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Before we get started, I have a few questions about your company and your background.

1. How long have you been in the HVAC equipment manufacturing industry?
2. What are your responsibilities in your current position?
4. How long has your company been in business?
5. Approximately how many full-time employees does your company have?
 - 5A. Of these, what percentage is involved in manufacturing residential HVAC equipment?
____ %

6. Is the market for your equipment local, regional, national, or international?
____ local ____ regional ____ national ____ international

7. What percentage of your sales is in California? ____ %

7A. Where is the remainder of your sales?

Residential HVAC Equipment Market

First, we would like to get an overall understanding of the market for residential gas furnaces and central air conditioners.

8. Approximately how many residential gas furnace and central air conditioning units did your company manufacture in 1998?

____ number of furnaces ____ number of air conditioners

Prompt for historical numbers that could be made available to our study effort; if no historical data available, ask about 1997 and 1991.

8A. What about 1997 and 1991?

furnaces: ____ units in 1997 ____ units in 1991

air conditioners: ____ units in 1997 ____ units in 1991

9. Approximately what percent of these units are used for new construction work as opposed to replacements, renovations and remodels?

____ % furnaces ____ % air conditioners

10. Approximately what percent of these units are designed for single-family detached homes?

____ % furnaces ____ % air conditioners

11. Are you aware of the current Federal and State minimum efficiency ratings for these units? (i.e., SEER ratings for air conditioners, AFUE ratings for gas furnaces)

____ Only Federal ____ Only State ____ Both Federal and State

____ Neither Federal or State

12. What percentages of residential central air conditioning units that you manufactured in 1998 had SEER ratings of 10 or less, between 10 and 12, or above 12?

____ 10 or less ____ between 10 and 12 ____ above 12

12A. We are particularly interested in the efficiency levels of residential central air conditioners sold in Northern and Central California. Would you say that the percentages you just provided

are representative of units you manufactured and sold in Northern/Central California?

yes no

12B. **[If No]** What percentages of units sold in Northern/Central California had SEER ratings of 10 or less, between 10 and 12, or above 12?

10 or less between 10 and 12 above 12

12C. Has this percentage changed since 1991?

yes → 12D. In what year(s)? _____ (*Probe to see if it changed since 1997, the pre-program year*)

no

[If Yes to 12C] 12E. What are the main reasons for the change? (Probe: state standards, utility energy efficiency programs, demand for comfort, other?)

[If Yes to 12C] 12F. What were the previous splits?

10 or less between 10 and 12 above 12

12G. You indicated that at least _____% (**answer to Q12 of % above 10**) of the residential central air conditioning units you manufactured were above appliance efficiency standard requirements. Do you see this continuing in the future?

yes no

12H. Why or why not?

12I. How would these percentages change if programs that promote the use of equipment that exceeds minimum efficiency levels were to be terminated in the areas you serve?

13. Now I'd like to ask you the same questions about the gas furnaces you manufacture. What percentage of residential gas furnaces that you manufactured in 1998 were rated below 80% AFUE? What percentage were 80% and above, up to 88% AFUE? What percentage were above 88% AFUE?

below 80% 80% and above, up to 88% above 88%

13A. We are particularly interested in the efficiency levels of residential gas furnaces sold in Northern and Central California. Would you say that the percentages you just provided are representative of units you manufactured and sold in Northern/Central California?

yes no

[If No to 13A] 13B. If No, what are the splits for Northern/Central California?

below 80% 80% and above, up to 88% above 88%

13C. Has the percentage of above standard efficiency units changed since 1991?
___ yes → 13D. In what year(s)? _____ (*Probe to see if it changed since 1997, the pre-program year*)
___ no

[If Yes to 13C] 13E. What are the main reasons for the change? (Probe: state standards, utility energy efficiency programs, demand for comfort, other?)

[If Yes to 13C] 13F. What were the old splits?

___ below 80% ___ 80% and above, up to 88% ___ above 88%

13G. You indicated that at least ___% (**answer to Q13 of 80% and above**) of the residential gas furnaces you manufactured were above appliance efficiency standard requirements. Do you see this continuing in the future? ___ yes ___ no

13H. Why or why not?

13I. How would these percentages change if programs that promote the use of equipment that exceeds minimum efficiency levels were to be terminated in the areas you serve?

14. What do you think has the most influence on your company' s decisions to manufacture HVAC equipment that exceeds the minimum appliance efficiency standards?

15. On a scale of 1 to 5 with zero meaning *not at all influential* and 5 meaning *very influential*, how influential are the following in your projections of future demand for energy efficiency levels of the units you manufacture?

- ___ Past sales records
- ___ Recommendations of distributors
- ___ Recommendations of HVAC contractors
- ___ Recommendations of builder/developers
- ___ Recommendations of in-house utility liaison staff
- ___ Recommendations of other in-house personnel
- ___ Competition from other manufacturers
- ___ Your own experience

16. Do you market the HVAC units that exceed appliance efficiency standards any differently than you market standard units?

___ no

___ yes 16A. Please explain the differences?

16B. What has been the response by buyers to the high-efficient units?

17. What are your company's general **stocking and inventory practices**? (*probe: do you keep inventory or manufacturer according to orders that come in*)

Q17A. Have your **stocking and inventory practices** changed since 1991?

___ no

___ yes Q17A1. When?

Q17A2. How has it changed?

18. Please give a brief description of your company's general **distribution practices**? (*probe: do you use a distributor(s)? Is the distributor manufacturer-owned or independent? Do you sell directly to retailers? Do you sell to builders/contractors?*)

Q18 A. Have your **distribution practices** changed since 1991?

___ no

___ yes Q18A1. When?

Q18A2. How has it changed?

Q18B. Who are your main distributors in Northern/Central California?

Q18C. Approximately what percent of the total number of residential gas furnaces and central air conditioning units manufactured are handled by distributors in Northern/Central California? ___ % furnaces _____ % air conditioners

Q18D. Has the market share for this area changed since 1991?

___ no

___ yes Q18D1. When?

Q18D2. How has it changed?

Research and Development of New Technologies and Manufacturing Innovations

The next set of questions are related to your research and development efforts for energy efficient air conditioning units.

19. Does your company have a research and development department for HVAC technologies?

no → **[Go to Q20]**

yes

19A. Approximately what percent of annual operating costs were R&D expenditures in 1998 for residential central air conditioning? _____%

for gas furnaces? _____%

19B. Have these percentages changed since 1991?

no

yes → In what year? _____

[If Yes to 19B] 19C. What is the main reason for the change?

20. What is your main source for information on new energy saving technologies and improvements in manufacturing techniques for residential HVAC equipment?

21. Has your company implemented any major manufacturing innovations for residential air conditioning since 1991? no yes

[If Yes to 21] 21A. What is the main reason for the change?

[If Yes to 21] 21B. In what year did the change take place?

Awareness of RNC Programs and Effects on Production, Quality, and Manufacturing Practices

Some government agencies, nonprofit organizations and utilities sponsor programs or services designed to increase the energy efficiency of HVAC equipment installed in new homes.

22. Does your company have a utility liaison or government relations department?

no yes

Company: _____

Contact/Title: _____

Phone: _____

23. Are you aware of any such programs?

no [Go to Q26]

yes

23 A. Who sponsored these programs?

23 B. When were these programs offered?

23 C. Please describe the programs.

24. How do you keep abreast of energy efficiency standards and the requirements of these types of programs in California and other states?

24A. Has this approach changed since 1991?

no

yes

Q24B. When?

Q24C. How has it changed?

25. Have you or your company made any changes to your business practices (manufacturing, sales, distribution) as a result of these programs? no yes

[If Yes to Q 25] 25A. Please describe these changes.

[If Yes to Q 25] 25B. Which features of the programs were the main reasons for implementing these changes?

[If Yes to Q 25] 25C. Have you continued or will you continue these practices even without these programs? yes no

25C1. Why or why not?

[If No to Q 25] 25D. What is the main reason why you haven't made any changes?

Probe for answers that tie into list of applicable market barriers.

Pacific Gas & Electric has offered residential home builders incentives to install high efficiency HVAC equipment.

26. Have you heard of PG&E's Comfort Home Program, PG&E's Comfort Home Plus Program, or EPA's ENERGY STAR New Homes Program?

yes Comfort Home yes Comfort Home Plus
 yes ENERGY STAR New Homes no **[Go to Q29]**

[If Yes to Comfort Home Plus and Yes to ENERGY STAR New Homes]

26A. Do you know about ENERGY STAR as a result of the Comfort Home Plus Program or apart from it?

27. When did you first hear about this(these) program(s)?

1992 1993 1994 1995
 1996 1997 1998 Don't know

28. Are any of these programs directly responsible for any of the changes you described to your manufacturing or distribution practices?

no
 yes → **[If Yes]** 28A. Which program?

28B. Please describe changes directly attributable to any of these programs.

(if not directly obvious which changes from Q25 respondent is referring to, probe for when the change took place, which program it is attributable to and whether or not it will continue).

Manufacturer's Perception of Buyer's Attitudes

The following questions relate to manufacturer's perception of the residential HVAC equipment buyers' attitudes towards energy efficient equipment and features.

29. Based upon your experience in the HVAC market, how much demand is there from homebuyers or builders for residential HVAC equipment that exceeds minimum efficiency standards?

- A lot
- Some
- Very little
- None
- Do not know

[If some or a lot for Q29] Q29A. Has this demand increased, decreased, or stayed about the same since 1991?

29B. Why do you think this is so?

30. What practices would you suggest that could be implemented to stimulate buyer demand for high-efficient units?

Need to explore for answers other than reduction in cost.

31. If you were to manufacture a residential central air conditioning unit designed to use 10% less energy than a similar unit designed to meet appliance efficiency standards, how much extra would this cost to manufacture? _____dollars

32. What percentage of this cost do you think the homebuyer or builder would be willing to pay? _____%

33. Assume for a moment that the **all homebuyers and/or builders** would be willing to pay for air conditioners that use 10% less energy than units that meet appliance standards. Is there anything that might get in the way of your company meeting buyer demand?

- yes (please explain)
- no, my company would have no problem meeting demand.

Need to probe for possible problems associated technical issues, availability, subcontractor relations.

34. Could you suggest anything that might help your company meet this demand?

Window Manufacturers

The target was to complete a total of five interviews with window manufacturers. Subsection C.3 details the sampling procedures and interviewing protocols for interviewing window manufacturers. Subsection C.4 presents the completed sample size and provides a list of the interview respondents.

As window manufacturers, these market actors are responsible for the availability and pricing of high performance fenestration products. In deciding what high performance products to offer, they may work with government agencies, builders, distributors, contractors, and other market actors. The primary objective of interviewing manufacturers was to identify characteristics of the regional residential market for these products and the roles of market actors.

C.3 Sample and Interview Protocol for Window Manufacturers

Sampling. The target was to complete five interviews with window manufacturers. The sample of manufacturers was constructed from the National Fenestration Rating Council (NFRC) member directory.

Protocol. A contact was removed from the sample after five unsuccessful contacts/recruit attempts.

C.4 Completed Interview Sample for Window Manufacturers

In-depth interviews were completed with six window manufacturers from a total of roughly 12 that were contacted, yielding a response rate of 50%. Table C-2 lists the business name and the respondent's title for the distributors that completed interviews.

Table C-2: Completed Interview Sample for Window Manufacturer

Business Name	Respondent's Title
Viking Windows	Engineering Manager
Kolbe and Kolbe	R&D Certification
Rylock	President
Blomberg	Product Design
Pella	Certification Engineer
Marvin Windows	Manager of Advanced Research

Interview Guide for Window Manufacturer

Research Objective High efficiency windows are a key element of both the PCH Base and Plus programs. To receive the optional windows incentive in the 1998 Base Program, builders had to meet windows requirements relating to both solar heat gain coefficients and U-values (as well as NFRC certification). Participation in the 1998 Plus Program was based on meeting the ENERGY STAR[®] New Home building performance level; high efficiency windows had the capability of contributing to the satisfaction of this requirement. Window standards in California are relatively complex, as Title 24 standards and ENERGY STAR New Home specifications vary by climate zone. The California Window Initiative (CWI) is also recommending standards relating to U-values, solar heat gain, and visual transmissivity. The objectives of interviewing window manufacturers are to identify characteristics of the regional residential market for these products, assess operating procedures, and discern capital/R&D investments. Further, the interview is designed to aid in the assessment of a market baseline of perceptions, attitudes and behavior.

Introduction

Hello. My name is _____. I'm calling on behalf of Pacific Gas & Electric company, a large utility located in California. May I please speak to _____?

Hello. My name is _____. I'm calling on behalf of Pacific Gas & Electric Company. We are conducting a study to better understand the market for residential windows in new homes in Northern and Central California. We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: probe to be certain this company manufactures windows for the residential market

If No: thank and terminate

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Before we get started, I have a few questions about your company and your background.

1. How long have you been in the window manufacturing industry?
2. What are your responsibilities in your current position?

3. How long has your company been in business?
4. Approximately how many full-time employees does your company have?
 - 4A. Of these, what percentage is involved in manufacturing residential windows?
 ___ % of full-time employees
5. Is the market for your windows, local, regional, national, or international?
 ___ local ___ regional ___ national ___ international
6. What percentage of your sales is in California? ___ %
 - 6A. Where is the remainder of your sales?
7. Do you specialize in manufacturing a particular type of window? Do you have a niche market?
 Please describe.

Residential Window Market

First of all we would like to get an overall understanding of residential window manufacturing practices.

8. Approximately how many residential window units did your company manufacture in 1998?
 ___ number of units

Prompt for historical numbers that could be made available to our study effort; If no historical data available, ask about 1997 and 1991.

- 8A. What about in 1997 and 1991?

 ___ number of units in 1997 ___ number of units in 1991

9. Approximately what percent of these units are used for residential new construction work as opposed to replacements, renovations and remodels? ___ %
10. Approximately what percent of these units are designed for single-family detached homes?
 ___ % single family

11. Are you aware of the National Fenestration Rating Council's whole window U-value rating system? ___yes ___no **[Go to Q13]**

11A. Do you use this system for the residential windows you manufacture?

___yes ___no

11B. Why or why not?

12. What percentages of window units that you manufactured in 1998 were rated with U-values less than/equal to .40? What percentages were greater than .40 and less than/equal to .60? What percentages were greater than .60 and less than/equal to .80? What percentages were .80 or above?

___ ≤ .40 U-value ___ > .40 and ≤ .60 U-value

___ > .60 and ≤ .80 U-value ___ > .80 U-value

12A. We are particularly interested in the efficiency levels of residential windows sold in Northern and Central California. Would you say that the percentages you just provided are representative of units you manufactured and sold in Northern/Central California?

___ yes ___no

12B. If no, what percentage of units sold in Northern/Central California had these ratings?

___ ≤ .40 U-value ___ > .40 and ≤ .60 U-value

___ > .60 and ≤ .80 U-value ___ > .80 U-value

12C. Have these percentages changed since 1991?

___ yes → 12D. In what year(s)? _____ (*probe to see if it changed since 1997, the pre-program year*)

___ no

[If Yes to 12C] 12E. What are the main reasons for the change? (Probe: state standards, utility energy efficiency programs, demand for comfort, other?)

[If Yes to 12C] 12F. What were the previous percentages of U-values?

___ ≤ .40 U-value ___ > .40 and ≤ .60 U-value

___ > .60 and ≤ .80 U-value ___ > .80 U-value

[If % \leq .40 in Q12 is > 0]12G. You indicated that at least ____% (**answer to Q12 of % \leq .40**) of the residential windows you manufactured were above appliance efficiency standard requirements. Do you see this continuing in the future?

____ yes ____ no

12 H. Why or why not?

12I. How would these percentages change if programs that promote the installation of high efficiency windows were to be terminated in the areas you serve?

13. What percentages of the residential window units that you manufactured for new homes in 1998 were single pane, double pane, triple pane and quadruple pane?

____ single ____ double ____ triple ____ quadruple

13A. Have these percentages changed since 1991?

____ yes → 13B. In what year(s)? _____ (*probe to see if it changed since 1997, the pre-program year*)

____ no

[If Yes to 13A] 13C. What are the main reasons for the change? (Probe: state standards, utility energy efficiency programs, demand for comfort, other?)

[If % of triple or quadruple pane units in Q13 is > 0] 13D. You indicated that at least ____% (**answer to Q13**) of the residential windows you sold were triple or quadruple pane units. Do you see this continuing in the future? ____ yes ____ no

13 E. Why or why not?

13 F. How would these percentages change if programs that promote the installation of high efficiency windows were to be terminated in the areas you serve?

14. Are you aware of the National Fenestration Rating Council' s solar heat gain coefficient rating system? ____yes ____no **[Go to Q16]**

15. What percentage of window units that you manufactured in 1998 were rated with solar heat gain coefficients of less than/equal to .40? What percentage was greater than .40 and less than .65? What percentage was .65 or above?

____ \leq .40 ____ $>$.40 and $<$.65 ____ \geq .65

15A. We are particularly interested in the efficiency levels of residential windows sold in Northern and Central California. Would you say that the percentages you just provided are representative of units you manufactured and sold in Northern/Central California?

___ yes ___ no

15B. If no, what percentage of units sold in Northern/Central California fall into these categories?

___ ≤ .40 ___ > .40 and < .65 ___ ≥ .65

15C. Have these percentages changed since 1991?

___ yes → 15D. In what year(s)? _____ (*probe to see if it changed since 1997, the pre-program year*)

___ no

[If Yes to 15C] 15E. What are the main reasons for the change? (Probe: state standards, utility energy efficiency programs, demand for comfort, other?)

[If Yes to 15C] 15F. What were the previous percentages in these categories?

___ ≤ .40 ___ > .40 and < .65 ___ ≥ .65

[If % of .40 or below in Q15 is > 0] 15G. You indicated that at least ___% (**answer to Q15 of % ≤ .40**) of the residential windows you manufactured had a SHGC of .40 or below.

Do you see this continuing in the future? ___ yes ___ no

15H. Why or why not?

15I. How would these percentages change if programs that promote the installation of high efficiency windows were to be terminated in the areas you serve?

16. What do you think has the most influence on your company's decisions to manufacture high efficiency windows?

17. On a scale of 1 to 5 with zero meaning *not at all influential* and 5 meaning *very influential*, how influential are the following in your projections of future demand for energy efficiency levels of the units you manufacture?

- Past sales records
- Recommendations of distributors
- Recommendations of window contractors
- Recommendations of builder/developers
- Recommendations of in-house utility liaison staff
- Recommendations of other in-house personnel
- Competition from other manufacturers
- Your own experience

18. Do you market the high-efficiency windows any differently than standard efficiency units?

- no
- yes 18A. Please explain the differences?

18B What has been the response by buyers to the high-efficient units?

19. What are your company' s general **stocking and inventory practices**? (*probe: do you keep inventory or manufacture according to orders that come in*)

Q19 A. Have your **stocking and inventory practices** changed since 1991?

- no
- yes Q19A1. When?
- Q19A2. How has it changed?

20. Please give a brief description of your company' s general **distribution practices**? (*probe: do you use a distributor(s)? Is the distributor manufacturer-owned or independent? Do you sell directly to retailers? Do you sell to builders/contractors?*)

Q20 A. Have your **distribution practices** changed since 1991?

- no
- yes Q20A1. When?
- Q20A2. How has it changed?

Q20B. Who are your main distributors in Northern/Central California?

Q20C. Approximately what percent of the total number of residential high efficiency windows manufactured are handled by distributors in Northern/Central California?

___ %

Q20D. Has the market share for this area changed since 1991?

___ no

___ yes Q20D1. How has it changed and when?

Research and Development of New Technologies and Manufacturing Innovations

The next questions are related to your research and development (R&D) efforts for energy efficient residential windows.

21. Does your company have a research and development department for window technologies?

___ yes ___ no

[If Yes to Q21] 21A. In 1998, approximately what percent of annual operating costs were R&D expenditures for windows? ___%

21B. Has this percentage changed since 1991?

___ no

___ yes → 21C. In what year? _____

[If Yes to Q21B] Q21D. What is the main reason for the change?

22. What is your main source for information on new energy saving technologies and improvements in manufacturing techniques for residential windows?

23. Has your company implemented any major manufacturing innovations for residential windows since 1991?

___ no

___ yes → 23A. What is the main reason for the change?

→ 23B. In what year did the change take place?

Awareness of RNC Programs and Effects on Production, Quality, and Manufacturing Practices

Some government agencies, non-profit organizations and utilities sponsor programs or services designed to encourage the installation of high efficiency windows in new homes.

24. Does your company have a utility liaison or government relations department?

___ no ___ yes

Company: _____
Contact/Title: _____
Phone: _____

25. Are you aware of any such programs ?

___ yes
___ no [Go to Q28]

25A. Who sponsored these programs?

25B. When were these programs offered?

25C. Please describe the programs.

26. How do you keep abreast of energy efficiency standards and the requirements of these types of programs in California and other states?

26A. Has this approach changed since 1991?

___ no
___ yes Q26B. When?
 Q26C. How has it changed?

27. Have you or your company made any changes to your business practices (**manufacturing, sales, distribution**) as a result of these programs?

___ yes ___ no

[If Yes to Q27] 27A. Please describe these changes.

[If Yes to Q27] 27B. Which features of the programs were the main reasons for implementing these changes?

[If Yes to Q27] 27C. Have you continued or will you continue these practices even without these programs? ___ yes ___ no

27C1. Why or why not?

[If No to Q27] 27D. What is the main reason you have not made any changes?

Probe for answers that tie into list of applicable market barriers.

Pacific Gas & Electric has offered residential homebuilders incentives to install high efficiency windows.

28. Have you heard of PG&E' s Comfort Home Program, PG&E' s Comfort Home Plus Program, or EPA' s ENERGY STAR New Homes Program?

___yes Comfort Home ___yes Comfort Home Plus
___yes ENERGY STAR New Homes ___no **[Go to Q31]**

[If Yes to Comfort Home Plus and Yes to ENERGY STAR New Homes]

28A. Do you know about ENERGY STAR as a result of the Comfort Home Plus Program or apart from it?

[If Yes to ENERGY STAR New Homes] 28B. Do you manufacture windows with the ENERGY STAR label? ___ yes ___no

[If Yes to 28B] 28C. When did you start doing this?

[If Yes to 28B] 28D. What percentage of your sales of residential windows are manufactured with the ENERGY STAR label?

[If Yes to 28B] 28E. What percentage of these are in Northern/Central California?

29. When did you first hear about this(these) program(s)?

___1992 ___1993 ___1994 ___1995
___1996 ___1997 ___1998 ___Don't know

30. Are any of these programs directly responsible for any of the changes you described to your manufacturing or distribution practices?

___ no
___ yes **[If Yes]** 30A. Which program?

30B. Please describe the changes directly attributable to any of these programs. *(if not directly obvious which changes from Q27 respondent is referring to, probe for when the change took place, which program it is attributable to and whether or not it will continue).*

Manufacturer's Perception of Window Buyers' Attitudes

The following questions relate to manufacturer's perception of the residential window buyers' attitudes towards energy efficient equipment and features.

31. Based upon your experience in the residential window market, how much demand is there from homebuyers or builders for high efficiency windows?

- A lot
- Some
- Very little
- None
- Do not know

[If some or a lot for Q31] Q31A. Has this demand increased, decreased, or stayed about the same since 1991?

31B. Why do you think this is so?

32. What practices would you suggest that could be implemented to stimulate buyer demand for high-efficient units?

Need to explore for answers other than reduction in cost.

33. If you were to build a window with a U-value of .40 as opposed to .65, how much extra would this cost to manufacture? ___dollars

34. What percentage of this cost do you think the homebuyer or builder would be willing to pay? ___%

35. Assume for a moment that the **all homebuyers and/or builders** would be willing to pay for units with U-values of .40. Is there anything that might get in the way of your company meeting buyer demand?

- yes (please explain)
- no, my company would have no problem meeting demand.

Need to probe for possible problems associated technical issues, availability, subcontractor relations.

36. Could you suggest anything that might help your company meet this demand?

HVAC Distributors

The target was to complete a total of five interviews with HVAC distributors. Subsection C.5 details the sampling procedures and interviewing protocols for interviewing HVAC distributors. Subsection C.6 presents the completed sample size and provides a list of the interview respondents.

HVAC equipment distributors are supply-side market actors that primarily serve as intermediaries between equipment manufacturers and HVAC contractors. The role of the distributor is generally limited to sales of heating and cooling equipment and air distribution system related materials.

C.5 Sample and Interview Protocol for HVAC Distributors

Sampling. The target was to complete five interviews with HVAC distributors. The sample of distributors was constructed by referrals from equipment manufacturers and from the Yellow Pages.

Protocol. A contact was removed from the sample after five unsuccessful contacts/recruit attempts.

C.6 Completed Interview Sample for HVAC Distributors

Completed interviews were obtained for five HVAC distributors from a total of roughly 11 that were contacted, yielding a response rate of 45%. Table C-3 lists the business name and the respondent's title for the HVAC distributors that completed interviews.

Table C-3: Completed Interview Sample for HVAC Distributor

Business Name	Respondent's Title
Slakey Brothers (Bryant/Payne)	Marketing Manager
Familian (York Distribution)	Product Marketing
Grainger, Inc.	Territory Manager
Johnstone Supply	Manager
William Wurzbach Company	Product Manager

Interview Guide for HVAC Distributors

HVAC equipment distributors are supply-side market actors that primarily serve as intermediaries between equipment manufacturers and HVAC contractors. The role of the distributor is generally limited to sales of heating and cooling equipment and air distribution system related materials. Because the PCH Base Program requires installation of high efficiency air conditioners and improved air distribution ducts, information obtained from HVAC equipment distributors will contribute to RER' s evaluation of market effects attributable to the Program.

Introduction

Hello. My name is _____. I' m calling on behalf of PG&E, a large utility located in Northern California. May I please speak to _____?

Hello. My name is _____. I' m calling on behalf of PG&E. We are conducting a study to better understand the market for HVAC equipment in new homes in Northern/Central California. We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: Probe to be certain this company sells equipment to the residential market

If No: thank and terminate

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Before we get started, I have a few questions about your company and your background.

1. How long have you been a distributor of HVAC equipment?
2. What are your responsibilities in your current position?
3. How long has your company been in business?
4. Approximately how many full-time employees does your company have?
 - 4A. Of these, what percentage is involved with the distribution of residential HVAC equipment? ___ %

5. Are you an independent company or owned by a manufacturer?
6. Does your company sell HVAC equipment from more than one manufacturer?
no
yes
- 6A. Which manufacturers do you distribute product for?
- 6B. What different brand names do you carry?
7. Please describe what type of equipment you sell.
8. What is the geographic scope of your distribution?
9. Do you set your own prices or are they set by the manufacturer?

Residential HVAC Equipment Market

First, we would like to get an overall understanding of the market for residential gas furnaces and central air conditioners.

10. Approximately how many residential gas furnace and central air conditioning units did your company sell in 1998?
number of furnaces number of air conditioners

Prompt for historical numbers which could be made available to our study effort; if no historical data available, ask about 1997 and 1991.

- 10A. What about 1997 and 1991?
furnaces: units in 1997 units in 1991
air conditioners: units in 1997 units in 1991

11. Approximately what percent of these units are used for new construction work as opposed to replacements, renovations and remodels?
 % furnaces % air conditioners
12. Approximately what percent of these units are designed for single family detached homes?
 % furnaces % air conditioners

13. What percentage of your sales of these units for residential new construction are in Northern/Central California? _____ %

14. Has the market share for this area changed since 1991?

_____ no

_____ yes 14A. How has it changed and when?

15. Who are your main customers in Northern/Central California?

Get names if possible, otherwise just get market actor types.

16. What percentage of the HVAC equipment you sell for residential new construction in Northern/Central California are sold directly to the following?

_____ Builders and developers

_____ HVAC contractors

_____ Homeowners

_____ Other [describe]

16A. Are the percentages the same for the rest of your sales areas?

_____ yes

_____ no 16A1. How do they differ?

17. Are you aware of the current Federal and State minimum efficiency ratings for these units? (i.e., SEER ratings for air conditioners, AFUE ratings for gas furnaces)

_____ Only Federal _____ Only State _____ Both Federal and State

_____ Neither Federal or State

18. What percentage of residential central air conditioning units that you sold in 1998 had SEER ratings of 10 or less, between 10 and 12, or above 12?

_____ 10 or less _____ between 10 and 12 _____ above 12

18A. We are particularly interested in the efficiency levels of residential central air conditioners sold in Northern and Central California. Would you say that the percentages you just provided are representative of units you sold in Northern/Central California?

_____ yes _____ no

18B. **[If No]** What are the splits for units sold in Northern/Central California?

_____ 10 or less _____ between 10 and 12 _____ above 12

18C. Have these percentages changed since 1991?

yes → 18D. In what year(s)? _____ (*Probe to see if it changed since 1997, the pre-program year*)

no

[If Yes to 18C] 18E. What are the main reasons for the change? (*Probe: state standards, utility energy efficiency programs, demand for comfort, other?*)

[If Yes to 18C] 18F. What were the previous splits?

10 or less between 10 and 12 above 12

18G. You indicated that at least _____% (**answer to Q18 of % > 10**) of the residential central air conditioning units you sold were above appliance efficiency standard requirements. Do you see this continuing in the future? yes no

18H. Why or why not?

18I. How would these percentages change if programs that promote the use of equipment that exceeds minimum efficiency levels were to be terminated in the areas you serve?

19. Now I'd like to ask you the same questions about the gas furnaces you sell. What percentage of residential gas furnaces that you manufactured in 1998 were rated below 80% AFUE? What percentage were 80% and above, up to 88% AFUE? What percentage were above 88% AFUE?

below 80% 80% and above, up to 88% above 88%

19A. We are particularly interested in the efficiency levels of residential gas furnaces sold in Northern and Central California. Would you say that the percentages you just provided are representative of units you sold in Northern/Central California?

yes no

[If No to 19A] 19B. What are the splits for units sold in Northern/Central California?

below 80% 80% and above, up to 88% above 88%

19C. Have the percentages of above standard efficiency units changed since 1991?

yes → 19D. In what year(s)? _____ (*Probe to see if it changed since 1997, the pre-program year*)

no

[If Yes to 19C] 19E. What are the main reasons for the change? (*Probe: state standards, utility energy efficiency programs, demand for comfort, other?*)

[If Yes to 19C] 19F. What were the old splits?

___ below 80% ___ 80% and above, up to 88% ___ above 88%

19G. You indicated that at least ___% (**answer to Q19 of 80% and above**) of the residential gas furnaces you sold were above appliance efficiency standard requirements. Do you see this continuing in the future? ___ yes ___ no

19H. Why or why not?

19I. How would these percentages change if programs that promote the use of equipment that exceeds minimum efficiency levels were to be terminated in the areas you serve?

20. Do you sell duct system equipment? ___ yes ___ no **[If No, go to Q21]**

20A. Have there been significant changes in the sales of these products since 1991?
___ yes → 20B. In what year(s)? _____ (*Probe to see if it changed since 1997, the pre-program year*)
___ no

[If Yes to 20A] 20C. Please describe the changes.

[If Yes to 20A] 20D. What are the main reasons for the change? (*Probe: state standards, utility energy efficiency programs, demand for comfort, other?*)

[If Yes to 20A] 20E. Are these changes specifically for the Northern/Central California region, or have similar changes occurred in other regions?

21. What do you think has the most influence on your company's decisions to sell HVAC equipment that exceeds the minimum appliance efficiency standards?

22. On a scale of 1 to 5 with zero meaning *not at all influential* and 5 meaning *very influential*, how influential are the following in your projections of future demand for energy efficiency levels of the units you manufacture?

- Past sales records
- Recommendations of manufacturers
- Recommendations of HVAC contractors
- Recommendations of builder/developers
- Recommendations of in-house utility liaison staff
- Recommendations of other in-house personnel
- Competition from other distributors
- Your own experience

23. Do you market the HVAC units that exceed appliance efficiency standards any differently than you market standard units?

- no
- yes 23A. Please explain the differences?

23B. What has been the response by buyers to the high-efficient units?

24. What are your company's general **stocking and inventory practices**? (*Probe: do you keep inventory or order equipment according to orders that come in*)

Q24A. Have your **stocking and inventory practices** changed since 1991?

- no
- yes Q24A1. When?
- Q24A2. How has it changed?

25. Please give a brief description of your company's general **distribution practices**? (*Probe: Do you sell directly to retailers? Do you sell to builders/contractors?*)

Q25A. Have your **distribution practices** changed since 1991?

- no
- yes Q25A1. When?
- Q25A2. How has it changed?

Awareness of RNC Programs and Effects on Production, Quality, and Distribution Practices

Some government agencies, nonprofit organizations, and utilities sponsor programs or services designed to increase the energy efficiency of HVAC equipment installed in new homes.

26. Does your company have a utility liaison or government relations department?

___ no ___ yes

Company: _____

Contact/Title: _____

Phone: _____

27. Are you aware of any such programs?

___ no **[Go to Q30]**

___ yes 27A. Who sponsored these programs?

27B. When were these programs offered?

27C. Please describe the programs.

28. How do you keep abreast of energy efficiency standards and the requirements of these types of programs in California and other states?

28A. Has this approach changed since 1991?

___ no

___ yes Q28B. When?

Q28C. How has it changed?

29. Have you or your company made any changes to your business practices (**sales, marketing, distribution**) as a result of these programs?

___ yes ___ no

[If Yes to Q29] 29A. Please describe these changes.

[If Yes to Q29] 29B. Which features of the programs were the main reasons for implementing these changes?

[If Yes to Q29] 29C. Have you continued or will you continue these practices even without these programs? ___ yes ___ no

29C1. Why or why not?

[If No to Q 29] 29D. What is the main reason you have not made any changes?

Probe for answers that tie into list of applicable market barriers.

Pacific Gas & Electric has offered residential homebuilders incentives to install high efficiency HVAC equipment.

30. Have you heard of PG&E' s Comfort Home Program, PG&E' s Comfort Home Plus Program, or EPA' s ENERGY STAR New Homes Program?

yes Comfort Home yes Comfort Home Plus
 yes ENERGY STAR New Homes no **[Go to Q33]**

[If Yes to Comfort Home Plus and yes to Energy Star New Homes]

30A. Do you know about ENERGY STAR as a result of the Comfort Home Plus Program or apart from it?

31. When did you first hear about this(these) program(s)?

1992 1993 1994 1995
 1996 1997 1998 Don't know

32. Are any of these programs directly responsible for any of the changes you described to business practices?

no
 yes **[If Yes]** 32A. Which program?

32B. Please describe the changes directly attributable to any of these programs.

(If not directly obvious which changes from Q29 respondent is referring to, probe for when the change took place, which program it is attributable to and whether or not it will continue).

Perception of Buyers' Attitudes

The following questions relate to distributors' perceptions of the residential HVAC equipment buyers' attitudes towards energy efficient equipment and features.

33. Based upon your experience in the HVAC equipment market, how much demand is there from homebuyers or builders for equipment that exceeds efficiency standards?

- A lot
- Some
- Very little
- None
- Do not know

[If some or a lot for Q33] Q33A. Has this demand increased, decreased, or stayed about the same since 1991?

33B. Why do you think this is so?

34. What practices would you suggest that could be implemented to stimulate buyer demand for units that exceed national appliance standards?

Need to explore for answers other than reduction in cost.

Window Distributors

The target was to complete a total of five interviews with window distributors. Subsection C.7 details the sampling procedures and interviewing protocols for interviewing window distributors. Subsection C.8 presents the completed sample size and provides a list of the interview respondents.

Window distributors play a supply-side role in the residential new construction market and act as intermediaries between window manufacturers and window contractors.

C.7 Sample and Interview Protocol for Window Distributors

Sampling. The target was to complete five interviews with window distributors. The sample of distributors was constructed by referrals from window manufacturers along with the member directories from Sash and Door Jobbers Association (NSDJA) and the National Fenestration Rating Council (NFRC).

Protocol. A contact was removed from the sample after five unsuccessful contacts/recruit attempts.

C.8 Completed Interview Sample for Window Distributors

Completed interviews were obtained for five window distributors from a total of roughly 13 that were contacted, yielding a response rate of 38%. Table C-4 lists the business name and the respondent's title for the distributors that completed interviews.

Table C-4: Completed Interview Sample for Window Distributors

Business Name	Respondent's Title
Rugby Builder Supply	Purchasing Manager
California Builder Supply	Manager of Executive Accounts
Maestro Products	Marketing Representative
Western Door and Sash	Architectural Sales Representative
Art Glass Millworks	Director of Marketing

Interview Guide for Window Distributors

The PCH program offered an optional additional incentive for installing high performance windows. Window distributors play a supply-side role in the RNC market and act as intermediaries between window manufacturers and window contractors. The objective of these interviews is to ascertain their attitudes and business practices in conjunction with characterizing the RNC market. In addition, some specific hypotheses will be tested regarding related market barriers.

Introduction

Hello. My name is _____. I'm calling on behalf of PG&E, a large utility located in Northern California. May I please speak to _____?

Hello. My name is _____. I'm calling on behalf of PG&E. We are conducting a study to better understand the market for windows in new homes in Northern/Central California. We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: probe to be certain this company sells windows for the residential market

If No: thank and terminate

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Before we get started, I have a few questions about your company and your background.

1. How long have you been a distributor of windows?
2. What are your responsibilities in your current position?
3. How long has your company been in business?
4. Approximately how many full-time employees does your company have?
 - 4A. Of these, what percentage is involved in manufacturing residential windows?
___ % of full-time employees
5. Are you an independent company or owned by a manufacturer?

6. Does your company sell windows from more than one manufacturer?
no yes
 - 6A. Which manufacturers do you distribute product for?
 - 6B. What different brand names do you carry?
7. Does your company sell products other than windows?
 no yes
 - 7A. What other products do you sell?
8. What is the geographic scope of your distribution?
9. Do you set your own prices for windows or are they set by the manufacturer?
10. Do you specialize in selling a particular type of window? Do you have a niche market? Please describe.

Residential Window Market

First of all we would like to get an overall understanding of residential window distributing practices. We are particularly interested in the residential new construction market.

11. Approximately how many residential window units did your company sell in 1998?
number of units

Prompt for historical manufacturing numbers that could be made available to our study effort; if no historical data available ask about 1997 and 1991.

- 11A. What about 1997 and 1991?

number of units in 1997 number of units in 1991

12. Approximately what percent of these units are used for residential new construction work as opposed to replacements, renovations and remodels? %
13. Approximately what percent of these units for residential new construction are designed for single family detached homes? % Single family

14. What percentage of your sales of these units for residential new construction are in Northern/Central California? _____ %

14A. Who are your main customers in Northern/Central California?

Get names if possible, otherwise just get customer types.

14B. Has the market share for this area changed since 1991?

_____ no _____ yes

[If Yes to 14B] 14C. How has it changed and when?

15. What percentage of the windows you sell for residential new construction in Northern/Central California are sold directly to the following?

_____ Builders and developers

_____ Window contractors

_____ Homeowners

_____ Other [describe]

15A. Are the percentages the same for the rest of your sales areas?

_____ yes

_____ no 15A1. How do they differ?

16. Are you aware of the National Fenestration Rating Council's whole window U-value rating system?

_____ no **[Go to Q18]**

_____ yes

16A. Do you use this system for the residential windows you sell?

_____ yes _____ no

16B. Why or why not?

17. What percentages of window units that you sold in 1998 were rated with U-values less than/equal to .40? What percentages were greater than .40 and less than/equal to .60? What percentages were greater than .60 and less than/equal to .80? What percentages were .80 or above?

_____ ≤ .40 U-value

_____ > .40 and ≤ .60 U-value

_____ > .60 and ≤ .80 U-value

_____ > .80 U-value

17A. We are particularly interested in the efficiency levels of residential windows sold in Northern and Central California. Would you say that the percentages you just provided are representative of units you sold in Northern/Central California?

____ yes ____no

17B. If no, what percentage of units sold in Northern/Central California had these ratings?

____ ≤ .40 U-value ____ > .40 and ≤ .60 U-value

____ > .60 and ≤ .80 U-value ____ > .80 U-value

17C. Have these percentages changed since 1991?

____ yes → 17D. In what year(s)? _____ (*probe to see if it changed since 1997, the pre-program year*)

____ no

[If Yes to 17C] 17E. What are the main reasons for the change? (*Probe: state standards, utility energy efficiency programs, demand for comfort, other?*)

[If Yes to 17C] 17F. What were the previous percentages of U-values?

____ ≤ .40 U-value ____ > .40 and ≤ .60 U-value

____ > .60 and ≤ .80 U-value ____ > .80 U-value

[If % ≤ .40 in Q17 is > 0] 17G. You indicated that at least ____% (**answer to Q17 of % ≤ .40**) of the residential windows you sold were above appliance efficiency standard requirements. Do you see this continuing in the future? ____ yes ____ no

17H. Why or why not?

17I. How would these percentages change if programs that promote the installation of high efficiency windows were to be terminated in the areas you serve?

18. What percentages of the residential window units that you sold for new homes in 1998 were single pane, double pane, triple pane and quadruple pane?

____ single ____ double ____ triple ____ quadruple

18A. Have these percentages changed since 1991?

yes → 18B. In what year(s)? _____ (*probe to see if it changed since 1997, the pre-program year*)

no

[If Yes to 18A] 18C. What are the main reasons for the change? (Probe: state standards, utility energy efficiency programs, demand for comfort, other?)

[If % of triple or quadruple pane units in Q18 is > 0] 18D. You indicated that at least _____% (**answer to Q18**) of the residential windows you sold were triple or quadruple pane units. Do you see this continuing in the future? yes no

18E. Why or why not?

18F. How would these percentages change if programs that promote the installation of high efficiency windows were to be terminated in the areas you serve?

19. Are you aware of the National Fenestration Rating Council's solar heat gain coefficient rating system? yes no **[Go to Q21]**

20. What percentage of window units that you sold in 1998 were rated with solar heat gain coefficients of less than/equal to .40? What percentage were greater than .40 and less than .65? What percentage were .65 or above?

_____ ≤ .40 _____ > .40 and < .65 _____ ≥ .65

20A. We are particularly interested in the efficiency levels of residential windows sold in Northern and Central California. Would you say that the percentages you just provided are representative of units you sold in Northern/Central California? yes no

20B. If no, what percentage of units sold in Northern/Central California fall into these categories?

_____ ≤ .40 _____ > .40 and < .65 _____ ≥ .65

20C. Have these percentages changed since 1991?

yes → 20D. In what year(s)? _____ (*probe to see if it changed since 1997, the pre-program year*)

no

[If Yes to 20C] 20E. What are the main reasons for the change? (Probe: state standards, utility energy efficiency programs, demand for comfort, other?)

[If Yes to 20C] 20F. What were the previous percentages in these categories?

_____ ≤ .40 _____ > .40 and < .65 _____ ≥ .65

[If % of .40 or below in Q20 is > 0] 20G. You indicated that at least _____% (answer to Q20 of % ≤ .40) of the residential windows you sold had a SHGC of .40 or below. Do you see this continuing in the future? _____ yes _____ no

20H. Why or why not?

20I. How would these percentages change if programs that promote the installation of high efficiency windows were to be terminated in the areas you serve?

21. What do you think has the most influence on your company's decisions to sell high efficiency windows?

22. On a scale of 1 to 5 with zero meaning *not at all influential* and 5 meaning *very influential*, how influential are the following in your projections of future demand for energy efficiency levels of the units you sell?

- ___ Past sales records
- ___ Recommendations of manufacturers
- ___ Recommendations of builder/developers
- ___ Recommendations of other in-house personnel
- ___ Competition from other distributors
- ___ Your own experience

23. Do you market the high-efficient window units any differently than you market standard units?

_____ no
_____ yes 23A. Please explain the differences?

23B. What has been the response by buyers to the high-efficient units?

24. What are your company's general **stocking and inventory practices**? (*probe: do you keep inventory on hand and how much?*)

Q24 A. Have your **stocking and inventory practices** changed since 1991?

_____ no
_____ yes Q24A1. When?
 Q24 A2. How has it changed?

25. Please give a brief description of your company's general **distribution practices**? (*probe for what type of market actors they sell to*)

Q25A. Have your **distribution practices** changed since 1991?

no

yes

Q25A1. When?

Q25A2. How has it changed?

Awareness of RNC Programs and Effects on Production, Quality, and Manufacturing Practices

Some government agencies, nonprofit organizations, and utilities sponsor programs or services designed to encourage the installation of high efficiency windows in new homes.

26. Does your company have a utility liaison or government relations department?

no yes

Company: _____

Contact/Title: _____

Phone: _____

27. Are you aware of any such programs?

no **[Go to Q30]**

yes 27A. Who sponsored these programs?

27B. When were these programs offered?

27C. Please describe the programs.

28. How do you keep abreast of energy efficiency standards and the requirements of these types of programs in California and other states?

28A. Has this approach changed since 1991?

no

yes

Q28B. When?

Q28C. How has it changed?

29. Have you or your company made any changes to your business practices (**sales, marketing, distribution**) as a result of these programs?

___ yes ___ no

[If Yes to Q29] 29A. Please describe these changes.

[If Yes to Q29] 29B. Which features of the programs were the main reasons for implementing these changes?

[If Yes to Q29] 29C. Have you continued or will you continue these practices even without these programs? ___ yes ___ no

29C1. Why or why not?

[If No to Q29] 29D. What is the main reason you have not made any changes?

Probe for answers that tie into list of applicable market barriers.

Pacific Gas & Electric has offered residential home builders incentives to install high efficiency windows.

30. Have you heard of PG&E' s Comfort Home Program, PG&E' s Comfort Home Plus Program, or EPA' s ENERGY STAR New Homes Program?

___yes Comfort Home ___yes Comfort Home Plus
___yes ENERGY STAR New Homes ___no **[Go to Q33]**

[If Yes to Comfort Home Plus and yes to Energy Star New Homes] 30A. Do you know about ENERGY STAR as a result of the Comfort Home Plus Program or apart from it?

[If Yes to ENERGY STAR New Homes] 30B. Do you distribute windows with the ENERGY STAR label? ___ yes ___no

[If Yes to 30B] 30C. When did you start doing this?

[If Yes to 30B] 30D. What percentage of your sales of residential windows carry the ENERGY STAR label?

[If Yes to 30B] 30E. What percentage of these are in Northern/Central California?

31. When did you first hear about this(these) program(s)?

1992 1993 1994 1995
 1996 1997 1998 Don't know

32. Are any of these programs directly responsible for any of the changes you described to business practices?

no
 yes **[If Yes]** 32A. Which program?

32B. Please describe the changes directly attributable to any of these programs.
(if not directly obvious which changes from Q29 respondent is referring to, probe for when the change took place, which program it is attributable to and whether or not it will continue).

Perception of Window Buyers' Attitudes

The following questions relate to distributors' perception of the residential window buyers' attitudes towards energy efficient equipment and features.

33. Calling on your experience in the window market, how much demand is there from homebuyers or builders for high efficiency windows?

A lot
 Some
 Very little
 None
 Do not know

[If some or a lot for Q33] Q33A. Has this demand increased, decreased, or stayed about the same since 1991?

33B. Why do you think this is so?

34. What practices would you suggest that could be implemented to stimulate buyer demand for high-efficient units?

Need to explore for answers other than reduction in cost.

HVAC Contractors

The target was to complete a total of five interviews with HVAC contractors. Subsection C.9 details the sampling procedures and interviewing protocols for interviewing HVAC contractors. Subsection C.10 presents the completed sample size and provides a list of the interview respondents.

HVAC contractors handle all aspects of HVAC system design, selection, purchasing, construction, and installation. Contractors work directly with builders, Title 24 consultants, architects, and equipment distributors in performing these functions. HVAC contractors typically have considerable input regarding efficiency parameters of HVAC equipment and the design of the air distribution system.

C.9 Sample and Interview Protocol for HVAC Contractors

Sampling. The target was to interview five HVAC contractors servicing the PG&E service territory. The sample of contractors was drawn from PG&E referrals, builder referrals, and the member lists from the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) serving the PG&E area. In addition, PG&E provided a contact list of possible HVAC contractors to be contacted. After identifying several large influential contractors that were not included in the provided list, approval was obtained from PG&E to add these companies to the contact list. The contractors that were surveyed and their office locations are listed in Table C-5.

Protocol. Individuals within each business were contacted at least once for an interview. In most cases a senior HVAC contractor was contacted and interviewed, as these individuals were the most likely to have more experience and be more knowledgeable about market trends. A special effort was made to get interviews with some of the more significant HVAC contractors in the PG&E area. Referred and non-referred contacts were not removed from the sample until after five failed contact attempts. In addition, contacts obtained from the SMACNA list were screened to ensure that the majority of their business was residential new construction in Northern California.

The initial survey protocol did not include the use of incentives. Due to the stringent timeframes and lack of willingness to participate in the interviews, in a few cases HVAC contractors were offered an incentive of \$25 to \$50 to participate.

C.10 Completed Interview Sample for HVAC Contractors

Completed interviews were obtained for five HVAC contractors in the PG&E service territory from a total of roughly 30 that were contacted, yielding a response rate of 17%. This statistic reflects the fact that HVAC contractors are currently very busy and usually out in the field installing equipment rather than in the office. In addition, some comments were obtained from one HVAC contractor who declined to complete an interview for the study. Table C-5 lists the business name and location for the HVAC contractors that completed interviews.

Table C-5: Completed Interview Sample for HVAC Contractors

Business Name	Location(s)
Beutler Heating and Air Conditioning	Main office, Sacramento (other locations)
Skelton Heating & Air Conditioning	Tracy
Donald P. Dick Air Conditioning	Fresno
ASCO Air Conditioning	Morgan Hill
Lodi Heating and Cooling	San Joaquin
Ashley' s Plumbing, Heating, Sheet Metal and Air Conditioning (comments only)	Yuba City

Interview Guide for HVAC Contractors

Information obtained from HVAC contractors will be crucial to assess the market effects of the Comfort Home Base and Plus programs for two primary reasons. First, HVAC contractors have two key functions in the residential new construction market: air distribution system design and HVAC equipment purchases and installation. Contractors work directly with several market actors to complete these functions, including builders, Title 24 consultants, and equipment distributors. In other words, HVAC contractors typically have considerable input regarding efficiency parameters of HVAC equipment and the design of the air distribution system. Second, the Comfort Home Base Program required the installation of high efficiency air conditioning units and enhanced HVAC ducts. Furthermore, the Training, seminars, and educational materials directly targeted builders and their contractors.

Introduction

Hello. My name is _____. I'm calling on behalf of PG&E, a large utility located in Northern California. May I please speak to _____?

Hello. My name is _____. I'm calling on behalf of PG&E. We are conducting a study to better understand the market for windows in new homes in Northern/Central California. We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: Probe to be certain this company sells equipment to the residential market

If No: thank and terminate

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Before we get started, I have a few questions about your company and your background.

1. First, what is the scope of services offered by your company?
2. How long have you worked as an HVAC contractor, and how much of that time have you worked in Northern/Central California?
_____ as HVAC contractor _____ time in N/C California

3. Do you work independently or with a company?

_____ independent contractor _____ work with a company

3A. How long have you been with your present company?

3B. What is your primary function?

3C. How many HVAC contractors work in your company?

3D. How many HVAC contractors work in residential new construction?

_____ Contractors

Current Practices

The following questions relate to your or your company's business practices. We are particularly interested in the work you do in new homes as opposed to remodeling and renovating existing homes.

4. From whom do you purchase your HVAC equipment? **[Check all that apply.]**

- * Manufacturer
- * Distributor
- * Builder
- * Other

Please specify:

5. For the following items, please indicate if each is determined by the builder, by you or your company as the HVAC contractor, or by a Title 24 consultant.

	Builder	You (HVAC Contractor)	Title 24 Consultant
System efficiency rating	*	*	*
System size	*	*	*
Different duct installation methods	*	*	*
R-value of duct insulation	*	*	*
Other	*	*	*

Please Describe: _____

6. How many different builders or developers did you or your company work with in 1998?

_____ builders

7. In how many new homes in Northern/Central California did you or your company install HVAC equipment in 1998? _____ homes

8. What percentage of the newly constructed homes in which you installed HVAC equipment in 1998 were detached single family homes? _____% single family

9. New single family home construction is often classified as tract or custom. Approximately what percentage of the newly constructed single family homes in which you installed HVAC in 1998 were tract homes? _____ % tract

10. Are you aware of the Title 24 requirements for residential new construction?

____ no

____ yes

10A. Do you have a working knowledge of the requirements of Title 24?

____ yes ____ no

Contact: _____

Title: _____

Phone: _____

Other: _____

11. What percentage of residential central air conditioning units that you installed in 1998 had SEER ratings of 10 or less, between 10 and 12, or above 12?

____ 10 or less ____ between 10 and 12 ____ above 12

11A. Has this percentage changed since 1991?

____ yes → 11B. In what year(s)? _____ (*Probe to see if it changed since 1997, the pre-program year*)

____ no

[If Yes to 11A] 11C. What are the main reasons for the change? (*Probe: state standards, utility energy efficiency programs, demand for comfort, other?*)

[If Yes to 11A] 11D. What were the previous splits?

____ 10 or less ____ between 10 and 12 ____ above 12

11E. You indicated that at least ____% (**answer to Q11 of % above 10**) of the residential central air conditioning units you installed were above appliance efficiency standard requirements. Do you see this continuing in the future?

____ yes ____ no

11F. Why or why not?

11G. How would these percentages change if programs that promote the use of equipment that exceeds minimum efficiency levels were to be terminated in the areas you serve?

12. Now I'd like to ask you the same questions about the gas furnaces you install. What percentage of residential gas furnaces that you manufactured in 1998 were rated below 80% AFUE? What percentage were 80% and above, up to 88% AFUE? What percentage were above 88% AFUE?

____ below 80% ____ 80% and above, up to 88% ____ above 88%

12A. Has the percentage of above standard efficiency units changed since 1991?

____ yes → 12B. In what year(s)? _____ (*Probe to see if it changed since 1997, the pre-program year*)

____ no

[If Yes to 12A] 12C. What are the main reasons for the change? (*Probe: state standards, utility energy efficiency programs, demand for comfort, other?*)

[If Yes to 12A] 12D. What were the old splits?

____ below 80% ____ 80% and above, up to 88% ____ above 88%

12E. You indicated that at least ____% (**answer to Q12 of 80% and above**) of the residential gas furnaces you installed were above appliance efficiency standard requirements. Do you see this continuing in the future? ____ yes ____ no

12F. Why or why not?

12G. How would these percentages change if programs that promote the use of equipment that exceeds minimum efficiency levels were to be terminated in the areas you serve?

13. Are you aware of the current standards for **duct insulation**? ____ yes ____ no

14. Have you attended any utility-sponsored training on installing energy efficient duct systems?
15. In what percentage of the homes that you worked on in Northern/Central California in 1998 did the **duct insulation exceed** Title 24 requirements? ____% **[if 0, go to Q16]**

15A. Has this percentage changed since 1991?

____ yes → 15B. In what year(s)? _____ (*Probe to see if it changed since 1997, the pre-program year*)

____ no

[If Yes to 15A] 15C. What are the main reasons for the change? (*Probe: state standards, utility energy efficiency programs, demand for comfort, other?*)

15D. You indicated that in ____% (**answer to Q15**) of the homes you worked on in 1998 the duct insulation exceeded Title 24 requirements. Do you see this continuing in the future?

____ yes ____ no

15E. Why or why not?

15F. How would these percentages change if programs that promote the use of equipment that exceeds minimum efficiency levels were to be terminated in the areas you serve?

16. What are your current practices for duct sealing?

16A. Have they changed since 1991?

____ yes → 16B. In what year(s)? _____ (*Probe to see if it changed since 1997, the pre-program year*)

____ no

[If Yes to 16A] 16C. What are the main reasons for the change? (*Probe: state standards, utility energy efficiency programs, demand for comfort, other?*)

17. Do you conduct duct blaster tests?

____ yes ____ no

[If No] Why not?

17A. In what percentage of the new homes you worked on in Northern/Central California in 1998 did you conduct duct testing? ____ % homes

17B. Has this percentage changed since 1991?

yes → 17C. In what year(s)? _____ (*Probe to see if it changed since 1997, the pre-program year*)

no

[If Yes to 17B] 17D. What is the main reason for the change?

Awareness of the RNC Program and Attribution to DSM Programs

Some government agencies, nonprofit organizations and utilities sponsor programs or services designed to encourage the installation of high efficiency windows in new homes.

18. Are you aware of any such programs?

no **[go to Q21]**

yes 18A. Who sponsored these programs?

18B. When were these programs offered?

18C. Please describe the programs.

19. How do you keep abreast of energy efficiency standards and the requirements of these types of programs in California and other states?

19A. Has this approach changed since 1991?

no

yes Q19B. When?

Q19C. How has it changed?

20. Have you or your company made any changes to your business practices (**sales, marketing, distribution**) as a result of these programs?

yes no

[If yes to Q20] 20A. Please describe these changes.

[If yes to Q20] 20B. Which features of the programs were the main reasons for implementing these changes?

[If yes to Q20] 20C. Have you continued or will you continue these practices even without these programs? yes no

20C1. Why or why not?

[If no to Q 20] 20D. What is the main reason you have not made any permanent changes?

Probe for answers that tie into list of applicable market barriers.

Pacific Gas & Electric has offered residential home builders incentives to install high efficiency windows.

21. Have you heard of PG&E' s Comfort Home Program, PG&E' s Comfort Home Plus Program, or EPA' s ENERGY STAR New Homes Program?

___yes Comfort Home ___yes Comfort Home Plus
___yes ENERGY STAR New Homes ___no [go to Q25]

[If yes to Comfort Home Plus and yes to Energy Star New Homes]

21A. Do you know about ENERGY STAR as a result of the Comfort Home Plus Program or apart from it?

22. When did you first hear about this(these) program(s)?

__1992 __1993 __1994 __1995
__1996 __1997 __1998 __Don't know

23. Are any of these programs directly responsible for any of the changes you described to business practices?

___ no
___ yes **[If yes]** 23A. Which program?

23B. Please describe the changes directly attributable to any of these programs.
(if not directly obvious which changes from Q29 respondent is referring to, Probe for when the change took place, which program it is attributable to and whether or not it will continue).

24. Have the builders you or your company contracts with made any changes to their building practices as a result of these programs? ___ yes ___ no

[If yes to Q24] 24A. Please describe these changes.

[If yes to Q24] 24B. Which features of the programs were the main reasons for implementing these changes?

[If yes to Q24] 24C. Do you think they will continue these practices even without these programs? ____ yes ____ no

24C1. Why or why not?

Probe for answers that tie into list of applicable market barriers.

Use of Energy-Efficient Measures

25. For the following list of equipment do you consider yourself very aware, somewhat aware, or not at all aware of the latest available energy saving high efficiency technologies?

	Very Aware	Somewhat Aware	Not At All Aware
High efficiency air conditioning	*	*	*
Gas furnaces	*	*	*
High efficiency windows	*	*	*
Insulation	*	*	*
Duct testing	*	*	*
Duct sealing	*	*	*

25A. What is the primary source of your information on new technologies?

26. What percentage of installations that you or your company did in Northern/Central California in 1998 that intentionally **exceeded** Title 24 were at the request of the builder and what percentage were a decision you made on your own?

_____ % Requested by builder _____ % Own decision

27. How influential would you say HVAC contractors are in assisting builders who want to build to energy efficiency standards that **exceed** Title 24?

- _____ Very influential
- _____ Somewhat influential
- _____ Not very influential
- _____ Not at all influential
- _____ Don't know

27A. In what way(s) do you feel HVAC contractors are [**your answer from Q27**]?

28. When you are contracting with builders, do you have the opportunity to suggest that they exceed minimum Title 24 requirements? ____ yes ____ no

[If Yes to Q28] 28A. Have you ever done this? yes no

[If No to Q 28A] 28A1. Why not?

[If Yes to Q 28A] 28A2. When you did suggest exceeding Title 24, was your suggestion followed? yes no

[If Yes to Q 28A] 28A3. Why or why not?

29. Is there anything that you as an HVAC contractor are doing now that is particularly helpful to **builders** who want to **exceed** the minimum requirements of Title 24?

no

yes 29A. Please describe.

30. Are there any changes HVAC contractors could do to encourage builders to exceed minimum Title 24 requirements?

no

yes 30A. Please describe the changes.

30B. Have you had the opportunity to make any of these changes in your business? yes no

[If Yes to Q 30B] 30B1. Which changes did you make?

[If Yes to Q 30B] 30B2. What were the primary reasons for these changes?

[If Yes to Q 30B] 30B3. When did you make them?

[If No to Q 30B] 30B4. Why not?

31. What do you think are the advantages and disadvantages of homes that exceed minimum Title 24 requirements?

Perception of Homebuyer Attitudes

32. Based upon your experience in the residential new construction market, how much demand is there from homebuyers or builders for energy saving equipment or features?

- A lot
- Some
- Very little
- None
- Do not know

[If “Very little” or “None” for Q32] 32A. What do you feel are the major factors for such little demand?

33. How much buyer demand is there for features that exceed Title 24? [*Regardless of whether or not buyer is aware of Title 24 requirements*]

- A lot
- Some
- Very little
- None
- Do not know

[If “Very little” or “None” for Q33] 33A. What do you feel are the major factors for such little demand?

34. Has customer demand for energy saving features increased, decreased, or stayed about the same since 1990?

- Increased
- Decreased
- Stayed about the same
- Do not know

[If “Increased” or “Decreased” for Q34] 34A. What do you feel are the major factors that have led to this increase/decrease?

Perceptions on Energy Efficiency

35. On a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, please indicate how important each of the following reasons is for why you would not install HVAC equipment that exceeds Title 24 requirements.

	Not At All Important	1	2	Somewhat Important	3	4	Very Important	5
Cost	1	2	3	4	5			
Lack of information on energy efficient measures	1	2	3	4	5			
Energy efficient products are not available	1	2	3	4	5			
Difficulty in choosing among options for energy efficient measures	1	2	3	4	5			
Hassle	1	2	3	4	5			
Financing	1	2	3	4	5			
Other	1	2	3	4	5			

Please Describe _____

Window Contractors

The target was to complete a total of five interviews with window contractors. Subsection C.11 details the sampling procedures and interviewing protocols for interviewing window contractors. Subsection C.12 presents the completed sample size and provides a list of the interview respondents.

Window contractors generally select, purchase, install, and service the windows for single-family residential new construction homes. Window contractors work directly with builders, Title 24 consultants, architects, and equipment manufacturers/distributors, and typically have considerable input regarding the performance parameters of windows. Window contractors are typically:

- Manufacturers who directly serve the builder by supplying *installed* windows (even though actual installation is usually contracted out).
- Window distributors who also do window installation
- Window contractors who do installation, and order windows from both manufacturers and distributors as needed

Each of these types of window contractors is represented in the completed interview sample.

C.11 Sample and Interview Protocol for Window Contractors

Sampling. The target was to interview five window contractors serving the PG&E service territory. The sample of window contractors was drawn primarily from builder referrals but also from the Yellow Pages. The window contractors that were surveyed, the type of contractor they appear to be, and their office locations are listed in Table C-6.

Protocol. Individuals within each business were contacted at least once for an interview. In most cases a senior window contractor was contacted and interviewed, as these individuals were the most likely to have more experience and be more knowledgeable about market trends. Referred and non-referred contacts were not removed from the sample until after five failed contact attempts. All contacts were screened to ensure that a significant portion of their business was involved with residential new construction in northern or central California.

The initial survey protocol did not include the use of incentives. Due to the stringent timeframes and lack of willingness to participate in the interviews, in a few cases window contractors were offered an incentive of \$25 to participate.

C.12 Completed Interview Sample for Window Contractors

Completed interviews were obtained for five window contractors in the PG&E service territory from a total of roughly ten that were contacted, yielding a response rate of 50%. Table C-6 lists the business name, the contractor type, and the location for the window contractors that completed interviews.

Table C-6: Completed Interview Sample for Window Contractors

Contractor Name	Contractor Type	Location
Summit Windows	Manufacturer/Installation	Stockton, CA
Pacific Window Corp	Manufacturer/Installation	Sacramento, CA
Window & Glass Dynamics	Distributor/Installation	Roseville, CA
Crossroads Glass & Door	Distributor/Installation	Bakersfield, CA
Insight Glass	Installation	Benicia, CA

Interview Guide for Window Contractors

Window contractors work directly with several market actors including builders, Title 24 consultants, and equipment distributors, and typically have considerable input regarding efficiency parameters of window performance. The PCH Base Program offered an optional incentive, which required the installation of high performance windows that meet the ENERGY STAR[®] New Home program requirements. The objective of these interviews is to ascertain contractors' attitudes and business practices in conjunction with characterizing the RNC market. In addition, some specific hypotheses will be tested regarding related market barriers.

Introduction

Hello. My name is _____. I'm calling on behalf of PG&E, a large utility located in Northern California. May I please speak to _____?

Hello. My name is _____. I'm calling on behalf of PG&E. We are conducting a study to better understand the market for windows in new homes in Northern/Central California. We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: probe to be certain this company sells equipment to the residential market

If No: thank and terminate

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Before we get started, I have a few questions about your company and your background.

1. First, what is the scope of services offered by your company?
2. How long have you worked as a window contractor, and how much of that time have you worked in Northern/Central California?
_____ as window contractor _____ in N/C California
3. Do you work independently or with a company?
_____ Independent contractor _____ Work with a company

- 3A. How long have you been with your present company?
- 3B. What is your primary function?
- 3C. How many window contractors work in your company?
- 3D. How many window contractors work in residential new construction?
 _____ Contractors

Current Practices

The following questions relate to your or your company's business practices. We are particularly interested in the work you do in new homes as opposed to remodeling and renovating existing homes.

4. From whom do you purchase your windows? **[Check all that apply]**

- * Manufacturer
- * Distributor
- * Builder
- * Other

Please specify:

5. For the following items, please indicate if each is determined by the builder, by you or your company as the window contractor, or by a Title 24 consultant.

	Builder	You (HVAC Contractor)	Title 24 Consultant
U-value	*	*	*
Number of panes	*	*	*
Solar heat gain coefficient	*	*	*
Other	*	*	*

Please Describe _____

6. How many different builders or developers did you or your company work with in 1998?

_____ builders

7. In how many new homes in Northern/Central California did you or your company install windows in 1998? _____ homes

8. What percentage of the newly constructed homes in which you installed windows in 1998 were detached single family homes? _____% single family

9. New single family home construction is often classified as tract or custom. Approximately what percentage of the newly constructed single family homes in which you installed windows in 1998 were tract homes? _____ % tract

10. Have you attended any utility-sponsored training on high efficiency windows?

11. Are you aware of the Title 24 requirements for residential new construction?

____ no

____ yes

11A. Do you have a working knowledge of the requirements of Title 24?

____ yes ____ no

Contact: _____

Title: _____

Phone: _____

Other: _____

12. Are you aware of the National Fenestration Rating Council's whole window U-value rating system?

____ no **[go to Q16]**

____ yes

13. What percentages of window units that you installed in 1998 were rated with U-values less than/equal to .40? What percentages were greater than .40 and less than/equal to .60? What percentages were greater than .60 and less than/equal to .80? What percentages were .80 or above?

____ ≤ .40 U-value ____ > .40 and ≤ .60 U-value

____ > .60 and ≤ .80 U-value ____ > .80 U-value

13A. Have these percentages changed since 1991?

____ yes → 13B. In what year(s)? _____ (*probe to see if it changed since 1997, the pre-program year.*)

____ no

[If Yes to 13A] 13C. What are the main reasons for the change? (Probe: state standards, utility energy efficiency programs, demand for comfort, other?)

13D. You indicated that at least ____% (**answer to Q13**) of the residential windows you sold were above appliance efficiency standard requirements. Do you see this continuing in the future? ____ yes ____ no

13E. Why or why not?

13F. How would these percentages change if programs that promote the installation of high efficiency windows were to be terminated in the areas you serve?

14. What percentages of the residential window units that you installed for new homes in 1998 were single pane, double pane, triple pane and quadruple pane?

____ single ____ double ____ triple ____ quadruple

14A. Have these percentages changed since 1991?

____ yes → 14B. In what year(s)? _____ (*probe to see if it changed since 1997, the pre-program year.*)

____ no

[If Yes to 14A] 14C. What are the main reasons for the change? (Probe: state standards, utility energy efficiency programs, demand for comfort, other?)

[If % of triple or quadruple pane units in Q14 is > 0]

14D. You indicated that at least ____% (**answer to Q14**) of the residential windows you sold were triple or quadruple pane units. Do you see this continuing in the future? ____ yes
____ no

14E. Why or why not?

14F. How would these percentages change if programs that promote the installation of high efficiency windows were to be terminated in the areas you serve?

15. Are you aware of the National Fenestration Rating Council's solar heat gain coefficient rating system? ____yes ____no **[go to Q17]**

16. What percentage of window units that you sold in 1998 were rated with solar heat gain coefficients of less than/equal to .40? What percentage were greater than .40 and less than .65? What percentage were .65 or above?

____ ≤ .40 ____ > .40 and < .65 ____ ≥ .65

16A. Have these percentages changed since 1991?

yes → 16B. In what year(s)? _____ (*probe to see if it changed since 1997, the pre-program year.*)

no

[If Yes to 16C] 16D. What are the main reasons for the change? (Probe: state standards, utility energy efficiency programs, demand for comfort, other?)

[If % of .40 or below in Q16 is > 0] 16E. You indicated that at least _____% (**answer to Q16**) of the residential windows you sold had a SHGC of .40 or below. Do you see this continuing in the future? yes no

16F. Why or why not?

16G. How would these percentages change if programs that promote the installation of high efficiency windows were to be terminated in the areas you serve?

Awareness of the RNC Program and Attribution to DSM Programs

Some government agencies, non-profit organizations and utilities sponsor programs or services designed to encourage the installation of high efficiency windows in new homes.

17. Are you aware of any such programs?

no **[go to Q20]**

yes 17A. Who sponsored these programs?

17B. When were these programs offered?

17C. Please describe the programs.

18. How do you keep abreast of energy efficiency standards and the requirements of these types of programs in California and other states?

18A. Has this approach changed since 1891?

no

yes

Q18B. When?

Q18C. How has it changed?

19. Have you or your company made any changes to your business practices (**sales, marketing, distribution**) as a result of these programs?

yes no

[If Yes to Q19] 19A. Please describe these changes.

[If Yes to Q19] 19B. Which features of the programs were the main reasons for implementing these changes?

[If Yes to Q19] 19C. Have you continued or will you continue these practices even without these programs? yes no

19C1. Why or why not?

[If No to Q19] 19D. What is the main reason you have not made any permanent changes?

Probe for answers that tie into list of applicable market barriers.

Pacific Gas & Electric has offered residential home builders incentives to install high efficiency windows.

20. Have you heard of PG&E' s Comfort Home Program, PG&E' s Comfort Home Plus Program, or EPA' s ENERGY STAR New Homes Program?

yes Comfort Home yes Comfort Home Plus
yes ENERGY STAR New Homes no **[go to Q24]**

(if yes to Comfort Home Plus and yes to Energy Star New Homes)

20A. Do you know about ENERGY STAR as a result of the Comfort Home Plus Program or apart from it?

21. When did you first hear about this(these) program(s)?

1992 1993 1994 1995
1996 1997 1998 Don't know

22. Are any of these programs directly responsible for any of the changes you described to business practices?

no
 yes **[If Yes]** 22A. Which program?

22B. Please describe the changes directly attributable to any of these programs.

(if not directly obvious which changes from Q29 respondent is referring to, probe for when the change took place, which program it is attributable to and whether or not it will continue).

23. Have the builders you or your company contracts with made any changes to their building practices as a result of these programs?

___ yes ___ no

[If Yes to Q23] 23A. Please describe these changes.

[If Yes to Q23] 23B. Which features of the programs were the main reasons for implementing these changes?

[If Yes to Q23] 23C. Do you think they will continue these practices even without these programs? ___ yes ___ no

23C1. Why or why not?

Probe for answers that tie into list of applicable market barriers.

Use of Energy-Efficient Measures

24. Do you consider yourself very aware, somewhat aware, or not at all aware of the latest available energy saving high efficiency technologies for windows?

24A. What is the primary source of your information on new technologies?

25. What percentage of installations that you or your company did in Northern/Central California in 1998 that intentionally **exceeded** Title 24 were at the request of the builder and what percentage were a decision you made on your own?

_____ % Requested by builder _____ % Own decision

26. How influential would you say window contractors are in assisting builders who want to build to energy efficiency standards that **exceed** Title 24?

- Very influential
- Somewhat influential
- Not very influential
- Not at all influential
- Don't know

26A. In what way(s) do you feel window contractors are **[your answer from Q26]**?

27. When you are contracting with builders, do you have the opportunity to suggest that they exceed minimum Title 24 requirements? yes no

[If Yes to Q27] 27A. Have you ever done this? yes no

[If No to Q27A] 27A1. Why not?

[If Yes to Q27A] 27A2. When you did suggest exceeding Title 24, was your suggestion followed? yes no

[If Yes to Q27A] 27A3. Why or why not?

28. Is there anything that you as an window contractor are doing now that is particularly helpful to **builders** who want to **exceed** the minimum requirements of Title 24?

- no
- yes 28A. Please describe.

29. Are there any changes window contractors could do to encourage builders to exceed minimum Title 24 requirements?

- no
- yes 29A. Please describe the changes.

29B. Have you had the opportunity to make any of these changes in your business?

- yes
- no

[If Yes to Q 29B] 29B1. Which changes did you make?

[If Yes to Q 29B] 29B2. What were the primary reasons for these changes?

[If Yes to Q 29B] 29B3. When did you make them?

[If No to Q 29B] 29B4. Why not?

30. What do you think are the advantages and disadvantages of homes that exceed minimum Title 24 requirements?

Perception of Homebuyer Attitudes

31. Based upon your experience in the residential new construction market, how much demand is there from homebuyers or builders for energy saving equipment or features?

- A lot
- Some
- Very little
- None
- Do not know

[If “Very little” or “None” for Q30] 31A. What do you feel are the major factors for such little demand?

32. How much buyer demand is there for features that exceed Title 24? *[Regardless of whether or not buyer is aware of Title 24 requirements]*

- A lot
- Some
- Very little
- None
- Do not know

[if “Very little” or “None” for Q32] 32A. What do you feel are the major factors for such little demand?

33. Has customer demand for energy saving features increased, decreased, or stayed about the same since 1990?

- Increased
- Decreased
- Stayed about the same
- Do not know

[if “Increased” or “Decreased” for Q 33] 33A. What do you feel are the major factors that have led to this increase/decrease?

Perceptions on Energy Efficiency

34. On a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, please indicate how important each of the following reasons is for why you would not install high efficiency windows.

	Not At All Important	1	2	Somewhat Important	3	4	Very Important	5
Cost	1	2	3	4	5			
Lack of information on energy efficient measures	1	2	3	4	5			
Energy efficient products are not available	1	2	3	4	5			
Difficulty in choosing among options for energy efficient measures	1	2	3	4	5			
Hassle	1	2	3	4	5			
Financing	1	2	3	4	5			
Other	1	2	3	4	5			

Please Describe _____

Architects

The target was to complete a total of ten interviews with architects in the PG&E service territory. Subsection C.13 details the sampling procedures and interviewing protocols for interviewing architects. Subsection C.14 presents the completed sample size and provides a list of the interview respondents.

Architects work directly with builders in the designing of residential homes. Thus, they may influence the choices builders make regarding the types of building shell energy efficient measures included in their plans.

C.13 Sample and Interview Protocol for Architects

Sampling. The target was to complete ten interviews with architects in the PG&E service territory. The sample of architects was obtained by referrals from builders, building inspectors, office rosters and references from Building Industry Associations (BIA), and the Yellow Pages.

Protocol. All referrals (particularly from builders) were considered to be “priority” sample points and a strong attempt was made to recruit these architects for participation. A referred contact was removed from the sample after five unsuccessful contacts/recruit attempts.

During the first contact, the architects were screened to ensure that they personally had residential new construction experience and that they conducted business in northern or central California. Architects were contacted at least once for an interview. A non-referred contact was removed from the sample after four unsuccessful contacts/recruit attempts.

The initial survey protocol did not include the use of incentives. Due to the stringent timeframes and lack of willingness to participate in the interviews, in a few cases architects were offered an incentive of \$25 to participate.

C.14 Completed Interview Sample for Architects

Completed interviews were obtained for ten architects in the PG&E service territory from a total of roughly 16 that were contacted, yielding a response rate of 63%. Table C-7 lists the business name and the respondent’s title for the architects that completed interviews.

Table C-7: Completed Interview Sample for Architects

Business Name	Respondent' s Title
Bill Fulton Associates Residential Design	Owner/Designer/Architect
Bloodgood Sharpbuster	Project Manager
James Plumb Associates	Principal/Architect
Robert Heidi Architects	Director of Designs
KTGY Group	Principal/Architect
Terry Armantrout Architect	Architect
Dahlin Group	Managing Partner/Architect
Joseph Pereyra Architect	Architect
Home Design Services	Architect
AEC Group	Architect

Interview Guide for Architects

The 1998 PCH Program offered technical assistance and product information to architects who assisted builders in the design of homes. Architects often work directly with builders in the designing of residential homes. Thus, they may influence the choices builders make regarding the types of energy efficient measures included in their plans. The objective of these interviews is to identify architects' perceptions of energy efficiency, their awareness of energy efficient products, and changes in their business practices that have resulted from the Comfort Home Program.

Introduction

Hello. My name is _____. I'm calling on behalf of [PG&E]. May I please speak to _____?

Hello. My name is _____. I'm calling on behalf of PG&E. We are conducting a study to better understand the market for new homes in Northern and Central California. We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: verify respondent has experience with residential new construction market

If No: thank and terminate

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Before we get started, I have a few questions about your background.

1. First, what is the scope of services offered by your company?

2. Do you work independently or with a company?

_____ Independent contractor _____ Work with a company

2A. How long have you been with your present company?

(If not long, probe for how long respondent has been an Architect).

2B. What is your primary function?

2C. How many Architects work in your company? _____ Architects

Business Practices

The following questions relate to your or your company's business practices.

3. How many homes did your company design in 1998? _____ homes

If 0 terminate interview.

4. What percentage of the homes that you design are for builder developers?

_____ % Builder _____ % Other

5. How many different builders did you or your company work with in 1998?

_____ Builders

6. What percentage of the homes you designed in 1998 were detached single family homes?

_____ % single family

7. New single family home construction is often classified as tract or custom. Approximately what percentage of the single family homes you designed in 1998 were for tract homes?

_____ % tract

8. Are you aware of the Title 24 requirements for residential new construction?

_____ no _____ yes

8A. Do you need to have a working knowledge of the requirements of Title 24?

_____ yes _____ no

If no, probe further to decide if we are talking to the right person.

Contact: _____

Title: _____

Phone: _____

Other: _____

9. What percentage of single family detached homes that you or your company designed in 1998 intentionally exceeded Title 24 requirements? _____% exceeded Title 24

9A. What percentage of these were tract homes? _____% tract

10. Is this a typical percentage for previous years, or has this percentage increased or decreased since 1991?

____ Increased

____ Decreased

____ Stayed about the same

____ Do not know

10A. Increased/decreased by how much?

10B. What is the main reason for these changes?

10C. When did these changes take place?

11. For single family detached homes that you or your company designed in 1998 that intentionally exceeded Title 24, what methods were used to exceed Title 24? [*heavier insulation, high efficiency equipment*]

11A. Have the methods used to exceed Title 24 changed since 1991?

____ no

____ yes

11A1. Please explain the changes.

11A2. When did these changes take place? _____year

12. Do you think you will continue to design homes that exceed Title 24?

____ yes 12A. About how many (or what %) per year?

____ no 12B. Why not?

13. What do you think are the advantages and disadvantages of homes that exceed minimum Title 24 requirements?

Awareness of the RNC Program and Attribution to DSM Programs

Some government agencies, nonprofit organizations and utilities sponsor programs or services designed to encourage the installation of high efficiency equipment and shell measures in new homes.

14. Are you aware of any such programs?

no [Go to Q17]

yes 14A. Who sponsored these programs?

14B. When were these programs offered?

14C. Please describe the programs.

15. How do you keep abreast of energy efficiency standards and the requirements of these types of programs in California and other states?

15A. Has this approach changed since 1991?

no

yes Q15B. When?

Q15C. How has it changed?

16. Have you or your company made any changes to your business practices as a result of these programs?

yes no

[If yes to Q16] 16A. Please describe these changes.

[If yes to Q16] 16B. Which features of the programs were the main reasons for implementing these changes?

[If yes to Q16] 16C. Have you continued or will you continue these practices even without these programs? yes no

16C1. Why or why not?

[if no to Q 16] 16D. What is the main reason you have not made any permanent changes?

Probe for answers that tie into list of applicable market barriers.

Pacific Gas & Electric has offered residential homebuilders incentives to install high efficiency windows.

17. Have you heard of PG&E' s Comfort Home Program, PG&E' s Comfort Home Plus Program, or EPA' s ENERGY STAR New Homes Program?

yes Comfort Home yes Comfort Home Plus
yes ENERGY STAR New Homes no [Go to Q21]

[If yes to Comfort Home Plus and yes to Energy Star New Homes]

17A. Do you know about ENERGY STAR as a result of the Comfort Home Plus Program or apart from it?

18. When did you first hear about this(these) program(s)?

1992 1993 1994 1995
1996 1997 1998 Don't know

19. Are any of these programs directly responsible for any of the changes you described to business practices?

no
 yes [if yes] 19A. Which program?

19B. Please describe the changes directly attributable to any of these programs.
(If not directly obvious which changes from Q29 respondent is referring to, probe for when the change took place, which program it is attributable to and whether or not it will continue).

20. Have the builders you or your company contracts with made any changes to their building practices as a result of these programs?

yes no

[if yes to Q20] 20A. Please describe these changes.

[if yes to Q20] 20B. Which features of the programs were the main reasons for implementing these changes?

[if yes to Q20] 20C. Do you think they will continue these practices even without these programs? yes no

20C1. Why or why not?

Probe for answers that tie into list of applicable market barriers.

[if yes to Comfort Home Plus or yes to Energy Star New Homes in Q17].

21. What percentage of new single family detached homes designed by your company in Northern/Central California in 1998 intentionally qualified as an ENERGY STAR[®] Home?

____% ENERGYSTAR[®] homes **[If 0% , Go to Q22]**

21A. Did all of these receive an ENERGY STAR New Home certificate?

If not all, why not?

21B. Is this a typical percentage for previous years, or has this percentage increased or decreased since 1990?

____ Increased – By how much?

____ Decreased – By how much?

____ Stayed about the same

____ Do not know

21C. What do you feel is(are) the main reason(s) for this(these) change(s)?

21D. When did these changes take place?

22. What methods/specifications were used in order for these homes to qualify as ENERGY STAR[®] homes? (heavier insulation, high efficiency equipment)

22A. Have the methods changed since 1991?

22A1. Please explain the changes.

22A2. When did these changes take place? ____ year

23. Do you know what the CHEERS rating requirement is for a newly constructed home to qualify as an ENERGY STAR home?

24. Do you think you will continue to design ENERGY STAR[®] homes?

____ yes – About how many per year, or what %?

____ no – Why not?

Influence on Use of Energy-Efficient Measures

25. For the following list of equipment and shell features do you consider yourself *very aware*, *somewhat aware* or *not at all aware* of the latest available energy saving high efficiency technologies?

	Very Aware	Somewhat Aware	Not At All Aware
High efficiency air conditioning	*	*	*
Gas furnaces	*	*	*
High efficiency windows	*	*	*
Insulation	*	*	*
Duct testing	*	*	*
Duct sealing	*	*	*

26. What is the primary source of your information on new technologies?

27. Do you get specific questions from builders or consumers regarding energy efficiency?

28. When your clients have an interest in energy efficiency, do they request at the outset that high efficiency measures be built into the project?

29. How influential would you say Architects are in assisting builders who want to build to energy efficiency standards that exceed Title 24?

- Very influential
- Somewhat influential
- Not very influential
- Not at all influential
- Don't know

29A. In what ways do you feel architects are **[answer from Q29]** influential?

30. When you are designing homes, do you have the opportunity to suggest to your clients to specify equipment and shell measures that exceed minimum Title 24 requirements?

yes no

[If Yes to Q30] 30A. Have you ever done this?

yes no

[If No to Q30A] 30A1. Why not?

[If Yes to Q30A] 30A2. When you did suggest exceeding Title 24, was your suggestion followed? ___ yes ___ no

[If Yes to Q 30A] 30A3. Why or why not?

31. Is there anything that you as an Architect are doing now that is particularly helpful to builders who want to exceed Title 24 standards?

32. Are there any changes Architects could make that would encourage builders to exceed Title 24? ___ yes ___ no

[If Yes to Q32] 32A. Please describe the changes.

[If Yes to Q32] 32B. Have you had the opportunity to make any of these changes in your business?

[If Yes to Q32B] 32B1. Which changes did you make?

[If Yes to Q32B] 32B2. Why did you make them?

[If Yes to Q32B] 32B3. When did you make them?

[If No to Q32B] 32B4. What is the main reason you did not make any of these changes?

Perception of Homebuyer Attitudes

33. Based upon your experience in the residential new construction market, how much demand is there from homebuyers for energy saving equipment or features?

___ A lot

___ Some

___ Very little

___ None

___ Do not know

[if “Very little” to “None” for Q33] 33A. What do you feel are the major factors for such little demand?

34. Has customer demand for energy saving features increased, decreased, or stayed about the same since 1990?

- Increased
- Decreased
- Stayed about the same
- Do not know

[if “Increased” or “Decreased” for Q34] 34A. What do you feel are the major factors that have led to this increase/decrease?

35. What practices would you suggest that could be implemented to stimulate buyer demand for homes that exceed Title 24?

Need to explore for answers other than reduction in cost.

36. In your opinion, what would it take to increase homebuilders’ willingness to build homes with energy saving features that exceed Title 24?

Need to explore for answers other than reduction in cost.

37. In your opinion, do homebuyers expect new homes to be energy efficient?

- yes no

38. Based upon your experience, what energy saving features are homebuyers most likely to look for in a new home?

39. Have the features homebuyers looked for changed since 1990?

- no
- yes

39A. What changes have you noted?

39B. When did these changes take place?

40. If you designed a home to use 10% less energy than a similar home designed to just meet Title 24 standards, how much extra would this cost (the builder) without any financial incentives?

_____dollars

41. What percentage of this cost do you think the homebuyer would be willing to pay?

_____%

Perceptions on Energy Efficiency

42. On a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, please indicate how important each of the following reasons are for why a builder would not build a house that exceeds Title 24 requirements.

	Not At All Important	1	2	Somewhat Important	3	4	Very Important	5
Cost	1	2	3	4	5			
Lack of information on energy efficient measures	1	2	3	4	5			
Energy efficient products are not available	1	2	3	4	5			
Difficulty in choosing among options for energy efficient measures	1	2	3	4	5			
Hassle	1	2	3	4	5			
Financing	1	2	3	4	5			
Other	1	2	3	4	5			

Please Describe: _____

Title 24 Consultants

The target was to complete a total of five interviews with Title 24 consultants. Subsection C.15 details the sampling procedures and interviewing protocols for interviewing Title 24 consultants. Subsection C.16 presents the completed sample size and provides a list of the interview respondents.

Title 24 consultants work with builders and architects to ensure compliance with local building codes. Previous studies have shown that Title 24 consultants are typically knowledgeable and influential regarding energy efficient measures, and they may influence builders' and architects' decisions regarding the types of energy efficient measures used in their new homes.

C.15 Sample and Interview Protocol for Title 24 Consultants

Sampling. The target was to complete five interviews with Title 24 consultants in the PG&E service area. The sample of Title 24 consultants was constructed by referrals from PG&E and builders along with the member list from California Association of Building Energy Consultants (CABEC).

Protocol. All referrals (particularly from PG&E and builders) were considered to be “priority” sample points and a strong attempt was made to recruit these consultants for participation. A referred contact was removed from the sample after five unsuccessful contacts/recruit attempts. A non-referred contact was removed from the sample after four unsuccessful contacts/recruit attempts.

C.16 Completed Interview Sample for Title 24 Consultants

Completed interviews were obtained for seven Title 24 consultants in the PG&E service territory from a total of roughly 8 that were contacted, yielding a response rate of 88%. Table C-8 lists the business name and the location name for the Title 24 consultants that completed interviews.

Table C-8: Completed Interview Sample for Title 24 Consultants

Business Name	Location
Consul, Inc.	Fresno
Accurate Energy	Sacramento
Title 24 Consulting	Fresno
Enercalc	Hesperia
California Living and Energy	Fresno
Beutler Heating & Air Conditioning	Sacramento
Donald P Dick Heating and A/C	Fresno

Title 24 Consultants

Title 24 Consultants work with builders and architects to ensure compliance with local building codes. Previous studies have shown that Title 24 Consultants are typically knowledgeable and influential regarding energy efficient measures, and they may influence builders' and architects' decisions regarding the types of energy efficient measures used in their new homes. Title 24 Consultants in the Comfort Home area will be interviewed to ascertain their role in the RNC market and to test specific hypotheses regarding their function in the market.

Introduction

Hello. My name is _____. I'm calling on behalf of PG&E. May I please speak to _____?

Hello. My name is _____. I'm calling on behalf of PG&E. We are conducting a study to better understand the market for new homes in Northern and Central California. We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: verify respondent has experience with residential new construction market

If No: thank and terminate

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Before we get started, I have a few questions about your background.

1. What is the scope of services offered by your company?

2. Do you work independently or with a company?

_____ Independent contractor _____ Work with a company

2A. How long have you been with your present company?

(if not long, probe for how long respondent has been an Title 24 consultant)

2B. What is your primary function?

2C. How many Title 24 consultants work in your company? _____ Title 24 consultants

Business Practices

The following questions relate to your or your company's business practices.

3. How many different building companies did you or your company work with in 1998?

_____ builders

4. How many residential building plans did you or your company review in 1998?

_____ residential building plans

If 0, ask if review residential plans at all. If Not, terminate interview.

4A. What percentage of the home plans you reviewed in 1998 were for detached single family homes? _____% single family

4B. New single family home construction is often classified as tract or custom. Of the single family home plans you reviewed in 1998, approximately what percentage were for tract homes?

_____ % tract

5. How do you currently report the results of your Title 24 compliance review to builders?
(probe for prescriptive or performance method? What software is used?)

6. In your current practices, do you report results of your Title 24 compliance review in different ways to different builders you work with?

___ no

___ yes 6A. Please describe the differences.

6B. What is the main reason you would report results differently to different builders?

6C. Do you expect this practice to continue? ___ no ___ yes

6D. If Yes, why? If No, why not?

7. What percentage of single family home plans reviewed by you or your company in 1998 intentionally **exceeded** Title 24 requirements? _____% exceeded **[If None, go to Q13]**

7A. What percentage of these were tract homes? _____% tract

8. Is this a typical percentage for previous years, or has this percentage increased or decreased since 1990?

- Increased – By how much?
- Decreased – By how much?
- Stayed about the same **[Go to Q11]**
- Do not know **[Go to Q11]**

8A. What is(are) the main reason(s) for this change?

8B. When did this change take place?

9. For single family home plans that you or your company reviewed in 1998 that intentionally exceeded Title 24, what methods were used to exceed Title 24? [*heavier insulation, high efficiency equipment; explain this is not about trade-offs but intentionally exceeding Title 24*]

9A. Have the methods used to exceed Title 24 changed since 1990?

- no
- yes

9A1. Please explain the changes.

9A2. What prompted these changes?

9A3. When did these changes take place? ___ year

10. Do you think builders will continue to build homes that exceed Title 24?

no 10A. Why not?

yes 10B. About how many (or %) per year will they build?

11. What do you think are the advantages and disadvantages of homes that exceed minimum Title 24 requirements?

Awareness of the Comfort Home Program and Attribution to DSM Programs

Some government agencies, nonprofit organizations and utilities sponsor programs or services designed to encourage the installation of high efficiency windows in new homes.

12. Are you aware of any such programs?

- no **[Go to Q15]**

___ yes 12A. Who sponsored these programs?

12B. When were these programs offered?

12C. Please describe the programs.

13. How do you keep abreast of energy efficiency standards and the requirements of these types of programs in California and other states?

13A. Has this approach changed since 1991?

___ no

___ yes

Q13B. When?

Q13C. How has it changed?

14. Have you or your company made any changes to your business practices (**sales, marketing, distribution**) as a result of these programs?

___ yes ___ no

[If Yes to Q14] 14A. Please describe these changes.

[If Yes to Q14] 14B. Which features of the programs were the main reasons for implementing these changes?

[If Yes to Q14] 14C. Have you continued or will you continue these practices even without these programs? ___ yes ___ no

14C1. Why or why not?

[If No to Q14] 14D. What is the main reason you have not made any permanent changes?

Probe for answers that tie into list of applicable market barriers.

Pacific Gas & Electric has offered residential homebuilders incentives to install high efficiency windows.

15. Have you heard of PG&E' s Comfort Home Program, PG&E' s Comfort Home Plus Program, or EPA' s ENERGY STAR New Homes Program?

___yes Comfort Home

___yes Comfort Home Plus

___yes ENERGY STAR New Homes

___no **[Go to Q19]**

[If Yes to Comfort Home Plus and Yes to ENERGY STAR New Homes]

15A. Do you know about ENERGY STAR as a result of the Comfort Home Plus Program or apart from it?

16. When did you first hear about this(these) program(s)?

1992 1993 1994 1995
 1996 1997 1998 Don't know

17. Are any of these programs directly responsible for any of the changes you described to business practices?

no
 yes **[If Yes]** 17A. Which program?

17B. Please describe the changes directly attributable to any of these programs.
(if not directly obvious which changes from Q29 respondent is referring to, probe for when the change took place, which program it is attributable to and whether or not it will continue).

18. Have the builders you or your company contracts with made any changes to their building practices as a result of these programs?

yes no

[If Yes to Q18] 18A. Please describe these changes.

[If Yes to Q18] 18B. Which features of the programs were the main reasons for implementing these changes?

[If Yes to Q18] 18C. Do you think they will continue these practices even without these programs? yes no

18C1. Why or why not?

Probe for answers that tie into list of applicable market barriers.

(if yes to Comfort Home Plus or yes to ENERGY STAR New Homes in Q15)

19. What percentage of new single family detached homes designed by your company in Northern/Central California in 1998 qualified intentionally as an ENERGY STAR[®] Home?

% ENERGYSTAR[®] homes **[If 0% , go to Q24]**

19A. Did all of these receive an ENERGY STAR New Home certificate? If not all, why not?

19B. Is this a typical percentage for previous years, or has this percentage increased or decreased since 1990?

___ Increased – By how much?

___ Decreased – By how much?

___ Stayed about the same **[Go to Q29]**

___ Do not know **[Go to Q20]**

19B. What do you feel is[are] the main reason[s] for this[these] change[s]?

19C. When did these changes take place?

20. What methods/specifications were used in order for these homes to qualify as ENERGY STAR[®] homes? (*heavier insulation, high efficiency equipment*)

20A. Have the methods changed since 1991?

20A1. Please explain the changes.

20A2. When did these changes take place? ____ year

21. Do you know what the CHEERS rating requirement is for a newly constructed home to qualify as an ENERGY STAR home?

22. Do you think the builders you work for will continue to build ENERGY STAR[®] homes?

___ yes → About how many per year, or what %?

___ no → Why not?

23. Do you see any benefit in Title 24 Consultants and CHEERS analysts working together?

Influence on Use of Energy-Efficient Measures

24. For the following list of equipment and shell features do you consider yourself *very aware*, *somewhat aware* or *not at all aware* of the latest available energy saving high efficiency technologies?

	Very Aware	Somewhat Aware	Not At All Aware
Gas furnaces	*	*	*
High efficiency air conditioning	*	*	*
High efficiency windows	*	*	*
Insulation	*	*	*
Duct testing	*	*	*
Duct sealing	*	*	*

25. What is the primary source of your information on new technologies?

26. How influential would you say Title 24 consultants are in assisting builders who want to build to energy efficiency standards that exceed Title 24?

- Very influential
- Somewhat influential
- Not very influential
- Not at all influential
- Don't know

26A. In what way(s) do you feel Title 24 consultants are **[answer from Q24]** influential?

27. When you are reviewing plans, do you have the opportunity to suggest to your clients to build to exceed the Title 24 standards?

no **[Go to Q28]**

yes

27A. Have you ever done this?

no 27A1. Why not?

yes 27A2. When you have suggested that the builder exceed Title 24, was your suggestion followed?

yes no

27A3. Why or why not?

28. Is there anything that you as a Title 24 consultant are doing now that is particularly helpful to builders who want to exceed Title 24?

29. Are there any changes consultants could make that would encourage builders to specify equipment and shell measures to exceed minimum Title 24 requirements?

no

yes

[If Yes to 29] 29A. Please describe the changes.

[If Yes to 29] 29B. Have you had the opportunity to make any of these changes in your business? yes no

[If Yes to Q29B] 29B1. Which changes did you make?

[If Yes to Q29B] 29B2. Why did you make them?

[If Yes to Q29B] 29B3. When did you make them?

[If No to Q29B] 29B4. Why not?

Perception of Homebuyer Attitudes

30. Based upon your experience in the residential new construction market, how much demand is there from homebuyers for energy saving equipment or features?

A lot

Some

Very little

None

Do not know

[If "Very little" to "None" for Q30] 30A. What do you feel are the major factors for such little demand?

31. Has customer demand for energy saving features increased, decreased, or stayed about the same since 1991?

Increased

Decreased

Stayed about the same

Do not know

[If “Increased” or “Decreased” for Q 31] 31A. What do you feel are the major factors that have led to this increase/decrease?

32. What practices would you suggest that could be implemented to stimulate buyer demand for homes that exceed Title 24?

Need to explore for answers other than reduction in cost.

33. In your opinion, what would it take to increase homebuilders’ willingness to build homes with energy saving features that exceed Title 24?

Need to explore for answers other than reduction in cost.

34. In your opinion, do homebuyers expect new homes to be energy efficient?

___ yes ___ no

35. Based upon your experience, what energy saving features are homebuyers most likely to look for in a new home? (*do not read from list*)

- ___ None
- ___ High efficiency windows [double or triple pane]
- ___ Efficient A/C
- ___ Efficient heating
- ___ Efficient water heaters
- ___ Insulation beyond Title 24 [wall, ceiling, and/or floor]
- ___ Other [please describe]

36. Have the features homebuyers looked for changed since 1990?

___ no
___ yes 34A. What changes have you noted?

34B. When did these changes take place?

37. If a home was built was designed to use 10% less energy than a similar home built to meet Title 24 standards, how much extra would this cost (the builder) without any incentives?

___ dollars

38. What percentage of this cost do you think the homebuyer would be willing to pay?

___ %

Perceptions on Energy Efficiency

39. On a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, please indicate how important each of the following reasons are for why a builder would not build a house that exceeds Title 24 requirements.

	Not At All Important	2	Somewhat Important	4	Very Important
Cost	1	2	3	4	5
Lack of information on energy efficient measures	1	2	3	4	5
Energy efficient products are not available	1	2	3	4	5
Difficulty in choosing among options for energy efficient measures	1	2	3	4	5
Hassle	1	2	3	4	5
Financing	1	2	3	4	5
Other	1	2	3	4	5

Please Describe _____

Builders

The target was to complete a total of 30 interviews with builders in northern and central California and 50 interviews in the control area. Subsection C.17 details the sampling procedures and interviewing protocols for interviewing the builders. Subsection C.18 presents the completed sample size and provides a list of the interview respondents.

As the market actors with the ultimate decision making power, builders and developers are the most important decision makers in regards to efficiency choices offered to the homebuyer in newly constructed single-family detached homes.

C.17 Sample and Interview Protocol for Builders

Sampling. The target was to interview 30 builders in northern and central California and 50 in the control area. The sample of builders in northern and central California was constructed from a builder list provided by PG&E, member lists from the National Association of Home Builders, Homes for Sale magazine, and the Yellow Pages. The sample of builders in the control area was constructed from trade association membership lists and Internet research with follow-up telephone calls to identify large residential builders in each area. Consideration was given for both samples to include “large” and “small” companies using either the number of developments in progress, the number of employees, or the number of electrical connections and/or sales in 1998 as criteria.

Protocol. Contacts were screened in an attempt to interview the person with the best overall knowledge of the builder’s decision making process, especially regarding decisions related to energy efficiency measures. An emphasis was also placed on securing interviews with builders from the largest companies. A contact was only removed from the sample after six unsuccessful contacts/recruit attempts due to the importance of these interviews.

The initial survey protocol did not include the use of incentives. Due to the stringent timeframes and lack of willingness to participate in the interviews, builders, especially those in the control area, were offered an incentive of \$50 to participate.

C.18 Completed Interview Sample of Builders

Northern and Central California

Completed interviews were obtained for 31 builders in northern and central California from a total of 81 that were contacted, yielding a response rate of 38%. Table C-9 lists the builder's business name, the respondent's title, and whether or not the builder reported being a PG&E Comfort Home program participant.

Table C-9: Completed Interviews for Northern California Builders/Developers

Business Name	Respondent's Title	PCH Participant
B&D Partners	Owner	Yes
Blackhawk Corp.	Project Manager	Yes
Bright Development	Project Manager	No
Brookfield Homes	Director of Planning	No
California Homes	Construction Manager	Yes
Centex Homes	Purchasing/Value Engineering	Yes
Centex Homes	Production Manager	Yes
Cresleigh Homes	General Superintendent	Yes
Custom Builder	Custom Builder	Yes
Custom Builder	Custom Builder	Yes
Custom Builder	Builder/Owner	Yes
Custom Builder	Builder	Yes
David Turner Homes	Owner/Builder	Yes
Elliot Homes	President/Builder/Owner	No
Frontiers	Project Manager	Yes
Granville Homes Inc.	Superintendent	Yes
Greco Development Co.	Partner	Yes
Greystone Homes	Project Manager	No
H.D. Arnaiz Corp.	Construction Manager	Yes
Jerry L. Knighten Construction	Project Manager	Yes
Keystone	Builder	Yes
Laurel Assoc.	Design Specification	Yes
Luciano Construction	Owner	Yes
Pulte Homes	Construction Manager	Yes
Renaissance homes	Director of Operations	Yes
SCM	VP of Construction	No
Self Help Enterprises	Building Supervisor	Yes
Shapell	In-house Architect	No
Spalding G. Wathen	Construction Manager	Yes
Stanley Davis	Junior Partner	Yes
US Homes	Vice President of Purchasing	Yes

Control Area

Completed interviews were obtained for 52 builders in the control area from a total of 218 that were contacted, yielding a response rate of 24%. Table C-10 lists the state, major city, builder's business name, and the respondent's title for the builders in the control area that completed interviews.

Table C-10: Completed Interviews for Builders/Developers in the Control Area

State	City	Business Name	Respondent's Title
AZ	Phoenix	Classic Stellar Homes	Co-Owner
	Phoenix	Medallion	President
	Phoenix	Saddleback	President
	Tucson	A1 Builder	President
	Tucson	Redman Industries	Sales and Marketing Manager
	Tucson	US Homes	VP or Purchasing
CO	Ft. Collins	Parkside Homes	Owner
	Ft. Collins	Rossi Homes	Owner
FL	Miami	Breakstone Group	Builder/Develop
	Miami	Lennar Homes	Director of Construction
	Miami	Watermark Communities	Purchasing Manager
	Tampa	Akers Customs Homes	President
	Tampa	Bob Segers Homes	General Manager
	Tampa	Cornerstone Home Builders	Owner
	Tampa	Suarez Housing	Purchasing Manager
GA	Atlanta	Bry Mel Homes Inc.	Owner/Developer
	Atlanta	Emerald Forest	Owner/Builder
	Atlanta	Hearthstone Group	Office Manager
	Atlanta	John Wieland Homes	Director of Production
NV	Las Vegas	Astoria	VP of Purchasing
	Las Vegas	Dell Webb Corp.	Manager of Housing Operations
	Las Vegas	Pageantry Communities	VP of Marketing
	Reno	Barker Homes	Office Manager
	Reno	Merit Homes	Office Manager
	Reno	Pearce Construction	Accounts Payable
NY	Rochester	RDC	Project Manager
	Rochester	Valley Homes Rochester	President
	Rochester	Woodshire Homes	VP/Co-Owner
NC	Charlotte	Centex Homes	Construction Manager
	Charlotte	D&D Construction	Project Manager
	Charlotte	Hobart Smith Builders	President
	Charlotte	Jordan Homes	Administrative Assistant
	Charlotte	Prestige Building Co.	President/Owner

Table C-10 (cont'd): Completed Interviews for Builders/Developers in the Control Area

State	City	Business Name	Respondent's Title
TX	Austin	Clark Wilson Homes	VP of Operations
	Austin	Huffman Homes	Project Manager
	Austin	Mangum Home	President
	Austin	Streetman Homes	Purchaser/Construction Coordinator
	Dallas	American Signature Homes	Owner
	Dallas	Axxium	Owner/Manager
	Dallas	Bentwood Custom Homes	President
	Dallas	DR Horton	Division Sales Manager
	Dallas	Hawkins Wellwood Homes	Plan Review
	Dallas	Standard Pacific Homes	Sales Manager
	Houston	Centex Homes	Estimation/Purchasing
	Houston	David Weekly Houston	Project Manager
	Houston	Pulte Homes	Warranty Service Manager
	San Antonio	Bailey Owen Homes	Owner
	San Antonio	Continental Homes of Texas	Construction Manager
	San Antonio	Flair Homes	Project Manager
	San Antonio	Japhet Homes	Purchasing Manager
	San Antonio	Prestige Homes	Supervisor
	San Antonio	Ryland Bldrs.	Construction Manager

Interview Guide for Builders and Developers in Northern/Central California

Research Objective

Builders and developers are key decision makers relating to efficiency choices in new construction. The interview is designed to aid in the assessment of market effects relating to perceptions, decision making, operational procedures, and behavior. The objective of these interviews is to identify key characteristics of the regional residential new construction market, assess awareness levels, discern efficiency choice criteria, decision-making practices, and evaluate general market perceptions.

Introduction

Hello. My name is _____. I'm calling on behalf of PG&E. May I please speak to _____?

Hello. My name is _____. I'm calling on behalf of PG&E. We are conducting a study to better understand the market for new homes in Northern California. We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: verify respondent has experience with residential new construction market

If No: thank and terminate

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Before we get started, I have a few questions about your background.

1. First, how long have you (and your company) been in the building industry?
2. How much of your time in the building industry has been in Northern California?
3. What are your responsibilities in your current position?

Residential New Home Construction Market

First, we would like to get an overall understanding of your company's residential construction practices in the Northern California region. We are particularly interested in detached single family construction.

4. Approximately how many single family detached homes did your company build in 1998? [*Prompt for historical construction numbers which could be made available to our study effort*] ____ homes

5. What percentage of the single family detached homes built by your company in 1998 have gas service available?

____ %

Is this a typical of previous years or has this changed significantly since 1991?

6. Single family new construction is often classified as tract or custom. What percentage of the single family homes built by your company in 1998 are tract homes?

____ % tract single family homes

I would like to learn the home design and specification procedure and how you [your company] work with other market actors throughout this process.

7. Please explain the process your company goes through [from a blank set of plans] up to the point the plans and specs are finalized, the building permit is issued, and the house is sold? Who at your company makes the final specification decisions?

[Interviewer would need to probe about the roles of the following market actors in the design and specification process. Questions might include: What role does this person have? How much input do they have in specification decisions? Has their role or responsibility changed over the years? How? What influenced the change(s)?]

Internal Staff (regional manager, project manager, corporate HQ, etc...),

Architect

Design Consultant

Title 24 Consultant

Contractors

Building Department Staff

Sales Department

Consumer

8. In approximately what percentage of new homes you completed in 1998 did the following people make the equipment and/or shell measure specification decisions?

- ____ % Homebuyer
- ____ % Architect
- ____ % Title 24 consultant
- ____ % Contractor
- ____ % You [builder developer]
- ____ % Other – who?

[if homebuyer > 0 in Q8] 8A. You mentioned that homebuyers make the equipment/shell measure decisions __% of the time. Under what circumstances are homebuyers able to select their equipment? [*Do you offer equipment allowances or packages? Are these choices offered to all homebuyers?*]

[if homebuyer > 0 in Q8] 8B. What arrangements are made for these decisions? [*Is there a pre-approved list of equipment. Do they get a budget, or are there different packages?*]

Current Practices and Awareness of Title 24

9. What influences the decisions you make with respect to the energy efficiency levels of equipment and shell measures in new homes built by your company? (*Probe: What is the strongest influence?*)

The following questions relate to your company’ s building practices. We are particularly interested in the building practices relative to California’ s Title 24 energy efficiency requirements.

10. Are you aware of the Title 24 requirements for residential new construction?

- ____ no (*Probe further to decide if we are talking to the right person*)
- ____ yes

10A. Do you have a working knowledge of the requirements of Title 24 requirements?

- ____ yes
- ____ no → *Get appropriate contact*

Contact: _____
Title: _____
Phone: _____
Other: _____

10B. What method do you use to comply with Title 24? [*Interviewer might need to explain methods.*]

___ Prescription

___ Performance → Do you use a software package? Which one?

11. What percentage of single family homes built by your company in Northern California in 1998 exceed Title 24 requirements? [*Interviewer might need to explain that we understand that it is not possible to exactly meet Title 24. We want to know the % of homes built that intentionally exceeded the minimum requirements.*]

___% exceed **[If 0% , go to Q15.]**

11A. Is this a typical percentage for previous years, or has this percentage increased or decreased since 1991?

___ Increased – By how much?

___ Decreased – By how much?

___ Stayed about the same **[Go Q11D]**

___ Do not know **[Go Q11D]**

11B. What do you feel is[are] the main reason[s] for this[these] change[s]?

11C. When did these changes take place?

11D. What percentage of single family homes built by your company in 1998 that exceed Title 24 requirements are tract homes?

___% tract

12. For single family homes that your company built in 1998 that [intentionally] exceeded Title 24, what methods were used to exceed Title 24? (*i.e., heavier insulation, high efficiency equipment*)

12A. Have the methods used to exceed Title 24 changed since 1991?

___ no, methods are the same now as in 1991 **[Go to Q13]**

___ yes, methods are different now than in the past

12A1. Please explain the changes.

12A2. What prompted these changes?

12A3. When did these changes take place? ___ year

13. Do you market the homes that [intentionally] exceed Title 24 any differently than you market homes that just meet the minimum Title 24 requirements?

no **[Go to Q14]**

yes

13A. Please explain the differences.

13B. What has been the response by buyers to the homes that exceed Title 24?

14. Will your company continue to build homes that [intentionally] exceed Title 24?

yes → About how many per year, or what %?

no → Why not?

Awareness of the RNC Program and Attribution to DSM Programs

Some government agencies, non-profit organizations and utilities sponsor programs or services designed to encourage the installation of high efficiency appliances and shell measures in new homes.

15. Are you aware of any such programs?

no **[Go to Q18]**

yes 15A. Who sponsored these programs?

15B. When were these programs offered?

15C. Please describe the programs.

16. How do you keep abreast of energy efficiency standards and the requirements of these types of programs in California and other states?

16A. Has this approach changed since 1991?

no

yes 16B. When?

16C. How has it changed?

17. Have you or your company made any changes to your business practices (**sales, marketing, distribution**) as a result of these programs?

yes no

[If Yes to Q17] 17A. Please describe these changes.

[If Yes to Q17] 17B. Which features of the programs were the main reasons for implementing these changes?

[If Yes to Q17] 17C. Have you continued or will you continue these practices even without these programs? yes no

17C1. Why or why not?

[If No to Q17] 17D. What is the main reason you have not made any changes?

Probe for answers that tie into list of applicable market barriers.

Pacific Gas & Electric has offered residential homebuilders incentives to install high efficiency appliances and shell measures.

18. Have you heard of PG&E' s Comfort Home Program, PG&E' s Comfort Home Plus Program, or EPA' s ENERGY STAR New Homes Program?

yes Comfort Home yes Comfort Home Plus
yes ENERGY STAR New Homes no **[Go to Q24]**

[If Yes to Comfort Home Plus and yes to ENERGY STAR New Homes]

18A. Do you know about ENERGY STAR as a result of the Comfort Home Plus Program or apart from it?

19. Are you aware of the requirements for any of these programs? yes no

20. Has your company participated in either the Comfort Home or Comfort Home Plus Program?

no → What is the main reason your company did not participate? **[Go to Q24]**
 yes

20A. Which program?

20B. What was the main reason your company participated?

20C. In what years did your company participate?

1992 1993 1994 1995 1996
 1997 1998 Don't know

20D. Approximately what percentage of single family tract homes were built under this program in the first year your company participated? In 1998?

% in first year % in 1998

[If less than 100% to Q20D] 20D1. What is the main reason your company did not build all homes under the program? [*Is your company participating in some counties and not in others? If so which ones and why? Is the program more attractive for some developments than for others? What is the cause of this feature?*]

[If different percentage to Q20D] 20D2. What was the cause of the increase or decrease over time? [*Was this caused by specific features of the program?*]

20E. Did you build some homes under the Base Program only, under the Plus Program only, and under both programs? [*Check all that apply and discuss reasons for using one program rather than the other, or using both.*]

Base program only
 Plus program only
 Both programs

20F. Would you continue to participate in the Comfort Home or Comfort Home Plus Programs if financial incentives are no longer available but promotional resources and marketing information is provided?

yes
 no → Why not?

21. Has your company made any changes to its building practices in Northern California as a result of participating in PG&E' s Comfort Home Base and/or Plus program?

no

21A. What do you feel are the primary reasons that your company has not made any changes? [*Probe for answers that tie into list of applicable market barriers*]

yes

21B. Please describe these changes.

21C. Which feature of the Comfort Home program was the main reason for implementing these changes?

21D. Have you continued or will you continue these practices in the future even without the program? yes no

[If Q14 > 0 and if Q20 = NO (if built ENERGY STAR[®] Homes, but did not participate in program) Else, Go to Q23]

22. Please explain reasons why your company built ENERGY STAR[®] homes but did not participate in PG&E's Comfort Home program.

23. Have the contractors you or your company work with made any changes to their business practices as a result of these programs?

yes no

[If Yes to Q23] 23A. Please describe these changes.

[If Yes to Q23] 23B. Which features of the programs were the main reasons for implementing these changes?

[If Yes to Q23] 23C. Do you think they will continue these practices even without these programs? yes no

23C1. Why or why not?

Probe for answers that tie into list of applicable market barriers.

[If Yes to Comfort Home Plus or yes to ENERGY STAR New Homes in Q18]

24. What percentage of new single family detached homes built by your company in Northern/Central California in 1998 intentionally qualified as an ENERGY STAR[®] Home?

% ENERGY STAR[®] homes **[If 0% , go to Q29]**

24A. Did all of these receive an ENERGY STAR New Home certificate? If not all, why not?

yes no

24A1. Is this a typical percentage for previous years, or has this percentage increased or decreased since 1991?

- Increased – By how much?
- Decreased – By how much?
- Stayed about the same [**Go to Q24D**]
- Do not know [**Go to Q24D**]

24B. What do you feel is[are] the main reason[s] for this[these] change[s]?

24C. When did these changes take place?

24D. What percentage of these ENERGY STAR homes are tract homes?

25. What methods/specifications were used in order for these homes to qualify as ENERGY STAR[®] homes? [heavier insulation, high efficiency equipment]

25A. Have the methods changed since 1991?

25A1. Please explain the changes.

25A2. When did these changes take place? _____ year

26. Do you market the ENERGY STAR[®] homes or CHEERS rated homes any differently than homes not qualified as ENERGY STAR[®] homes?

- no [**Go to Q28**]
- yes → Please explain the differences

26A. What has been the response by buyers to the homes that exceed Title 24?

27. Do you know what the CHEERS rating requirement is for a newly constructed home to qualify as an ENERGY STAR home?

28. Do you think you will continue to build ENERGY STAR[®] homes?

- yes → About how many per year, or what %?
- no → Why not?

HVAC and Water Heating Equipment and Building Shell Measure Installation Decisions

Now I would like to ask some questions relating to the decision to install HVAC equipment and building shell measures.

29. For the following list of equipment and shell features do you consider yourself *very aware*, *somewhat aware* or *not at all aware* of the latest available energy saving [high efficiency] technologies?

	Very Aware	Somewhat Aware	Not At All Aware
High efficiency air cond.			
Gas furnaces			
High efficiency windows			
Insulation			
Duct testing			
Duct sealing			

30. What is the primary source of your information on new technologies?

31. On a scale of 1 to 5 with 1 meaning *not at all important* and a 5 meaning *very important*, how influential are the following in your choice of energy efficiency levels?

	Not At All Influential	1	2	Somewhat Influential	3	4	Very Influential	5
Recommendations of Title 24 contractor	1		2		3	4		5
Recommendations of HVAC contractors	1		2		3	4		5
Recommendations of distributors	1		2		3	4		5
Recommendations of manufacturers	1		2		3	4		5
Recommendations of architects	1		2		3	4		5
Recommendations of other in-house personnel	1		2		3	4		5
Recommendations from sales agents and realtors	1		2		3	4		5
Competition from other builders	1		2		3	4		5
Your own experience	1		2		3	4		5

32. As a builder or developer, when specifying the [*insert measure name here*] type, brand, manufacturer, etc., what are the important factors you consider? [*Need to probe for importance of homebuyer preferences, What about energy efficiency?*]

- ___ HVAC equipment
- ___ Windows
- ___ Wall, ceiling, and floor insulation

33. Do you purchase your air conditioners and windows directly from the manufacturer, from a distributor or is this function handled by a subcontractor?

	Manufacturer	Distributor	Subcontractor
Air conditioning			
Gas furnaces			
Windows			

Builder/Developer Perception of Homebuyer Attitudes

The following questions relate to the builder/developers perception of the homebuyer’s attitudes towards energy efficient equipment and features.

34. Based upon your experience in the residential new construction market, how much demand is there from homebuyers for energy saving equipment or features? [*Probe: Do homebuyers ever ask if a home meets or exceeds energy efficiency requirements?*]

- ___ A lot
- ___ Some
- ___ Very little
- ___ None
- ___ Do not know

[If very little to none for Q34] 34A. What do you feel are the major factors for such little demand?

35. Has customer demand for energy saving features increased, decreased, or stayed about the same since 1991?

- Increased
- Decreased
- Stayed about the same
- Do not know

[If increased or decreased for Q35] 35A. What do you feel are the major factors that have led to this increase/decrease?

36. What practices would you suggest that could be implemented to stimulate buyer demand for homes that exceed Title 24? [*Need to explore for answers other than reduction in cost*]

37. In your opinion, do homebuyers expect new homes to be energy efficient?

- yes no

38. Again, based upon your experience, what energy savings features are buyers most likely to look for in a new home? [*do not read from list*]

- None
- High efficiency windows [double or triple pane]
- Efficient A/C
- Efficient gas heating
- Efficient gas water heaters
- Beyond T24 insulation [wall, ceiling, and/or floor]
- Other [please describe]

39. Have the features homebuyers looked for changed since 1990?

- no
- yes

39A. What changes have you noted?

39B. When did these changes take place?

40. If you were to build a home that was designed to use 10% less energy than a similar home built to meet Title 24 standards, how much extra would this cost you, the builder, with out any financial incentives? dollars

41. What percentage of this cost do you think the homebuyer would be willing to pay?
 ____%
42. Assume for a moment that the **all buyers** would be willing to pay for homes that use 10% less energy than homes that meet Title 24. Is there anything that might get in the way of your company meeting buyer demand? [*Need to probe for possible problems associated technical issues, availability, subcontractor relations*]
43. Could you suggest anything that might help your company meet this demand?

Builders Perceptions on Energy Use

44. On a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, please indicate how important each of the following reasons is for not [intentionally] exceeding minimum Title 24 requirements.

	Not At All Important		Somewhat Important		Very Important
Cost	1	2	3	4	5
Lack of information on energy efficient measures	1	2	3	4	5
Energy efficient products are not available	1	2	3	4	5
Difficulty in choosing among options for energy efficient measures	1	2	3	4	5
Hassle	1	2	3	4	5
Financing	1	2	3	4	5
Other	1	2	3	4	5

Please Describe _____

45. Does your company have its own mortgage company?
 ____ no **[Go to Q 46]**
 ____ yes 45A. Does the mortgage company offer loan incentives for high efficiency homes? ____ yes ____ no

46. Do you have any other comments that you would like to share about the residential new construction industry, energy efficiency, and the Title 24 requirements?

Interview Guide for Builders and Developers Outside of Northern/Central California

Research Objective

Builders and developers are key decision-makers relating to efficiency choices in new construction. The interview is designed to aid in the assessment of market effects relating to perceptions, decision making, operational procedures, and behavior. The objective of these interviews is to identify key characteristics of the regional residential new construction market, assess awareness levels, discern efficiency choice criteria, decision-making practices, and evaluate general market perceptions.

Introduction

Hello. My name is _____. I'm calling on behalf of Pacific Gas & Electric, a utility in Northern California. May I please speak to _____?

Hello. My name is _____. I'm calling on behalf of Pacific Gas & Electric, a utility in Northern California. We are conducting a study to better understand the market for new homes in your area. We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: verify respondent has experience with residential new construction market

If No: thank and terminate

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Before we get started, I have a few questions about your background.

1. First, how long have you (and your company) been in the building industry?
2. How much of your time in the building industry has been in _____ (state or area)?
3. What are your responsibilities in your current position?

Residential New Home Construction Market

First, we would like to get an overall understanding of your company's residential construction practices in your region. We are particularly interested in detached single family construction.

4. Approximately how many single family detached homes did your company build in 1998? [*Prompt for historical construction numbers which could be made available to our study effort*] ____ homes

5. What percentage of the single family detached homes built by your company in 1998 have gas service available?

____ %

Is this a typical of previous years or has this changed significantly since 1991?

6. Single family new construction is often classified as tract or custom. What percentage of the single family homes built by your company in 1998 are tract homes?

____ % tract single family homes

I would like to learn the home design and specification procedure and how you [your company] work with other market actors throughout this process.

7. Please explain the process your company goes through [from a blank set of plans] up to the point the plans and specs are finalized, the building permit is issued, and the house is sold? Who at your company makes the final specification decisions?

[Interviewer would need to probe about the roles of the following market actors in the design and specification process. Questions might include: What role does this person have? How much input do they have in specification decisions? Has their role or responsibility changed over the years? How? What influenced the change(s)?]

Internal Staff (regional manager, project manager, corporate HQ, etc...),

Architect

Design Consultant

Energy Consultant

Contractors

Building Department Staff

Sales Department

Consumer

8. In approximately what percentage of new homes you completed in 1998 did the following people make the equipment and/or shell measure specification decisions?

- ____ % Homebuyer
- ____ % Architect
- ____ % Energy consultant
- ____ % Contractor
- ____ % You [builder developer]
- ____ % Other – who?

[If homebuyer > 0 in Q8] 8A. You mentioned that homebuyers make the equipment/shell measure decisions __% of the time. Under what circumstances are homebuyers able to select their equipment? [*Do you offer equipment allowances or packages? Are these choices offered to all homebuyers?*]

[If homebuyer > 0 in Q8] 8B. What arrangements are made for these decisions? [*Is there a pre-approved list of equipment. Do they get a budget, or are there different packages?*]

Current Practices and Awareness of Energy Codes

9. What influences the decisions you make with respect to the energy efficiency levels of equipment and shell measures in new homes built by your company? (*Probe: What is the strongest influence?*)

The following questions relate to your company's building practices. We are particularly interested in the building practices relative to your state's energy efficiency requirements.

10. Does your state or local area have a required energy code for residential new construction?

- ____ no **[Go to Q15]**
- ____ yes

10A. What is (are) the name of the code(s)?

10B. Do you have a working knowledge of the requirements of the code?

- ____ yes
- ____ no → *Get appropriate contact*

Contact: _____
Title: _____
Phone: _____
Other: _____

11. What percentage of single family homes built by your company in _____ (state or area) in 1998 exceed your area's energy code requirements? *[Interviewer might need to explain that we understand that it is not possible to exactly meet the energy code. We want to know the % of homes built that intentionally exceeded the minimum requirements.]*

____% exceed **[If 0% , go to Q15]**

11A. Is this a typical percentage for previous years, or has this percentage increased or decreased since 1991?

____ Increased – By how much?

____ Decreased – By how much?

____ Stayed about the same **[Go Q11D]**

____ Do not know **[Go Q11D]**

11B. What do you feel is[are] the main reason[s] for this[these] change[s]?

11C. When did these changes take place?

11D. What percentage of single family homes built by your company in 1998 that exceed energy code requirements are tract homes?

____% tract

12. For single family homes that your company built in 1998 that [intentionally] exceeded the energy code, what methods were used to exceed it? *(i.e., heavier insulation, high efficiency equipment)*

12A. Have the methods used to exceed the energy code changed since 1991?

____ no, methods are the same now as in 1991 **[Go to Q13]**

____ yes, methods are different now than in the past

12A1. Please explain the changes.

12A2. What prompted these changes?

12A3. When did these changes take place? ____ year

13. Do you market the homes that [intentionally] exceed the energy code any differently than you market homes that just meet the minimum code requirements?

____ no **[Go to Q14]**

____ yes

13A. Please explain the differences.

13B What has been the response by buyers to the homes that exceed the energy code?

14. Will your company continue to build homes that [intentionally] exceed the energy code?

___ yes → About how many per year, or what %?

___ no → Why not?

Awareness of and Attribution to DSM Programs

Some government agencies, nonprofit organizations and utilities sponsor programs or services designed to encourage the installation of high efficiency appliances and shell measures in new homes.

15. Are you aware of any such programs in your area?

___ no [Go to Q18]

___ yes 15A. Who sponsored these programs?

15B. When were these programs offered?

15C. Please describe the programs.

16. How do you keep abreast of energy efficiency standards and the requirements of these types of programs in your area?

16A. Has this approach changed since 1991?

___ no

___ yes 16B. When?

16C. How has it changed?

17. Have you or your company made any changes to your business practices (**sales, marketing, distribution**) as a result of these programs?

___ yes ___ no

[If yes to Q17] 17A. Please describe these changes.

[If yes to Q17] 17B. Which features of the programs were the main reasons for implementing these changes?

[If yes to Q17] 17C. Have you continued or will you continue these practices even without these programs? yes no

17C1. Why or why not?

[If no to Q17] 17D. What is the main reason you have not made any changes?

Probe for answers that tie into list of applicable market barriers.

18. Have you heard of the EPA's ENERGY STAR New Homes Program?

yes no **[Go to Q25]**

19. Do you know what the HERS rating requirement is for a newly constructed home to qualify as an ENERGY STAR home?

20. Has your company built ENERGY STAR homes?

no → What is the main reason your company did not build ENERGY STAR homes?
[Go to Q25]

yes

20A. What was the main reason your company built these homes?

20B. In what years did your company build them?

1992 1993 1994 1995 1996
 1997 1998 Don't know

21. What percentage of new single family detached homes built by your company in 1998 intentionally qualified as an ENERGY STAR Home?

% ENERGY STAR homes **[If 0% , go to Q25]**

21A. Did all of these receive an ENERGY STAR New Home certificate? If not all, why not?

21A1. Is this a typical percentage for previous years, or has this percentage increased or decreased since 1991?

Increased – By how much?

Decreased – By how much?

Stayed about the same **[Go to Q21D]**

Do not know **[Go to Q21D]**

- 21B. What do you feel is[are] the main reason[s] for this[these] change[s]?
- 21C. When did these changes take place?
- 21D. What percentage of these ENERGY STAR homes are tract homes?
22. What methods/specifications were used in order for these homes to qualify as ENERGY STAR homes? [heavier insulation, high efficiency equipment]
- 22A. Have the methods changed since 1991?
- 22A1. Please explain the changes.
- 22A2. When did these changes take place? ____ year
23. Do you market the ENERGY STAR homes any differently than homes not qualified as ENERGY STAR homes?
- ____ no **[Go to Q24]**
- ____ yes → Please explain the differences
- 23A What has been the response by buyers to the ENERGY STAR homes?
24. Do you think you will continue to build ENERGY STAR homes?
- ____ yes → About how many per year, or what %?
- ____ no → Why not?

HVAC and Water Heating Equipment and Building Shell Measure Installation Decisions

Now I would like to ask some questions relating to the decision to install HVAC equipment and building shell measures.

25. For the following list of equipment and shell features do you consider yourself *very aware*, *somewhat aware* or *not at all aware* of the latest available energy saving [high efficiency] technologies?

	Very Aware	Somewhat Aware	Not At All Aware
High efficiency Air Cond.			
Gas furnaces			
High efficiency windows			
Insulation			
Duct testing			
Duct sealing			

26. What is the primary source of your information on new technologies?

27. On a scale of 1 to 5 with 1 meaning *not at all important* and a 5 meaning *very important*, how influential are the following in your choice of energy efficiency levels?

	Not At All Influential	1	2	Somewhat Influential	3	4	Very Influential	5
Recommendations of energy consultants	1		2		3		4	5
Recommendations of HVAC contractors	1		2		3		4	5
Recommendations of distributors	1		2		3		4	5
Recommendations of manufacturers	1		2		3		4	5
Recommendations of architects	1		2		3		4	5
Recommendations of other in-house personnel	1		2		3		4	5
Recommendations from sales agents and realtors	1		2		3		4	5
Competition from other builders	1		2		3		4	5
Your own experience	1		2		3		4	5

28. As a builder or developer, when specifying the [*insert measure name here*] type, brand, manufacturer, etc., what are the important factors you consider? [*Need to probe for importance of homebuyer preferences, What about energy efficiency?*]

- ___ HVAC equipment
- ___ Windows
- ___ Wall, ceiling, and floor insulation

29. Do you purchase your air conditioners, furnaces and windows directly from the manufacturer, from a distributor or is this function handled by a subcontractor?

	Manufacturer	Distributor	Subcontractor
Air-conditioning			
Gas furnaces			
Windows			

Builder/Developer Perception of Homebuyer Attitudes

The following questions relate to the builder/developers perception of the homebuyer's attitudes towards energy efficient equipment and features.

30. Based upon your experience in the residential new construction market, how much demand is there from homebuyers for energy saving equipment or features? [*Probe: Do homebuyers ever ask if a home meets or exceeds energy efficiency requirements?*]

- ___ A lot
- ___ Some
- ___ Very little
- ___ None
- ___ Do not know

[If very little to none for Q30] 30A. What do you feel are the major factors for such little demand?

31. Has customer demand for energy saving features increased, decreased, or stayed about the same since 1991?

- Increased
- Decreased
- Stayed about the same
- Do not know

[If increased or decreased for Q31] 31A. What do you feel are the major factors that have led to this increase/decrease?

32. In your opinion, do homebuyers expect new homes to be energy efficient?

- yes no

33. Again, based upon your experience, what energy savings features are buyers most likely to look for in a new home? [*do not read from list*]

- None
- High efficiency windows [double or triple pane]
- Efficient A/C
- Efficient gas heating
- Efficient gas water heaters
- Insulation that exceeds energy codes [wall, ceiling, and/or floor]
- Other [please describe]

34. Have the features homebuyers looked for changed since 1991?

- no
- yes

34A. What changes have you noted?

34B. When did these changes take place?

35. If you were to build a home that was designed to use 10% less energy than a similar home built to meet standards, how much extra would this cost you, the builder, with out any financial incentives? dollars

36. What percentage of this cost do you think the homebuyer would be willing to pay?

%

37. Assume for a moment that the **all buyers** would be willing to pay for homes that use 10% less energy than homes that meet energy standards. Is there anything that might get in the way of your company meeting buyer demand? [*Need to probe for possible problems associated technical issues, availability, subcontractor relations*]
38. Could you suggest anything that might help your company meet this demand?

Builders Perceptions on Energy Use

39. On a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, please indicate how important each of the following reasons is for not [intentionally] exceeding minimum energy code requirements.

	Not At All Important	1	2	Somewhat Important	3	4	Very Important	5
Cost	1	2	3	4	5			
Lack of information on energy efficient measures	1	2	3	4	5			
Energy efficient products are not available	1	2	3	4	5			
Difficulty in choosing among options for energy efficient measures	1	2	3	4	5			
Hassle	1	2	3	4	5			
Financing	1	2	3	4	5			
Other	1	2	3	4	5			
Please Describe _____								

40. Does your company have its own mortgage company?
 ___ no **[Go to Q 41]**
 ___ yes 40A. Does the mortgage company offer loan incentives for high efficiency homes? ___ yes ___ no
41. Do you have any other comments that you would like to share about the residential new construction industry, energy efficiency, and the energy code requirements?

Building Inspectors

The target was to complete a total of ten interviews with building inspectors in the PG&E service territory. Subsection C.19 details the sampling procedures and interviewing protocols for interviewing building inspectors. Subsection C.20 presents the completed sample size and provides a list of the interview respondents.

Building inspection occurs at several stages of construction, in addition to a final general inspection at completion. Aside from general building inspectors, all municipalities employ numerous, more specialized field inspectors who check for building code compliance pertaining to specific aspects of construction. In particular, the electrical, plumbing, and mechanical inspectors inspect the electrical work, plumbing equipment, and HVAC systems, respectively, when the relevant stage of construction is completed.

In addition to field inspection, the plans of each project must be approved by the city/county building department *prior* to the groundbreaking. Building plans, containing equipment and shell specifications, are reviewed and inspected to ensure the building comply with state and federal building codes.

C.19 Sample and Interview Protocol for Building Inspectors

Sampling. The target was to complete ten interviews with building inspectors, plan reviewers, and building officials in each the PG&E service territory. The sample of inspectors was obtained by contacting the building departments in the PG&E service area. These included the City of Chico, Pacific Grove, Cloverdale, Belvedere, Monterrey, Madera, Sacramento, Campbell, Fresno, and Humbolt County Unincorporated building departments. Each building department either supplied the names of the appropriate individuals, or forwarded the interviewer to the building inspection department.

Protocol. Individuals in building departments were contacted at least once for an interview. A strong attempt was made to contact the senior building inspectors, as these individuals were likely to have more experience and be more knowledgeable about trends over time. Further, these individuals were more likely to be in the office rather than on-site performing inspections. A contact (but not necessarily the municipality) was removed from the sample after five failed contact attempts.

C.20 Completed Interview Sample for Building Inspectors

Completed interviews were obtained for ten building inspectors and building officials in the PG&E service territory from a total of roughly 14 that were contacted, yielding a response rate of 38%. Table C-11 lists the municipality/department, and the respondent's title for the building inspectors that completed interviews.

Table C-11: Completed Interview Sample for Building Inspectors

Municipality/Department	Respondent's Title
Humbolt County Unincorporated	Building Inspector
City of Chico	Building Inspector
City of Pacific Grove	Building Official/Senior Inspector
City of Cloverdale	Building Inspector
City of Belvedere	Building Official/Senior Inspector
City of Monterey	Senior Building Inspector
City of Madera	Building Inspector
City of Sacramento	Building Inspector
City of Campbell	Building Inspector
City of Fresno	Building Official/Senior Inspector

Interview Guide for Building Inspectors and Plans Examiners

Building inspectors directly examine the energy efficient measures installed in the home. The objective of these interviews is to identify their perception of energy efficiency, awareness of energy efficient products, and any changes to their standard business practices that might have resulted from DSM programs.

Introduction

Hello. My name is _____. I'm calling on behalf of PG&E. May I please speak to _____?

Hello. My name is _____. I'm calling on behalf of PG&E. We are conducting a study to better understand the market for new homes in Northern/Central California. We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: continue

If No: thank and terminate

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Screen to make sure the respondent inspects residential new construction. If No, then request a referral:

Can you refer us to another individual in your office who inspects residential new construction?

Contact: _____

Title: _____

Phone: _____

Other: _____

Before we get started, I have a few questions about your background.

1. First, how long have you been a building inspector? _____ Years

2. How much of that time have you worked in Northern/Central California? _____ Years

3. Is residential new construction inspection your primary job function?

_____ Yes _____ No

[If No to Q3] 3A. What is your primary job function? (probe: mechanical, plumbing)

4. How many residential new construction building inspectors work in this office?

_____ Inspectors

Current Business Practices

The following questions relate to your or your company's business practices. We are particularly interested in inspections you have performed in the residential new home construction market as opposed to commercial buildings and remodels and renovations.

5. How many new homes or plans did the inspectors in your office inspect in 1998?

___ Homes

If do not know, ask how many homes the respondent inspected themselves.

If 0 to Q5, ask if they inspect commercial buildings only. If so, thank and terminate

6. How many different builders constructed the homes you inspected in 1998?

_____ Builders

7. What percentage of the newly constructed homes you inspected in 1998 were detached single family homes? _____ % Single Family

8. New single family home construction is often classified as tract or custom. Of the newly constructed single family homes you inspected in 1998, approximately what percentage were new tract homes? _____ % Tract

9. Are you aware of the Title 24 requirements for residential new construction?

_____ Yes _____ No

9A. Do you have a working knowledge of these requirements?

_____ Yes _____ No

Air Conditioning Equipment

10. Are you aware of the current standard SEER rating for air conditioning equipment?

_____ yes _____ no

11. What percentages of residential central air conditioning units that you manufactured in 1998 had SEER ratings of 10 or less, between 10 and 12, or above 12? *(Enter % for each category.)*

_____ 10 or less _____ between 10 and 12 _____ above 12

11A. Have these percentages changed since 1991? _____ yes _____ no

[If Yes to 11A] 11B. What is the main reason for the change?

[If Yes to 11A] 11C. About what year did the change[s] take place? _____ year

Duct Systems

12. Are you aware of the current standards for **duct insulation**? _____ yes _____ no

13. In what percentage of the homes that you inspected in Northern/Central California in 1998 did the **duct insulation exceed** Title 24 requirements? _____%

13A. Has it changed since 1991? _____ yes _____ no

[If Yes to 13A] 13B. What is the main reason for the change?

[If Yes to 13A] 13C. In what year did the change take place? _____ year

[If Q13 >0] 13D. You indicated that _____% of the homes you inspected last year had **duct insulation that exceeded** Title 24 requirements. Do you see this continuing in the future?

_____ yes _____ no

[If Q13 >0] 13E. Why or why not?

14. When you inspect new homes, is there any information available to you as to whether or not **duct testing** has been conducted?

_____ no **[Go to Q15]**

_____ yes

14A. In what percentage of the new homes that you inspected in Northern/Central California in 1998 had duct testing been conducted? _____ % homes

14B. Has it changed since 1991? yes no

[If Yes to 14B] 14C. What is the main reason for the change?

[If Yes to 14B] 14D. In what year did the change take place? year

[If % > 0 in Q14A] 14E. You indicated that duct testing had been conducted in % of the homes you inspected in 1998. Do you see this continuing in the future?

yes no

14F. Why/why not?

Windows

15. In what percentage of the single family homes you inspected in 1998 did the windows exceed code? %

15A. Has it changed since 1991? yes no

[If Yes to 15A] 15A1. What is the main reason for the change?

[If Yes to 15A] 15A2. In what year did the change take place? year

[If % > 0 in Q15] 15B. You indicated that in % of the homes you inspected in 1998 the windows exceeded building standards. Do you see this continuing in the future?

yes no

[If % > 0 in Q15] 15C. Why or why not?

Awareness of the Comfort Home Program and Attribution to DSM Programs

Over the past few years, Pacific Gas & Electric has offered cash incentives and informational services to builders and developers to promote the installation of high efficiency equipment in residential new construction.

16. Have you heard of PG&E's Comfort Home Program or Comfort Home Plus Program?

yes both

yes Comfort Home only

yes Comfort Home Plus only

no **[Go to Q22]**

[If Yes to Q21] 21B. Which feature of the program was the main reason for implementing these changes?

[If Yes to Q21] 21C. Do you think they will continue these practices even without the program? ___ yes ___ no

[If No to Q21] 21D. What is the main reason you think they haven't made any permanent changes?

Probe for answers that tie into list of applicable market barriers.

22. Are you aware of the California Home Energy Rating System (or CHEERS rating) for residential new construction?

___ no

[If No] 22A. Are you aware of the ENERGY STAR New Homes Program?

___ yes ___no **[Go to Q27]**

___ yes

[If Yes] 22B. Do you know what the CHEERS rating requirement is for a newly constructed home to qualify as an ENERGY STAR[®] Home?

___ yes ___no

23. How did you become aware of the ENERGY STAR Program?

24. What percentage of single family homes inspected by your company in Northern/Central California in 1998 qualified as an ENERGY STAR[®] Home?

___% ENERGYSTAR[®] homes **[If 0% , go to Q27]**

24A. Is this a typical percentage for previous years, or has this percentage increased or decreased since 1990?

___Increased → By how much?

___Decreased → By how much?

___Stayed about the same **[Go to Q24D]**

___Do not know **[Go to Q24D]**

24B. What do you feel is(are) the main reason(s) for this(these) change(s)?

24C. When did these changes take place?

24D. What percentage of these ENERGY STAR[®] home are tract homes?

____% tract ENERGYSTAR[®] homes

25. What methods/specifications did the builders use in order for these homes to qualify as ENERGY STAR[®] homes? (heavier insulation, high efficiency equipment)

25A. Have the methods changed since 1990?

____ no, methods are the same now as in 1990

____ yes, methods are different now than in the past

25A1. Please explain the changes.

25A2. When did these changes take place? ____ year

26. Do you think builders will continue to build ENERGY STAR[®] homes?

____ yes → About how many per year, or what %?

____ no → Why not?

Energy-Efficient Measures

27. For the following list of equipment do you consider yourself *very aware*, *somewhat aware*, or *not at all aware* of the latest available energy saving high efficiency technologies?

	Very Aware	Somewhat Aware	Not At All Aware
High efficiency air conditioners	*	*	*
Gas furnaces	*	*	*
Gas water heaters	*	*	*
High efficiency windows	*	*	*
Insulation	*	*	*
Duct testing	*	*	*
Duct sealing	*	*	*

27A. What is the primary source of your information on new technologies?

28. How influential would you say building inspectors are in assisting builders who want to build to energy efficiency standards that **exceed** Title 24?

- Very influential
- Somewhat influential
- Not very influential
- Not at all influential
- Don't know

28A. In what way(s) do you feel building inspectors are **[your answer from Q28]**?

29. When you are working with builders, do you have the opportunity to suggest to them to build to exceed Title 24?

yes no **[Go to Q30]**

29A. Have you ever done this?

no

[If No to Q29A] 29A1. What is the main reason you have not suggested this?

yes

[If Yes to Q29A] 29A2. When you did suggest exceeding Title 24, was your suggestion followed? yes no

29A3. Why or why not?

30. Is there anything that you as a building inspector are doing now that is particularly helpful to **builders** who want to **exceed** Title 24?

___ no

___ yes → 30A. Please describe.

31. Are there any changes building inspectors could make that would be helpful to the builders in this effort?

___ no [**Go to Q32**]

___ yes

31A. Please describe the changes.

31B. Have you had the opportunity to make any of these changes in your business?

___ yes ___ no

[If Yes to Q31B] 31B1. Which changes did you make?

[If Yes to Q31B] 31B2. What were the primary reasons for these changes?

[If Yes to Q31B] 31B3. When did you make them? ___ year

[If No to Q31B] 31B4. What is the main reason you did not make any such changes?

32. Would you be able to promote energy efficiency to builders applying for building permits if the utility supplied you with information to do so?

Perception of Homebuyer Attitudes

33. Based upon your experience in the residential new construction market, how much demand is there from homebuyers for energy saving equipment or features?

___ A lot

___ Some

___ Very little

___ None

___ Do not know

[If “Very little” or “None” for Q33] 33A. What do you feel are the major factors for such little demand?

34. Has customer demand for energy saving features increased, decreased, or stayed about the same since 1990?

Increased

Decreased

Stayed about the same

Do not know

[If “Increased” or “Decreased” for Q34] 34A. What do you feel are the major factors that have led to this increase/decrease?

Builders' Sales Agents

The target was to complete a total of 20 interviews with builders' sales agents in the PG&E service territory. Subsection C.21 details the sampling procedures and interviewing protocols for interviewing sales agents. Subsection C.22 presents the completed sample size and provides a list of the interview respondents.

Builders' sales agents facilitate the sale of the home and are responsible for all transactions between the consumer and the builder or developer. Their primary function is to help consumers find a home in which they feel comfortable and that fits their lifestyle. They provide consumers with information on the features of the home and can directly influence consumers' choices regarding those features.

C.21 Sample and Interview Protocol for Builders' Sales Agents

Sampling. The target was to interview 20 builders' sales agents in the PG&E service territory. The sample of sales agents was developed from the Housing Guides of America On Line and other builder websites.

Protocol. During the first contact, sales agents were screened to ensure that they personally had residential new construction experience. Individuals in the builder's sales office were contacted at least once for an interview. A contact was removed from the sample after four unsuccessful contacts/recruit attempts.

The initial survey protocol did not include the use of incentives. Due to the stringent timeframes and lack of willingness to participate in the interviews, in a few cases sales agents were offered an incentive of \$25 to participate.

C.22 Completed Interview Sample for Builders' Sales Agents

Completed interviews were obtained for 20 sales agents in the PG&E service territory from a total of roughly 34 that were contacted, yielding a response rate of 59%. Table C-12 lists the name of the builder and the community that the sales agent represented, for the sales agents that completed interviews.

Table C-12: Completed Interview Sample for Builders' Sales Agents

Builder	Community
Ponderosa Homes	Ponderosa Heights at Scottscreek
Grupe	Morningside & South Shore
Brookfield Homes	Rush Creek
SMC/Ahmanson Developer	Highlands Estates
Greystone Homes	Stillwater Cove
Renaissance Homes	Renaissance Homes at Lakeside
Western Pacific Housing	Glen View
Anderson Homes	The Gardens at Ranchwood
Presley Homes	The Preserve
Pulte Homes	Heritage Point
Renaissance Homes	Renaissance Homes at Lakeside
Brookfield Homes	The Gallery at Palmide
Walker, Donant & Company	Quail Ranch Estates
Barnett & Company	Green Valley Highlands
Raymus Development	Chadwick Square
Shapell Builders	The Bridges of Gayle Ranch
SCM Homes	The Bluff at Seven Falls
Kaufman & Broad	California Meadows
Kaufman & Broad	The Home Center
Heritage Homes	Wyndemere

Interview Guide for Builders' Sales Agents

Builders' sales agents provide consumers with information on the features of the home and can directly influence consumers' choices regarding those features. The objective of these interviews is to characterize the role of sales agents in the RNC market, to assess current awareness levels and attitudes, and to test hypotheses related to market barriers.

Introduction

Introduction

Hello. My name is _____. I'm calling on behalf of some California utilities and the Energy Commission. We are conducting a study to better understand the market for new residential homes. Is this a residential sales office for _____ [builder's name]?

If Yes: verify respondent has experience with residential new construction market

If No: thank and terminate

We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: continue

If No: Would another time be more convenient?

If Yes: arrange interview time

If No: thank and terminate

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Name: _____

Builder: _____

Development/Community _____

Address _____

Before we get started, I have a few questions about your background.

1. How long have you been in the real estate industry? ____ years

1A. How much of that time has been in Northern/Central California? ____ years

1B. How much of that time has been with the builder you are currently working for?
____years

2. Are you employed by the builder you work for, or do you work on a contract basis?
____employed ____ contract

Residential New Home Construction Market

First of all we would like to get an overall understanding of the residential construction practices in the Northern/Central California Region. We are interested in detached single family new construction.

3. Approximately how many homes do you sell each year? _____homes

4. What percentage of the new homes you sold in 1998 were detached single family?
_____ % single family

6. Single family new construction is often classified as tract or custom. What percentage of the new single family homes you sold in 1998 were tract homes?
____ % tract ____zero

Current Practices and Awareness of Energy Efficiency Standards

8. Do you consider yourself *very*, *somewhat*, or *not very aware* of the latest available energy saving high efficiency features in new homes? In particular,

	Very Aware	Somewhat Aware	Not At All Aware
High efficiency air conditioning	*	*	*
Gas furnaces	*	*	*
Efficient duct systems	*	*	*
High efficiency windows	*	*	*

8A. What is the primary source of your information on energy saving features?

9. Newly built homes have minimum energy efficiency building standards [called Title 24]. Are you aware of these standards?

____ no [Go to Q14] ____ yes

10. What percentage of the single family detached homes you sold in 1998 would you classify as exceeding the minimum energy efficiency standards?

____% exceed ____ don' t know

10A. Is this a typical percentage for previous years, or has this percentage increased or decreased since 1991?

____Increased

____Decreased

____Stayed about the same

____Do not know

10B. Increased/decreased by how much?

10C. What is the main reason for these changes?

10D. When did these changes take place?

10E. How many of these are tract homes?

11. Do you market the homes that exceed the minimum energy efficiency standards any differently than you market homes that just meet them?

____ no [**Go to Q12**]

____ yes 11A. Please explain the differences.

11B What has been the response by buyers to the homes that exceed the standards?

12. Do you think builders will continue to build homes that exceed the minimum energy efficiency standards? ____ yes ____ no

12A. Why or why not?

13. What do you think are the advantages and disadvantages of homes that exceed minimum energy efficiency requirements?

Awareness of the Comfort Home Program and Attribution to DSM Programs

14. Pacific Gas & Electric has offered residential home builders incentives to install high efficiency air conditioners, duct work and windows. Have you heard of PG&E' s Comfort Home Program, Comfort Home Plus Program, or the EPA' s ENERGY STAR New Homes Program?

___yes Comfort Home

___yes Comfort Home Plus

___yes ENERGYSTAR

___no [Go to Q17]

(If Yes to Comfort Home Plus and yes to Energy Star New Homes)

14A. Do you know about ENERGY STAR as a result of the Comfort Home Plus Program or apart from it?

15. Did you sell homes that were built under one of these programs?

___yes

___no [Go to Q17]

15A. When?

___1992

___1993

___1994

___1995

___1996

___1997

___1998

___Don't know

16. Do you think builders will continue to build homes under these programs?

___ no

___ yes

16A. Why or why not?

17. Are you aware of special mortgages available to help buyers purchase energy efficient homes?

___ no [Go to Q19]

___ yes

17A. Which ones?

___Energy Efficient Mortgages

___Energy Star Mortgages

___Other (describe)

18. What percentage of new single family detached homes that you sold in 1998 qualified for these types of mortgages? ___% [If 0% , go to Q19]

18A. Is this a typical percentage for previous years, or has this percentage increased or decreased since 1991?

- Increased → By how much?
- Decreased → By how much?
- Stayed about the same **[Go to Q19]**
- Do not know **[Go to Q19]**

18B. What do you feel is(are) the main reason(s) for this(these) change(s)?

18C. When did these changes take place?

Perception of Homebuyer Attitudes

The following questions relate to the sales agent's perception of the homebuyer's attitudes towards energy efficient equipment and features.

19. What are some of the most important home features that buyers generally want?

20. What sources of information are there for homebuyers on energy saving home features?

20A. Do you provide any of this information to your customers?

- yes
- no

[If Yes] 20B. Who decides what information to offer customers?

[If Yes] 20C. Do you only give information when customers ask for it?

[If No] 20D. Why not?

21. How much buyer demand is there for features that exceed the minimum energy efficiency building code standards? *[Regardless of whether or not buyer is aware of code requirements]*

- A lot
- Some
- Very Little
- None **[Go to Q23]**
- Do not know **[Go to Q23]**

[If very little or none] Q21A. Why do you think this is so?

22. Has customer demand for energy saving features increased, decreased, or stayed about the same since 1991?

- increased
- decreased
- stayed about the same
- do not know

Q22A. Why do you think this is so?

23. What practices would you suggest to stimulate buyer demand for homes that exceed the minimum energy efficiency standards? [*Need to explore for answers other than reduction in cost*]

24. In your opinion do homebuyers expect new homes to be energy efficient?

- yes no

25. Based on your experience, what energy savings features are buyers most likely to look for? (*do not read from list*)

- none
- high efficiency windows [double or triple pane]
- high efficiency A/C
- high efficiency gas furnaces
- enhanced insulation and ductwork
- Other

26. Have the features homebuyers looked for changed since 1991?

- yes no [**Go to Q27**]

Q26A. What changes have you noted?

Q26B. When did these changes take place?

27. What percentage of your customers have asked you about homes that were more energy efficient than the state requires? _____ %

Influence on Use of Energy Efficient Measures

28. How influential would you say sales agents are in assisting builders to build and market homes that exceed the minimum required energy efficiency standards?

- Very influential
- Somewhat influential
- Not very influential
- Not influential at all
- Don't Know

28A. In what way?

29. How influential would you say sales agents are in encouraging homebuyers to buy homes that exceed the minimum required energy efficiency standards?

- Very influential
- Somewhat influential
- Not very influential
- Not influential at all
- Don't Know

29A. In what way?

30. Have you ever suggested to your customers to buy homes that exceed the minimum required energy efficiency standards?

yes no [**Go to Q31**]

30A. When you did, was your suggestion followed?

30B. Why or why not?

30C. What is the main reason you did not suggest this?

31. Is there anything that you as a sales agent are doing now that is particularly helpful to builders or homebuyers who want to exceed the minimum energy efficiency standards?

32. Are there any changes sales agents could make that would be helpful?

yes no [**Go to Q33**]

32A. Please describe the changes.

32B. Have you had the opportunity to make any of these changes in your business?

yes no [**Go to Q33**]

[If Yes to 32B] 32B1. Which changes did you make?

[If Yes to 32B] 32B2. Why did you make them?

[If Yes to 32B] 32B3. When did you make them?

[If No to 32B] 32B4. What is the main reason you did not make any of these changes?

33. If training on energy efficient housing were available at a reasonable cost that could be used as educational credit with the Real Estate Licensing Board, would you take advantage of it?

___yes ___no

[If No to 33] Why not?

Perceptions on Energy Use

34. On a scale of 1 to 5, where 1 is not important and 5 is very important, please indicate how important each of the following characteristics is in the marketability of a new house.

___ selling price
___ location
___ energy efficiency
___ style of the home
___ floor plan
___ square footage

35. On a scale of 1 to 5, where 1 is not influential and 5 is very influential, please indicate how influential the following factors are in discouraging purchases of energy efficient homes.

___ cost
___ lack of information on energy efficient measures
___ energy efficient products are not available
___ difficulty in choosing among options for energy efficient measures
___ hassle
___ financing

36. Please describe what kind of marketing or other information the builder provides you on his homes.

37. Does your builder work with a particular lender or group of lenders?

___ yes ___ no

Q37A. Does the lender offer loan incentives for high efficiency homes?

___ yes ___ no

Lenders

The target was to complete a total of ten interviews with lenders in the PG&E service territory. Subsection C.23 details the sampling procedures and interviewing protocols for interviewing lenders. Subsection C.24 presents the completed sample size and provides a list of the interview respondents.

Lenders can provide financing for both consumers and builders. However, for the purposes of this study, the focus was on lenders who provide homebuyers with the financing required to purchase a new home, and whether or not the lenders can indirectly influence homebuyers preferences. The objective of the interviews with lenders was to identify the role that they play in this decision process.

C.23 Sample and Interview Protocol for Lenders

Sampling. The target was to interview ten lenders who provide mortgages for homes in the PG&E service territory. The sample of lenders was constructed from the Residential Energy Services Network and the Mortgage Association of California.

Protocol. During the first contact, the lenders were screened to ensure that they were involved in either homebuyer loans/mortgages or construction loans in northern or central California. Lenders were contacted at least once for an interview. A contact was removed from the sample after four unsuccessful contacts/recruit attempts.

C.24 Completed Interview Sample for Lenders

Completed interviews were obtained for ten lenders in the PG&E service territory from a total of roughly 23 that were contacted, yielding a response rate of 43%. Table C-13 lists the business name for the lenders that completed interviews.

Table C-13: Completed Interview Sample for Lenders

Business Name
All California Mortgage
The Money Lenders
Montgomery Mortgage
Home Lending Corporation
Group One Mortgage
AAA Mortgage
Chase Manhattan Mortgage
Stockton Mortgage
Western Capital Mortgage
Freeman Investments

Interview Guide for Lenders

Lenders provide financing for consumers, thus, indirectly influencing homebuyer preferences for new homes. The objective of these interviews is to identify the role that lenders play in the RNC market. Further, the interview is designed to test specific hypotheses about relative market barriers and to aid in the assessment of current perceptions, operational procedures, and behavior.

Introduction

Hello. My name is _____. May I please speak to _____?

Hello. My name is _____. I'm calling on behalf of PG&E. We are conducting a study to better understand the market for new homes in Northern and Central California. A very large part of our research involves speaking with all of the different types of people involved in the new construction industry - including builders, architects, subcontractors, and lenders. (Which is the purpose of this call.)

Because of your involvement in the lending industry, we would greatly appreciate the benefit of your experience as input for this study.

- Yours truly, participation involves answering some questions over the phone, which would probably take only about 15 minutes of your time. I would like to ask you some general questions about your company's lending practices - to new homebuyers and/or builders who are building new homes in Northern/Central California.
- I do not need any detailed information about any particular loans/mortgages written by your company. Regardless, all information that you provide will remain confidential and will only be summarized with the information I collect from other lenders in the area.

Would you be willing to participate?

If Yes: continue

If No: thank and terminate

Screen respondent for their involvement with homebuyer loans and construction loans in Northern/Central California.

Are you involved in either homebuyer loans/mortgages or construction loans in Northern/Central California?

- _____ Yes, both [**Continue Interview**]
- _____ Yes, homebuyer loans only [**Continue Interview**]
- _____ Yes, construction loans only [**Continue Interview**]
- _____ No [**Respondent is ineligible - ask for referral**]

Can you refer us to another lender in your company who has more experience with these types of loans?

Contact/Title: _____

Phone: _____

Other: _____

Begin again with new respondent

Is now a good time to go through the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Before we get started, I have a few questions about your background.

1. How long have you been in the lending industry? _____ years
2. How much of that time has been in Northern/Central California? _____ years
3. How long have you worked with the company you are with now? _____ years
4. What is your title or primary responsibility?

4A. Has this changed over time?

_____ yes → Please explain:

_____ no

5. How many individual lending officers/brokers currently work in your company?

_____ lenders

If do not know # in entire company, ask about the # of lending officers in division or office, and note what the response reflects.

Homebuyer Loans

6. Do you write mortgage loans to **homebuyers**?

_____ no **[Go to Q18]**

_____ yes

6A. Approximately how many mortgages did you write in 1998?

_____ Mortgages _____ Do not know/refused

6B. Approximately what percentage of your company's total loans to homebuyers in 1998 were for newly constructed single-family detached housing? _____ %

If do not know % in entire company, ask about the % of new construction mortgages in division or office, and note what the response reflects.

7. Single family new construction is often classified as custom or tract/production housing. About what **percentage of the mortgages** you wrote for newly constructed homes in 1998 were for tract homes?

_____ % Tract _____ Do not know/refused

Mortgaging Practices

8. In general, does the energy efficiency of a new home influence the terms of the mortgage?

_____ no **[Go to Q9]** _____ yes

8A. Please describe how a mortgage for a more energy efficient home is different than that for a less energy efficient home.

Probe for loan features such as interest rate, closing costs, and qualifying terms.

8B. Has this practice changed over time?

_____ no

_____ yes → 8B1. Please explain the changes.

8B1. When did the change occur?

9. When a buyer seeks financing for a newly built home, do you require any information about the equipment or features of the home that pertain to energy efficiency, such as the home's heating/air conditioning equipment, insulation, or windows?

Ask the respondent if the energy efficiency of their new home is considered when calculating the homebuyer's ratios, mortgage, qualifying terms, etc...

Do they require proof that the home meets the minimum building code requirements?

_____ no **[Go to Q10]**

_____ yes → 9A. Please describe.

Probe for things like equipment brand, efficiency rating, number of units...

10. Does your company offer any financial incentives to homebuyers who want to either purchase a home that has more energy efficient equipment, or to upgrade the equipment of a new home they are purchasing? *[For example, upgrade HVAC equipment efficiency, better windows, more air duct insulation.]*

_____ no **[Go to Q11]**

_____ yes → 10A. What type of financial incentives? Please describe.

Probe for the following if necessary.

_____ Reduced interest rate _____ Qualifying terms _____ Reduced closing costs

11. On a scale of 1 to 5 with a 1 meaning *not at all likely* and a 5 meaning *very likely*, how likely do you think that the energy efficiency of a new home will influence mortgages in the next five years? *(Circle answer.)*

Not At All Likely		Somewhat Likely		Very Likely
1	2	3	4	5

Energy Efficient Mortgages

12. Have you heard of mortgages available to help buyers purchase homes that exceed energy efficiency standards?

no **[Go to Q18]**

yes

[If yes] 12A. Which mortgages are you aware of?

Energy Efficient Mortgages ENERGYSTAR Mortgages

Other (describe)

13. Have you heard of these mortgages being offered in Northern/Central California?

yes no

14. Does your company presently offer any of these energy efficient mortgages, or has your company offered them in the past?

yes, company presently offers energy efficient mortgages to homebuyers.

yes, company offered them to homebuyers in the past, but does not now.

no, company never offered them to homebuyers **[Go to Q18]**

15. About how many energy efficient mortgages did you write last year? About how many did you write prior to 1998?

EEMs in 1998 EEMs prior to 1998

[If 0 for either] 15A. What is the primary reason you did not write any EEMS?

Probe for homebuyer demand, hassle, financial/costs, no incentives etc.

[If difference between the number written in 1998 is different than than prior to 1998] 14A. Why were more/less Energy Efficient mortgages written in 1998 than in previous years?

16. About what percentage of these were written for newly constructed homes and what percentage were written to upgrade the energy efficiency of a pre-existing home?

% Newly Constructed Homes % Upgrade Pre-existing Homes

Do Not Know

17. What methods were/are used by your company to help your customers become aware of the Energy Efficient Mortgage?

We're interested in the marketing efforts. Probe for the following: educating realtors & sales agents, seminars, advertising, pamphlets in the bank, etc...

Construction Loans

18. Does your company offer **construction loans** to **builders** involved in residential new construction in Northern/Central California?

_____ no **[Go to Q24]**

_____ yes

Note that we are only interest in loans to builders, NOT construction loans to homebuyers (not owner-occupied loans).

18A. Approximately how many construction loans did you write in 1998?

_____ Loans _____ Do not know/refused

18B. About what percent of the construction loans written last year were for single family and about what percent were for multi-family housing?

_____ % single family _____ % multi family _____ Do not know/refused

*General rule: single family = houses
multi-family = apartment complex/condos*

19. Single family new construction is often classified as custom or tract/production housing. About **what percentage of the construction loans** you wrote to builders last year were for tract homes? _____ % tract

20. Does your company work with a particular builder or group of builders? [Do you have a builder or group of builders that are “repeat customers?”]

_____ no [Go to Q21]

_____ yes

Q20A. Is this a builder of tract housing? _____ yes _____ no

Q20B. Please describe in what capacity you worked with them.

Probe for things like provided builder with construction loan, provided homebuyers with mortgage loans, etc.

21. Do you require proof that plans meet building and energy efficiency codes?

_____ no [Go to Q23]

_____ yes → 21A. Please describe.

22. Does the energy efficiency levels of the homes being built influence the terms of the construction loan?

_____ no [Go to Q23]

_____ yes

22B. Describe how a construction loan for homes that are more energy efficient is different than that for less energy efficient homes.

22C. Has this practice changed over time?

___ no [Go to Q23]

___ yes → 22C1. Please explain the change(s).

22C2. When did it change?

23. On a scale of 1 to 5 with a 1 meaning *not at all likely* and a 5 meaning *very likely*, how likely is will it be in the next five years that your company will offer favorable loan incentives to builders who want to build more energy efficient homes? (Circle answer.)

Not At All Likely		Somewhat Likely		Very Likely
1	2	3	4	5

Energy Efficient Measures

24. How influential would you say lenders are in financially assisting **builders** that want to build homes that exceed the minimum required energy efficiency standards? (*Check One.*)

- Very influential
- Somewhat influential
- Not very influential
- Not at all influential
- Don't Know

24A. In what way(s) do you feel lenders are [*your answer from Q24*]?

25. Do you feel there are any changes lenders could make in their lending practices that would be more helpful to **builders** in this effort?

- no [**Go to Q26**]
- yes → 25A. Please explain.

25B. Have you had the opportunity to make any of these changes?

- no → 25B1. What is the main reason you did not make any of these changes?
- yes → 25B2. Which changes did you make?

25B3. What factors led to these changes?

25B4. When did you make them?

Awareness of the RNC Program and Attribution to DSM Programs

26. Pacific Gas & Electric has offered residential homebuilders incentives to install high efficiency appliances and duct systems. Have you heard of PG&E's Comfort Home Program or Comfort Home Plus Program?

- yes Comfort Home
- yes Comfort Home Plus
- no [**Go to Q33**]

27. When did you first hear about this(these) program(s)?

- 1992 1993 1994 1995
- 1996 1997 1998 Don't know

28. Have you ever worked with a builder who received incentives under one of these programs?

no [Go to Q30] do not know [Go to Q30] yes

29A. Please describe in what capacity you worked with them.

*Probe for things like: provided builder with construction loan,
provided homebuyers with mortgage loans, etc.*

29B. Did you or the builder offer any favorable loan incentives to homebuyers who bought homes built under the program?

no do not know yes

29B1. Please describe.

29. Have you as a lender made any changes to your lending practices as a result of builders participating in either program?

no → 30A. What is the main reason you haven't made any changes?

yes → 30B. Please describe these changes.

30C. What was the main reason for implementing these changes?

30. Do you have any other comments or insights relating to the lending industry, lending practices, and the energy efficiency levels of new homes built in Northern/Central California?

Government Agents

The target was to complete a total of ten interviews with government and nonprofit agencies. Subsection C.25 details the sampling procedures and interviewing protocols for interviewing government agents. Subsection C.26 presents the completed sample size and provides a list of the interview respondents.

Government and nonprofit agencies implement building energy codes and standards, fund and conduct research, implement programs, and provide informational services regarding energy efficiency.

C.25 Sample and Interview Protocol for Government Agents

Sampling. The target was to complete ten interviews with government and nonprofit agencies. Respondents with government agencies were recruited from federal agencies such as the Department of Energy, the International Code Council, national research laboratories, and California state agencies. In addition, several non-government organizations involved in promoting the energy efficiency levels of new homes were included in the sample frame.

Protocol. A contact was removed from the sample after five unsuccessful contacts/recruit attempts.

C.26 Completed Interview Sample for Government Agents

Completed interviews were obtained for 11 government agents from a total of 14 that were contacted, yielding a response rate of 79%. Table C-14 lists the government organization and the respondent's title for the government agents that completed interviews.

Table C-14: Completed Interview Sample for Government Agents

Government Organization	Respondent's Title
International Code Council / Building Officials and Code Administrators International (ICC / BOCA)	Technical Manager
The California Association of Building Energy Consultants (CABEC)	Chairman
Home Energy Rating System Council (HERSC)	Executive Director
Affordable Comfort, Inc.	Executive Director
Building America Program	Program Manager
Energy Efficiency Standards Office at the California Energy Commission (CEC)	Supervisor
ICF, Inc. for the ENERGY STAR New Homes Program at the U.S. Department of Energy (DOE)	Energy Efficiency Programs Associate
U.S. Department of Energy (DOE)	Regional Director
Oak Ridge National Laboratory	Executive Director
California Institute for Energy Efficiency (CIEE) at the Lawrence Berkeley National Laboratory (LBNL)	Research Manager
California Home Energy Efficiency Rating System, Inc. (CHEERS)	Executive Director

Interview Guide for Government Agents

Government agencies implement building energy codes and standards, and they provide informational services regarding energy efficiency. The objectives of these interviews are to identify relevant programs and policies and their objectives, to determine the influences these have on the RNC market, and to learn about the past and future trends in this area. The interviews are designed to aid in the assessment of market characterization.

Introduction

Hello. My name is _____. I'm calling on behalf of [PG&E]. May I please speak to _____?

Hello. My name is _____. I'm calling on behalf of PG&E. We are conducting a study to better understand the market for energy efficient products in new homes in Northern and Central California. We are interested in your attitudes toward energy efficiency and your opinions about the market. Would you be willing to participate?

If Yes: continue

If No: thank and terminate

Screen respondent for direct involvement in either designing or implementing energy/building codes and standards, or other government program that provides informational services and other assistance to market actors regarding the energy efficiency levels of new homes.

Is now a good time to do the interview or would another time be more convenient?

If Yes: continue

If No: arrange interview time

Before we get started, I have a few questions about you and your agency's background.

1. First, what are your job title and primary job responsibilities?
2. We are primarily interested in the energy efficiency levels of new homes. Have you worked in other capacities before this in either an energy or residential construction industry or organization?

____ no ____ yes

3. Please describe the general characteristics and nature of the agency and how you and your organization are involved with energy efficiency in residential new construction.

*What is the primary function/responsibilities/objectives of this agency?
Is this a state or federal agency?
How is the agency funded?
Who/what oversees this agency?*

*If agency is involved in **standards and codes**, go to **Q5**.
If agency provides **informational** and **financial** assistance to consumers,
or **other services**, go to **Q18**.*

Standards and Codes

4. In what way are you and your agency involved in the energy standards/building codes in residential new construction?

*Probe for name of specific program or building standards.
We are likely to know this information before we make contact.*

5. What are the primary objectives of the codes/standards? [What is the focus?]
6. Who [market actor] is targeted by the codes?
7. What is the area of jurisdiction of these codes?
8. What type of education/training is provided [either by your agency or others] with respect to these codes?

*We're interested in training for not only builders but also municipal/county building official [building inspectors & plan reviewers].
Seminars, workshops, literature, etc.*

9. What are the programs compliance/monitoring requirements/practices?

Who does the monitoring? What are the reporting procedures? What happens if someone does not comply?

10. What/who are the primary influences on the codes [what factors prompt what is revised in the codes]?

Who are the decision makers?

11. How do the decision makers arrive at their decisions?

*Do they have a team of people they work with?
who are they?, what are their quals?
What research is done to arrive at decisions?
Do they get information and feedback from market actors? How?
How much does the agency communicate with other market actors?*

12. What are your and your agency' s primary information sources?

13. What type of feedback do you receive from others involved in the industry with respect to the codes/standards?

Feedback from builders, other gov't agencies, building departments, etc... Feedback on the codes themselves, if they are "successful," the compliance and reporting procedures, on any aspect of the codes.

14. Do you believe the codes have accomplished their intended objectives?

___ no → Please explain.
___ yes → Please explain.

15. Are there likely to be significant revisions to the codes in the near future?

___ no
___ yes → Please explain.

16. What do you feel are the strengths and weaknesses of the standards/codes?

Informational & Other Government Programs

17. In what way are you and your agency involved in the energy efficiency levels in new homes [if state agency, specify in Northern California]?

*Probe for name of specific program.
We are likely to know this information before we make contact.
If multiple programs, as the following for each.*

18. What are the primary objectives of this program?

19. Who [market actor] is targeted by this program?

20. What is the geographic scope of this program?

21. What type of education/training is provided [either by your agency or others] with respect to the program?

We're interested in learning anything they do to get information to the market actor[s] Seminars, workshops, literature, etc ...

22. Do those participating in the program [or those that benefit from the program] need to meet specific qualifying criterion?

23. Are there any compliance/monitoring requirements/practices?

Who does the monitoring? What are the reporting procedures? What happens if someone does not comply?

24. Please explain a brief history of the program. What need prompted its development? Who initiated their development/implementation?

A primary objective of this research is to learn how the program has changed over time, how the decisions are made and who makes them. Further, we are interested in learning the extent to which other programs, agencies, and market actors influence the program.

25. What/who are the primary influences on this program?

Who are the decision makers?

26. How do the decision makers arrive at their decisions?

*Do they have a team of people they work with?
who are they?, what are their quals?
What research is done to arrive at decisions?
Do they get information and feedback from market actors? How?
How much does the agency communicate with other market actors?*

27. What are your and your agency' s primary information sources?

Information on the targeted market actor, information on the industry, information on energy efficiency of residential buildings, information on new technologies and features [gas heating and gas water heating equip., windows, insulation, duct systems...]

28. What type of feedback do you receive from others involved in the industry that pertains to this program?

Feedback from builders, other gov't agencies, building departments, consumers, etc...If the program is "successful," feedback on the codes themselves...

29. Do you believe this program is accomplishing its objectives?
 ___ no → Please explain.
 ___ yes → Please explain.
30. Are there likely to be significant revisions to the program in the near future?
 ___ no → Please explain.
 ___ yes → Please explain.
31. Has it changed significantly since 1991?
 ___ no
 ___ yes → Please explain how and when it changed.
32. Will the program change significantly in the near future?
 ___ no
 ___ yes → Please explain.
33. About how many [market actors] participated in your program in 1998?
- 33A. Has the level of participation changed significantly since 1991?
 ___ no
 ___ yes - Please explain how and when it changed.
34. Do you believe this program has accomplished its objectives?
 ___ no → Please explain.
 ___ yes → Please explain.

Awareness of the ENERGY STAR New Homes Program

35. Are you aware of the Home Energy Rating Systems (or HERS rating) for residential new construction?
 ___ yes ___ no
- [If no]** 35A. Are you aware of the ENERGY STAR New Homes Program?
 ___ yes ___ no **[Go to Q38]**
36. Do you feel that the existence of this program has influenced your agency/program?
 ___no → 36A. Please explain.
 ___yes → 36B. Please explain.
- 36C. Which feature of the program was the main reason for implementing these changes?

37. Do you feel the ENERGY STAR New Homes program has influenced the stringency of the energy codes?

no → 37A. Please explain.

yes → 37B. Please explain.

37C. Which feature of the program was the main reason for implementing these changes?

38. Are you aware of energy efficient mortgages? no yes

[If yes to Q38] 38A. Have these had any influence on consumer demand for energy efficient features in new homes?

Awareness of the Residential New Construction Programs

Another focus of this research is to determine if energy efficiency programs have influenced the stringency of the energy codes over the years.

Over the past few years, the Pacific Gas & Electric Company has offered cash incentives and informational services to builders and developers to promote the installation of high efficiency equipment in residential new construction. Two such programs are PG&E's Comfort Home Program and Comfort Home Plus Program.

39. Are you aware of either program?

yes both

yes Comfort Home

yes Comfort Home Plus

no

other

40. Do you feel that the existence of these programs has influenced the codes and standards?

We are interested in learning if the DSM programs have influenced the stringency of the codes. When they revise the codes every 3 years, do these programs come up in any discussions?

no → 40A. Please explain.

yes → 40B. Please explain.

40C. Which feature of the program[s] was the main reason for implementing these changes?

41. Do you feel that the existence of these programs has influenced your agency or program?

___no → 41A. Please explain.

___yes → 41B. Please explain.

41C. Which feature of the program[s] was the main reason for implementing these changes?

42. **[If aware of Comfort Home Plus]** What do you think the influence of the Comfort Home Plus program will be on the ENERGY STAR New Homes program?

Influences on Energy Efficiency Levels of New Homes

43. What do you feel are the primary reasons for a new home having equipment and features that do not exceed building energy codes/standards?

Do not read list. Indicate the market actor the respondent mentions, and record any comments. After they respond, mention the items below not mentioned and record any comments.

	Not At All Important		Somewhat Important		Very Important
Cost	1	2	3	4	5
Lack of information on energy efficient measures	1	2	3	4	5
Energy efficient products are not available	1	2	3	4	5
Difficulty in choosing among options for energy efficient measures	1	2	3	4	5
Hassle	1	2	3	4	5
Financing	1	2	3	4	5
Other	1	2	3	4	5

Homebuyer Attitudes

44. Based upon your experience, how much demand is there from homebuyers for energy saving equipment or features?

- A lot
- Some
- Very Little
- None
- Do not know

[If very little to none for Q44] Q44A. What do you feel are the major factors for such little demand?

45. Has customer demand for energy saving features increased, decreased, or stayed about the same since 1990?

- increased
- decreased
- stayed about the same
- do not know

[If increased or decreased for Q45] Q45A. What do you feel are the major factors that have led to the increase/decrease?

46. In your opinion, do homebuyers expect new homes to be energy efficient?

- yes
- no

47. Do you have a sense of homebuyer attitudes and level of understanding of the energy efficiency of their new home? Can you suggest anything that might stimulate homebuyer demand for more efficient equipment and features when they purchase a new home?

Ask respondent for literature, websites, or other references that would be helpful in the study.

Consumers in Participant Homes

The target was to complete a total of 255 interviews with consumers in participant homes. Subsection C.27 details the sampling procedures and interviewing protocols for interviewing the consumers in participant homes. Subsection C.28 presents the completed sample size.

Consumers living in PG&E Comfort Homes are the ultimate end users of the energy efficient measures installed in the homes that were part of this program. Their perceptions of costs and benefits, the presence or lack of opportunities for efficiency choices, and their awareness levels and attitudes towards these measures is extremely important

C.27 Sample and Interview Protocol for Consumers in Participant Homes

Sampling. The target was to interview 255 consumers in participant homes. The sample of participants was provided by PG&E from their records and billing frame of move-ins to committed homes under the 1998 PG&E Comfort Home Program. As a small number of move-ins to Comfort Home Plus homes was provided, we attempted a census of these consumers, with the remainder of the sample being move-ins to Comfort Home homes.

Protocol. A contact was removed from the sample after six unsuccessful contacts/recruit attempts. The higher six-callback procedure was justified for the following reasons: 1) a census of the Comfort Home Plus consumers was being conducted, and 2) a large proportion of contact numbers for the remaining consumers were incorrect or blocked. Consumers were also screened to ensure that the respondent was a qualified respondent. The screening process was accomplished in a two step process by first asking when their home was built and then how many months they had lived at that address. Interviews were terminated if the respondent answered that their home was built prior to 1998 or if they had lived at the address for more than 16 months.

C.28 Completed Interview Sample for Consumers in Participant Homes

Completed interviews were obtained for 244 participant consumers from a total of 619 consumers that were called, yielding a response rate of 39%.² This was the only market actor where the target was not met. Some of the reasons for not being able to meet the target include the following:

- Nearly 25% of the contacts provided were wrong numbers or numbers belonging to the developer,
- A few of the contacts have blocked numbers so they could not be reached, and
- Approximately 14% of the consumers contacted refused to participate.

The names of the individual consumers interviewed are not reported here to maintain their privacy.

² The total number of individuals called includes unreached and unqualified consumers.

Consumers in Participant Homes

Background Information

First, we'd like to obtain some background information about you and your home.

1. When was your home built?
If prior to 1998, thank and terminate interview. If unsure, continue.
2. How many months have you lived at this address? ____ months
If more than 16 months, thank and terminate interview
3. How many people are currently living in this home? ____ # people
4. How old is the head of this household?
____ Less than 29 years ____ 50-59 years ____ 30-39 years
____ 60-69 years ____ 40-49 years ____ 70 years or over
5. What is your *typical monthly* electric bill? \$_____
6. What is your *typical monthly* gas bill? \$_____

Awareness of Energy Efficiency

Now we'd like to ask a few general questions about energy efficiency.

7. On a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, please answer the following questions. (*read each question and circle one number for each*)

	Not At All Important		Somewhat Important		Very Important
How important is energy efficiency to you now ?	1	2	3	4	5
How important was energy efficiency to you before you moved into your current home?	1	2	3	4	5
How important was it 4 years ago?	1	2	3	4	5
How important was it 7 years ago?	1	2	3	4	5

8. On a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, how important was the energy efficiency of this home in your decision to purchase or rent it?
(Circle one number)

Not At All Important		Somewhat Important		Very Important
1	2	3	4	5

9. As far as you know, do new homes built in California have to meet any energy-efficiency standards relating to appliances, windows and insulation levels?

yes
 no **[Skip to Q11]**
 don't know **[Skip to Q11]**

10. To the best of your knowledge, does your home...*(read the first three options)*

just meet these standards
 fall short of these standards
 exceed these standards
 don't know

11. As far as you know, are there any minimum energy efficiency standards on air conditioning equipment?

yes
 no **[Skip to Q13]**
 don't know **[Skip to Q13]**

12. To the best of your knowledge, does your air conditioning equipment...*(read the first three options)*

just meet these standards
 fall short of these standards
 exceed these standards
 don't know
 don't own any air conditioning equipment **[Skip to Q16]**

13. What kind of air conditioning equipment do you have?

central air conditioner
 wall or window air conditioner → How many? _____
 don't know
 don't own any air conditioning equipment **[Skip to Q16]**

14. In general, do you feel the air-conditioner and duct work installed in your home have had an effect on your electricity bills?

yes

no

don't know **[Skip to Q15]**

don't pay electric bill **[Skip to Q15]**

14A. Is that effect an increase or decrease in your electricity bills?

increase

decrease

14B. Is that effect a lot or a little?

increased or decreased a lot

increased or decreased a little

15. Are you satisfied with the performance of your air conditioning equipment?

yes no

16. Would you say that different kinds of residential windows.....(*read the first two options*)

all have pretty much the same levels of energy efficiency

differ substantially in energy efficiency levels

don't know

17. If you were to look for a new house, would you look for one with energy-efficient measures?

yes no **[Skip to Q18]**

17A. Please describe the energy-efficient measures you would look for.

Awareness of Energy Efficient Programs

18. Some government agencies and utilities sponsor programs designed to encourage the installation of energy efficient features in new homes. Two such programs are the ENERGY STAR New Homes Program and PG&E' s Comfort Home Program. Have you heard of either of these? yes no **[Skip to Q21]**

18A. Which one? ENERGYSTAR Comfort Homes

18B. (if yes to ENERGY STAR) Did you hear about the ENERGY STAR program in connection with Comfort Homes or apart from them?

19. Was your home built under one of these programs?

yes

no **[Skip to Q21]**

don't know **[Skip to Q21]**

19A. Which one? ENERGYSTAR Comfort Home both

20. Did the fact that this was a(n) (*answer to 19A -- ENERGYSTAR OR COMFORT HOME*) Home influence your decision to purchase or rent this home? yes no

21. PG&E ran an advertising campaign last year for their Comfort Home Program. Did you or anyone in your household see a television commercial or magazine ad about Comfort Homes?

yes

no

don't know or don't remember

21A. Did you or anyone in your household call their 800 number to get more information on the program?

yes

no

don't know or don't remember

Ownership/Rental Decision

Now, we have some questions on your decision to purchase or rent your present home.

22. Do you own or rent this home? own rent **[Skip to Q35]**

23. Are you the original owner? yes no

24. Throughout your lifetime, how many homes have you purchased for your own occupancy?

25. When you purchased this home, were you aware that it qualified as an energy-efficient home because the developer had installed a high efficiency air-conditioner, energy-efficient gas appliances and/or enhanced duct systems at the time of its construction?

yes no **[Skip to Q28]**

26. Who gave you information on your home's energy efficiency? (Check all that apply)

the builder/developer

the sales agent or a realtor

your utility

the previous owner

other → Please specify.

27. Given your experience with this energy-efficient home, on a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, how important will energy efficiency be in your next purchase of a home? (Circle one number)

Not At All Important		Somewhat Important		Very Important
1	2	3	4	5

28. Based on your experience with your present air conditioner, if you replace your current equipment will you choose (read all and choose one)

- same model or efficiency level
- model with lower efficiency
- model with higher efficiency
- will not purchase a replacement unit
- undecided

29. Suppose you were considering purchasing a home and you had the option of upgrading the energy efficiency of the home. If the increase in energy efficiency would save you \$10 a month on your gas and/or electric bill as long as you lived in the home, would you be willing to pay more for the home?

- yes no [**Skip to Q31**]

30. Assuming that you could finance at least part of the additional cost, how much of a premium on the selling price would you be willing to pay for the upgrade of the home's efficiency? \$ _____ don't know

31. Are you aware of special mortgages available to help buyers purchase energy efficient homes?

- yes no [**Thank and terminate interview**]

31A. Which ones have you heard of? (Check all that apply)

- Energy Efficient Mortgage
- ENERGYSTAR Mortgage
- other → Please specify.
- don't know

32. Did you finance your current home with one of these mortgages?

yes no [**Thank and terminate interview**]

32A. Which one?

Energy Efficient Mortgage

ENERGYSTAR Mortgage

other → Please specify.

don't know

33. Would you have purchased your home without the benefit of an energy efficient mortgage? yes no

34. Do you believe you are saving money with the energy efficient mortgage?

yes no

You have completed the survey.

Thank You.

We appreciate your time.

RENTAL ONLY

35. When you decided to rent this home, were you aware that it qualified as an energy-efficient home because the developer had installed a high efficiency air-conditioner, energy-efficient gas appliances and/or enhanced duct systems at the time of its construction?

yes no [**Skip to Q38**]

36. Who gave you information on your home's energy efficiency? (Check all that apply)

the landlord

the rental agent

the previous tenant

other → Please specify.

37. Given your experience with this energy-efficient home, on a scale of 1 to 5, where 1 is not at all important and 5 is very important, how important will energy efficiency be the next time you rent or buy a home? (Circle one number)

Not At All
Important

1

2

Somewhat
Important

3

4

Very
Important

5

38. Suppose you were considering purchasing a home and you had the option of upgrading the energy efficiency of the home. If the increase in energy efficiency would save you \$10 a month on your gas and/or electric bill as long as you lived in the home, would you be willing to pay more for the home?

yes no

39. Assuming that you could finance at least part of the additional cost, how much of a premium on the selling price would you be willing to pay for the upgrade of the home's efficiency? \$ _____ don't know

You have completed the survey.

Thank You.

We appreciate your time.

Consumers in Non-Program Homes

The target was to complete a total of 255 interviews with consumers in non-program homes located in northern and central California and 255 interviews in the control area. Subsection C.29 details the sampling procedures and interviewing protocols for interviewing the consumers in nonparticipant homes. Subsection C.30 presents the completed sample sizes.

Consumers living in homes that were not part of the PG&E Comfort Homes programs were interviewed to provide a baseline comparison for PG&E Comfort Home participants. As with the participants, since homeowners are the ultimate end users their perceptions of costs and benefits, the presence or lack of opportunities to make efficiency choices, and their awareness levels and attitudes towards these measures is extremely important.

C.29 Sample and Interview Protocol for Consumers in Nonparticipant Homes

Sampling. The target was to interview 255 consumers in non-program homes located in northern and central California and 255 in the control area. The sample of consumers in the PG&E area was provided by PG&E from their records and billing frame of single-family with meter set dates after January 1, 1998 and with the residential class indicator equal to 1. The non-program PG&E customers were oversampled from climate zones 11, 12, and 13. The sample of consumers in the control area was obtained from American Consumer Lists³ and Hugo Dunhill Mailing Lists⁴.

Protocol. A contact was removed from the sample after four unsuccessful contacts/recruit attempts. Consumers were also screened to ensure that the respondent was a qualified respondent. Qualifications for a valid respondent included only those that lived in a single family detached home constructed in 1998.

³ American Consumer Lists, Omaha, Nebraska

⁴ Hugo Dunhill Mailings Lists, New York, New York.

C.30 Completed Interview Sample for Consumers in Nonparticipant Homes

For non-program consumers in the PG&E area, completed interviews were obtained for 256 consumers from a total of 633 that were contacted, yielding a response rate of 39%.⁵ For consumers in the control area, completed interviews were obtained for 260 consumers from a total of 828 that were contacted, yielding a response rate of 31%.⁶

⁵ The total number of individuals called includes unreached and unqualified consumers.

⁶ The total number of individuals called includes unreached and unqualified consumers.

Consumers in Nonparticipant Homes

Background Information

First, we'd like to obtain some background information about you and your home.

1. Do you live in a single family detached home?
 yes
 no [**Thank and terminate interview**]
2. When was your home built?
If previous to 1998, thank and terminate interview. If unsure, continue.
3. How many months have you lived at this address? _____ months
If more than 16 months, thank and terminate interview.
4. How many people are currently living in this home? _____ # people
5. How old is the head of this household?
 Less than 29 years 50-59 years 30-39 years
 60-69 years 40-49 years 70 years or over
6. What is your *typical monthly* electric bill? \$_____
7. What is your *typical monthly* gas bill? \$_____

Awareness of Energy Efficiency

Now we'd like to ask a few general questions about energy efficiency.

8. On a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, please answer the following questions. (*read each question and circle one number for each*)

	Not At All Important		Somewhat Important		Very Important
How important is energy efficiency to you now ?	1	2	3	4	5
How important was energy efficiency to you before you moved into your current home?	1	2	3	4	5
How important was it 4 years ago?	1	2	3	4	5
How important was it 7 years ago?	1	2	3	4	5

9. On a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, how important was the energy efficiency of this home in your decision to purchase or rent it?
(Circle one number)

Not At All Important		Somewhat Important		Very Important
1	2	3	4	5

10. As far as you know, do new homes built in California have to meet any energy-efficiency standards relating to appliances, windows and insulation levels when they construct new homes?

- yes
- no **[Skip to Q12]**
- don't know **[Skip to Q12]**

11. To the best of your knowledge, does your home...*(read the first three options)*

- just meet these standards
- fall short of these standards
- exceed these standards
- don't know

12. As far as you know, are there any minimum efficiency standards on air conditioning equipment?

- yes
- no **[Skip to Q14]**
- don't know **[Skip to Q14]**

13. To the best of your knowledge, does your air conditioning equipment...*(read the first three options)*

- just meet these standards
- fall short of these standards
- exceed these standards
- don't know
- don't own any air conditioning equipment **[Skip to Q17]**

14. What kind of air conditioning equipment do you have?

- central air conditioner
- wall or window air conditioner → how many? _____
- don't know
- don't own any air conditioning equipment **[Skip to Q17]**

15. In general, do you feel the air conditioner and duct work installed in your home have had an effect on your electricity bills?

yes

no

don't know **[Skip to Q16]**

don't pay electric bill **[Skip to Q16]**

15A. Is that effect an increase or decrease in your electricity bills?

increase

decrease

15B. Is that effect a lot or a little?

increased or decreased a lot

increased or decreased a little

16. Are you satisfied with the performance of your air conditioning equipment?

yes no

17. Would you say that different kinds of residential windows...*(read the first two options)*

all have pretty much the same levels of efficiency

differ substantially in efficiency levels

don't know

18. If you were to look for a new house, would you look for energy-efficient measures?

yes no **[Skip to Q19]**

18A. Please describe the energy-efficient measures you would look for.

Awareness of Energy Efficient Programs

19. Some government agencies and utilities sponsor programs designed to encourage the installation of energy efficient features in new homes. Two such programs are the ENERGY STAR New Homes Program and PG&E's Comfort Home Program. Have you heard of either of these?

yes no **[Skip to Q22]**

19A. Which one? ENERGYSTAR Comfort Homes

19B. **[if yes to ENERGY STAR]** Did you hear about the ENERGY STAR program in connection with Comfort Homes or apart from them?

20. Was your home was built under one of these programs?

- yes
- no **[Skip to Q22]**
- don't know **[Skip to Q22]**

20A. Which one? ENERGYSTAR Comfort Homes both

21. Did the fact that this was a(n) (*answer to 20A -- ENERGY STAR OR COMFORT HOME*) Home influence your decision to purchase or rent this home? yes no

22. PG&E ran an advertising campaign last year for their Comfort Home Program. Did you or anyone in your household see a television commercial or magazine ad about Comfort Homes?

- yes
- no
- don't know or don't remember

22A. Did you or anyone in your household call their 800 number to get more information on the program?

- yes
- no
- don't know or don't remember

Ownership/Rental Decision

Now, we have some questions on your decision to purchase or rent your present home.

23. Do you own or rent this home? own rent **[Skip to Q34]**

24. Are you the original owner? yes no

25. Throughout your lifetime, how many homes have you purchased for your own occupancy? _____ # homes

26. When you purchased this home, did you have any information about its overall energy efficiency and/or efficiency of appliances, windows or insulation?

- yes
- no **[Skip to Q28]**

27. Who gave you information on your home's energy efficiency? (Check all that apply)

- the developer
- the sales agent or a realtor
- your gas utility
- the previous owner
- other → Please specify.

28. Suppose you were considering purchasing a home and you had the option of upgrading the energy efficiency of the home. If the increase in energy efficiency would save you

\$10 a month on your gas and/or electric bill as long as you lived in the home. Would you be willing to pay more for the home? ___ yes ___ no **[Skip to Q30]**

29. Assuming that you could finance at least part of the additional cost, how much of a premium on the selling price would you be willing to pay for the upgrade of the home's efficiency? \$_____

30. Are you aware of special mortgages available to help buyers purchase energy efficient homes?
___ yes ___ no **[Thank and terminate interview]**

30A. Which ones have you heard of? (Check all that apply)

- ___ Energy Efficient Mortgage
- ___ ENERGYSTAR Mortgage
- ___ other → Please specify.
- ___ don't know

31. Did you finance your current home with one of these mortgages?
___ yes ___ no **[Thank and terminate interview]**

31A. Which one?

- ___ Energy Efficient Mortgage
- ___ ENERGYSTAR Mortgage
- ___ other → Please specify.
- ___ don't know

32. Would you have purchased your home without the benefit of an energy efficient mortgage? ___ yes ___ no

33. Do you believe you are saving money with the energy efficient mortgage?
___ yes ___ no

**You have completed the survey.
Thank You.
We appreciate your time.**

Rental Only

34. When you rented this home, did you have any information about its overall energy efficiency? ___ yes ___ no **[Skip to Q36]**
35. Who gave you information on your home' s energy efficiency? (Check all that apply)
- ___ the landlord
 - ___ the rental agent
 - ___ the previous tenant
 - ___ other → Please specify.
36. Suppose you were considering purchasing a home and you had the option of upgrading the energy efficiency of the home. If the increase in energy efficiency would save you \$10 a month on your gas and/or electric bill as long as you lived in the home, would you be willing to pay more for the home?
- ___ yes ___ no
37. Assuming that you could finance at least part of the additional cost, how much of a premium on the selling price would you be willing to pay for the upgrade of the home' s efficiency? \$_____ _____ don't know

**You have completed the survey.
Thank You.
We appreciate your time.**

Consumers in Nonparticipant Homes Outside of California

Background Information

First, we'd like to obtain some background information about you and your home.

1. Do you live in a single-family detached home?

yes

no **[thank and terminate interview]**

2. When was your home built?

If previous to 1998, thank and terminate interview. If unsure, continue.

3. How many months have you lived at this address? _____ months

If more than 16 months, thank and terminate interview.

4. How many people are currently living in this home? _____ # people

5. How old is the head of this household?

Less than 29 years

50-59 years

30-39 years

60-69 years

40-49 years

70 years or over

6. What is your *typical monthly* electric bill? \$_____

7. What is your *typical monthly* gas bill? \$_____

Awareness of Energy Efficiency

Now we'd like to ask a few general questions about energy efficiency.

8. On a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, please answer the following questions. (*read each question and circle one number for each*)

	Not At All Important	1	2	Somewhat Important	3	4	Very Important	5
How important is energy efficiency to you now ?	1	2	3	4	5			
How important was energy efficiency to you before you moved into your current home?	1	2	3	4	5			
How important was it 4 years ago?	1	2	3	4	5			
How important was it 7 years ago?	1	2	3	4	5			

9. On a scale of 1 to 5, where 1 is *not at all important* and 5 is *very important*, how important was the energy efficiency of this home in your decision to purchase or rent it?
(Circle one number)

Not At All Important		Somewhat Important		Very Important
1	2	3	4	5

10. As far as you know, do new homes built in your state have to meet any energy-efficiency standards relating to appliances, windows and insulation levels when they construct new homes?

yes
 no [Go to Q12]
 don't know [Go to Q12]

11. To the best of your knowledge, does your home...*(read the first three options)*

just meet these standards
 fall short of these standards
 exceed these standards
 don't know

12. As far as you know, are there any minimum efficiency standards on air conditioning equipment?

yes
 no [Go to Q14]
 don't know [Go to Q14]

13. To the best of your knowledge, does your air conditioning equipment...*(read the first three options)*

just meet these standards
 fall short of these standards
 exceed these standards
 don't know
 don't own any air conditioning equipment **[Go to Q17]**

14. What kind of air conditioning equipment do you have?

central air conditioner
 wall or window air conditioner → how many? _____
 don't know
 don't own any air conditioning equipment **[Go to Q17]**

15. In general, do you feel the air-conditioner and duct work installed in your home have had an effect on your electricity bills?

yes

no

don't know **[Go to Q16]**

don't pay electric bill **[Go to Q16]**

15A. Is that effect an increase or decrease in your electricity bills?

increase

decrease

15B. Is that effect a lot or a little?

increased or decreased a lot

increased or decreased a little

16. Are you satisfied with the performance of your air conditioning equipment?

yes no

17. Would you say that different kinds of residential windows...*(read the first two options)*

all have pretty much the same levels of efficiency

differ substantially in efficiency levels

don't know

18. If you were to look for a new house, would you look for energy-efficient measures?

yes no **[Go to Q19]**

18A. Please describe the energy-efficient measures you would look for.

Awareness of Energy Efficient Programs

19. Some government agencies and utilities sponsor programs designed to encourage the installation of energy efficient features in new homes. One such program is the ENERGY STAR New Homes Program. Have you heard of this or a utility-sponsored program in your area?

yes no **[Go to Q22]**

19A. Which one? ENERGYSTAR Other

19B. **[if yes to Other]** What was the name of the program?

_____ name _____ don't know

20. Was your home was built under one of these programs?

yes

no **[Go to Q22]**

don't know **[Go to Q22]**

20A. Which one? ENERGYSTAR Other both

21. Did the fact that this was a(n) (*answer to 20A -- ENERGYSTAR OR Other*) Home influence your decision to purchase or rent this home? yes no

22. How did you find out about the program?

television ad

newspaper or magazine advertising

builder promotion

other → specify

Ownership/Rental Decision

Now, we have some questions on your decision to purchase or rent your present home.

23. Do you own or rent this home? own rent **[Go to Q34]**

24. Are you the original owner? yes no

25. Throughout your lifetime, how many homes have you purchased for your own occupancy? _____ # homes

26. When you purchased this home, did you have any information about its overall energy efficiency and/or efficiency of appliances, windows or insulation?

yes no **[Go to Q28]**

27. Who gave you information on your home's energy efficiency? (Check all that apply)

the developer

the sales agent or a realtor

your gas utility

the previous owner

other → Please specify.

28. Suppose you were considering purchasing a home and you had the option of upgrading the energy efficiency of the home. If the increase in energy efficiency would save you \$10 a month on your gas bill as long as you lived in the home. Would you be willing to pay more for the home? yes no **[Go to Q30]**

29. Assuming that you could finance at least part of the additional cost, how much of a premium on the selling price would you be willing to pay for the upgrade of the home's efficiency? \$_____

30. Are you aware of special mortgages available to help buyers purchase energy efficient homes?

yes no **[thank and terminate interview]**

30A. Which ones have you heard of? (Check all that apply)

Energy Efficient Mortgage

ENERGYSTAR Mortgage

other → Please specify.

don't know

31. Did you finance your current home with one of these mortgages?

yes no **[thank and terminate interview]**

31A. Which one?

Energy Efficient Mortgage

ENERGYSTAR Mortgage

other → Please specify.

don't know

32. Would you have purchased your home without the benefit of an energy efficient mortgage? yes no

33. Do you believe you are saving money with the energy efficient mortgage?

yes no

You have completed the survey.

Thank You.

We appreciate your time.

Rental Only

34. When you rented this home, did you have any information about its overall energy efficiency? ___ yes ___ no **[Go to Q36]**
35. Who gave you information on your home' s energy efficiency? (Check all that apply)
- ___ the landlord
 - ___ the rental agent
 - ___ the previous tenant
 - ___ other → Please specify.
36. Suppose you were considering purchasing a home and you had the option of upgrading the energy efficiency of the home. If the increase in energy efficiency would save you \$10 a month on your gas and/or electric bill as long as you lived in the home, would you be willing to pay more for the home?
- ___ yes ___ no
37. Assuming that you could finance at least part of the additional cost, how much of a premium on the selling price would you be willing to pay for the upgrade of the home' s efficiency? \$_____ _____ don't know

You have completed the survey.

Thank You.

We appreciate your time.

Appendix D

Builder and Consumer Analysis

This appendix presents results of the builder and consumer regression analysis. Subsection D.1 (Table D-1 through Table D-4) presents the results of the builder regression analysis using data obtained through the builder's survey. Subsection D.2 (Table D-5 through Table D-8) present the results of the consumer regression analysis using data obtained from the consumer survey.

D.1 Builder Regression Analysis

Builder Model Group 1

Table D-1 provides the results of the first group of regression models relating to builders. The dependent variables are defined as:

<i>BACI</i>	Binary variable indicating awareness of the latest available high efficiency air conditioning technology. (1 = Very Aware)
<i>BGASFURI</i>	Binary variable indicating awareness of the latest available gas furnace technology. (1 = Very Aware)
<i>BWINDOWI</i>	Binary variable indicating awareness of the latest available high efficiency windows. (1 = Very Aware)
<i>BINSULAI</i>	Binary variable indicating awareness of the latest available insulation. (1 = Very Aware)
<i>BDUTESTI</i>	Binary variable indicating awareness of the latest available duct testing practices. (1 = Very Aware)
<i>BDUTSEAI</i>	Binary variable indicating awareness of the latest available duct sealing methods. (1 = Very Aware)

The explanatory variables appearing in Table D-1 are defined below.

<i>HMBUILT</i>	Number of homes built in 1998,
<i>TRACTHM</i>	Percent of 1998 homes that were tract homes,
<i>HDDNORM</i>	Normal heating degree days,
<i>CDDNORM</i>	Normal cooling degree days,

NEWCONP1 Binary indicator of the presence of utility new construction program in the builder's area (other than PG&E).

CA Binary indicator with the value of 1 for PG&E builders and 0 for others.

Table D-1: Builder Regression Analysis – Model Group 1

Explanatory Variable	Dependent Variable					
	BAC1	BGASFUR1	BWINDOW1	BINSULA1	BDUTEST1	BDUTSEA1
Intercept	.055 (.049)	.154 (.631)	.348 (1.978)	.568 (2.68)	-2.267 (-2.558)	-.509 (-.544)
HMBUILT	.0002 (1.7)	.0002 (2.264)	.00005 (.551)	.0002 (2.396)	.0002 (2.018)	.000001 (.0009)
TRACTHM	-.002 (-1.13)	-.004 (-2.616)	-.004 (-3.142)	-.001 (-.783)	.002 (1.183)	
HDDNORM	.0001 (.813)	.0002 (3.527)	.0002 (4.251)		.0004 (2.729)	.002 (1.545)
CDDNORM	.00002 (.067)				.0005 (2.235)	.0001 (.401)
NEWCONP1	.227 (1.302)	.029 (.190)		.078 (.516)		
CA	-.121 (-.443)	-.121 (-1.035)	-.214 (-1.919)	-.186 (-1.428)	.494 (2.244)	.084 (.399)
R-square	.306	.402	.349	.256	.226	.147
Adj R-square	.250	.363	.314	.215	.172	.100
Prob>F	.0001	.0001	.0001	.0002	.002	.019

T statistics in parentheses.

Builder Model Group 2

Table D-2 provides the results of the second group of regression models relating to builders. The dependent variables are defined as:

COST Binary variable with a 1 indicating *cost* was identified as important or very important reason for not exceeding code.

LACKINFO Binary variable with a 1 indicating *lack of information on energy efficiency measures* was identified as important or very important reason for not exceeding code.

<i>UNAVAIL</i>	Binary variable with a 1 indicating <i>lack of availability of energy efficiency measures</i> was identified as important or very important reason for not exceeding code.
<i>DIFF</i>	Binary variable with a 1 indicating <i>difficulty in choosing among alternatives</i> was identified as important or very important reason for not exceeding code.
<i>HASSLE</i>	Binary variable with a 1 indicating <i>hassle</i> was identified as important or very important reason for not exceeding code.
<i>FINANC</i>	Binary variable with a 1 indicating <i>difficulties in financing</i> was identified as important or very important reason for not exceeding code.

See builder model group 1 above for definitions of explanatory variables.

Table D-2: Builder Regression Analysis – Model Group 2

Explanatory Variable	Dependent Variable					
	COST	LACKINFO	UNAVAIL	DIFF	HASSLE	FINANC
Intercept	1.226 (4.413)	.273 (2.21)	-.013 (-.095)	-1.609 (-2.346)	.086 (.394)	-.212 (-.927)
HMBUILT	-.0001 (-.834)	-.0002 (-2.351)			.0001 (1.327)	.00001 (.077)
TRACTHM	-.006 (-2.42)	.0003 (.330)	-.00002 (-.058)	.0004 (.186)	.005 (2.787)	.002 (1.166)
HDDNORM			.000002 (.086)	.0004 (3.288)		
CDDNORM	-.0002 (-2.532)		.000005 (.113)	.0004 (2.188)		
NEWCONP1	.286 (1.294)		.0007 (.019)	-.243 (-1.384)	-.205 (-1.320)	.205 (1.261)
CA	.515 (4.029)	-.163 (-1.83)	.008 (.214)	-.087 (-.453)	-.622 (-6.188)	.330 (2.861)
R-square	.480	.133	.001	.527	.474	.221
Adj R-square	.438	.090	-.080	.487	.438	.152
Prob>F	.0001	.033	.9998	.0001	.0001	.0216

T statistics in parentheses.

Builder Model Group 3

Table D-3 provides the results of the third group of regression models relating to builders. The dependent variables are defined as:

- EXCEEDP1* Proportion of single-family homes that exceed energy efficiency code (Title 24) standards in 1998.
- EXCEED2* Binary variables with a 1 indicating that proportion of houses built that exceed code has increased since 1991.
- TRACT98A* Percentage of exceeding homes that are production homes
- DOAGAIN1* Binary variables with a 1 indicating company will continue to build homes that (intentionally) exceed code (Title 24 in CA).

See builder model group 1 above for definitions of explanatory variables.

Table D-3: Builder Regression Analysis – Model Group 3

Explanatory Variable	Dependent Variable			
	EXCEEDP1	EXCEED2	TRACT98A	DOAGAIN1
Intercept	70.983 (2.614)	.698 (3.259)	-49.371 (-1.136)	-.633 (-1.367)
HMBUILT	-.067 (-3.679)	.0001 (.518)	-.005 (-.579)	-.0003 (-3.253)
TRACTHM	.290 (1.240)	-.005 (-2.355)	.886 (11.343)	.006 (7.771)
HDDNORM			.008 (1.194)	.0002 (2.155)
CDDNORM			.018 (1.687)	.0003 (2.931)
NEWCONP1	-1.597 (-.077)		7.409 (.961)	.097 (1.200)
CA	-16.555 (-1.044)	-.118 (-.841)	15.909 (1.766)	.283 (2.948)
R-square	.256	.207	.850	.793
Adj R-square	.207	.157	.830	.772
Prob>F	.001	.011	.0001	.0001

T statistics in parentheses.

Builder Model Group 4

Table D-4 provides the results of the final group of regression models relating to builders. The dependent variables are defined as:

<i>DEMANDA</i>	Binary variable with a 1 indicating the builder perceives some to a lot of demand from homebuyers for energy saving equipment or features.
<i>DEMANDB</i>	Binary variable with a 1 indicating that the builder believes customer demand for energy saving features has increased since 1991.
<i>EXPECTEE</i>	Binary variable with a 1 indicating that the builder believes homebuyers expect new homes to be energy efficient.
<i>COSTWIL1</i>	The proportion of the incremental cost builder believes homebuyers would be willing for a home that exceeded code by 10%.
<i>MKTDIFF2</i>	Binary variable with a 1 indicating that builder markets homes that exceed code (Title 24) differently than market homes that just meet minimum requirements.

See builder model group 1 above for definitions of explanatory variables.

Table D-4: Builder Regression Analysis – Model Group 4

Explanatory Variable	Dependent Variable				
	DEMANDA	DEMANDB	EXPECTEE	COSTWIL1	MKTDIFF2
Intercept	.799 (6.320)	.369 (2.779)	.880 (7.149)	-34.106 (-1.217)	-.300 (-1.008)
HMBUILT	.0001 (1.689)	.0003 (3.566)	.00001 (.962)	.028 (1.596)	.0002 (.553)
TRACTHM	.0005 (.432)	.003 (2.821)	.00005 (.253)	.771 (3.223)	.006 (2.330)
HDDNORM			.00001 (.722)		
CDDNORM			.00003 (.877)		
NEWCONP1			.013 (.686)	33.868 (1.613)	.229 (1.007)
CA	-.257 (-2.825)	-.048 (-.499)	.032 (1.044)	-25.364 (-1.854)	.077 (.426)
R-square	.166	.167	.0228	.274	.127
Adj R-square	.132	.133	-.0587	.211	.053
Prob>F	.003	.0035	.9449	.0046	.1628

T statistics in parentheses.

D.2 Consumer Regression Analysis

Consumer Model Group 1

Table D-5 provides the results of the first group of regression models relating to consumers. The dependent variables are defined as:

<i>AWARE_CD</i>	Binary variable with a 1 indicating consumer is aware of energy efficiency standards relating to appliances, windows and insulation.
<i>ACMIN2</i>	Binary variable with a 1 indicating consumer is aware of minimum energy efficiency standards for air conditioners.
<i>EEFIN1</i>	Binary variable with a 1 indicating consumer is aware of energy efficient mortgages.
<i>WINDOW1</i>	Binary variable with a 1 indicating consumer is aware of differences in windows.

The explanatory variables are defined as:

<i>FIRSTHM</i>	Binary variable indicating first-home owners.
<i>EDUYEARS</i>	Number of years of education of the head of household,
<i>PEOPLE</i>	Number of people in household.
<i>AGE1</i>	Age of head of household.
<i>HDDNORM</i>	Normal heating degree days,
<i>CDDNORM</i>	Normal cooling degree days,
<i>CENTKWH</i>	Residential electricity price,
<i>NEWCONPI</i>	Binary variable indicating the presence of utility new construction program in the builder' s area (other than PG&E).
<i>CA</i>	Binary variable indicating builders in PG&E service area.

Table D-5: Consumer Regression Analysis – Model Group 1

Explanatory Variable	Dependent Variable			
	AWARE_CD	ACMIN2	EEFIN1	WINDOW1
INTERCEP	0.823 (3.880)	0.260 (.841)	-0.058 (-.472)	0.940 (6.537)
FIRSTHM	0.016 (.408)	0.028 (.435)	0.008 (.238)	-0.158 (-4.000)
EDUYEARS	-0.014 (-1.727)	-0.012 (-.941)	0.004 (.555)	0.008 (.992)
PEOPLE	-0.020 (-1.614)	-0.019 (-.936)	0.004 (.372)	-0.030 (-2.391)
AGE1	-0.017 (-1.256)	0.011 (.525)	0.039 (3.272)	-0.050 (-3.462)
HDDNORM	0.00006 (2.823)	0.0001 (3.268)	--	--
CDDNORM	0.00004 (1.028)	0.0002 (2.875)	--	--
CENTKWH	0.005 (.405)	--	--	--
NEWCONP1	0.132 (3.427)	0.088 (1.487)	--	0.059 (1.785)
CA	0.181 (2.232)	0.144 (1.502)	0.080 (1.854)	0.010 (.187)
R-square	0.070	0.041	0.027	0.043
Adj R-square	0.053	0.021	0.019	0.034
Prob>F	0.0001	0.044	0.004	0.0002

T statistics are included in parentheses.

Consumer Model Group 2

Table D-6 provides the results of the second group of regression models relating to consumers. The dependent variables are defined as:

- AWARE_ES* Binary variable indicating awareness of ENERGY STAR[®] Program.
- EENOW1* Binary variable indicating energy efficiency is important or very important.
- EENOW4Y1* Binary variable indicating energy efficiency has become more important over the past four years.

EENOW7Y1 Binary variable indicating energy efficiency has become more important over the past seven years.

See consumer model group 1 above for definitions of most explanatory variables. In addition,

STANDARD Binary variable indicating the presence of local or state standards.

Table D-6: Consumer Regression Analysis – Model Group 2

Explanatory Variable	Dependent Variable			
	AWARE_ES	EENOW1	EENOW4Y1	EENOW7Y1
INTERCEP	-0.159 (-1.640)	0.472 (2.692)	0.285 (1.228)	0.307 (1.246)
FIRSTHM	0.037 (1.424)	-0.008 (-.255)	0.302 (7.085)	0.239 (5.304)
EDUYEARS	0.018 (3.511)	0.002 (.355)	-0.024 (-2.874)	-0.020 (-2.352)
PEOPLE	-0.016 (-1.970)	-0.009 (-.906)	-0.013 (-.966)	-0.020 (-1.412)
AGE1	-0.005 (-.554)	0.019 (1.629)	-0.075 (-4.955)	-0.097 (-6.025)
HDDNORM	--	0.00003 (1.507)	0.00005 (1.962)	0.00003 (1.352)
CDDNORM	--	0.00007 (2.019)	0.00009 (2.157)	0.00009 (2.057)
CENTKWH	--	0.016 (1.618.)	0.003 (.222)	0.023 (1.579)
STANDARD	--	--	0.160 (2.877)	0.172 (2.927)
NEWCONP1	--	--	0.080 (1.901)	0.014 (.311)
CA	0.098 (3.011)	0.057 (0.800)	0.218 (2.255)	0.155 (1.515)
R-square	0.041	0.026	0.2093	0.1928
Adj R-square	0.033	0.015	0.198	0.181
Prob>F	0.0001	0.0221	0.0001	0.0001

T statistics are included in parentheses.

Consumer Model Group 3

Table D-7 provides the results of the third group of regression models relating to consumers. The dependent variables are defined as:

<i>EETHIS1</i>	Binary with a 1 indicating energy efficiency of consumer's home was important or very important in the decision to buy or rent it.
<i>YOURMET4</i>	Binary with a 1 indicating consumer's home exceeds energy efficiency standards on appliances, windows and insulation levels.
<i>EENEWI</i>	Binary with a 1 indicating that if the consumer were to look for a new home, they would look for one with energy efficiency measures.
<i>ACSATIS2</i>	Binary with a 1 indicating consumer is satisfied with performance of air conditioner.

See consumer model groups 1 and 2 above for definitions of explanatory variables.

Table D-7: Consumer Regression Analysis – Model Group 3

Explanatory Variable	Dependent Variable			
	EETHIS1	YOURMET4	EENEW1	ACSATIS2
INTERCEP	0.656 (3.808)	0.701 (2.159)	0.680 (3.916)	0.889 (9.249)
FIRSTHM	-0.054 (-1.149)	-0.248 (-3.847)	-0.008 (-.196)	0.005 (.206)
EDUYEARS	-0.018 (-1.976)	-0.014 (-1.000)	0.009 (1.114)	0.003 (.722)
PEOPLE	0.036 (2.457)	-0.010 (-.545)	-0.012 (-.936)	-0.014 (-1.778)
AGE1	0.044 (2.619)	-0.057 (-2.493)	0.005 (.371)	0.003 (.347)
HDDNORM	--	0.00004 (1.325)	--	0.00001 (1.240)
CDDNORM	--	0.00001 (.047)	--	--
CENTKWH	--	0.007 (0.417)	-0.004 (-.313)	--
STANDARD	--	--	0.024 (.454)	0.026 (.841)
NEWCONP1	0.076 (1.947)	--	--	--
CA	0.109 (1.794)	-0.066 (-.566)	0.141 (2.033)	-0.075 (-2.406)
R-square	0.049	0.070	0.013	0.022
Adj R-square	0.040	0.052	0.003	0.011
Prob>F	0.0001	0.0001	0.251	0.058

T statistics are included in parentheses.

Consumer Model Group 4

Table D-8 provides the results of the final group of regression models relating to consumers. The dependent variables are defined as:

EEDI0A Binary variable indicating consumer would be willing to pay more for the home if they could upgrade the efficiency of a new home and save \$10/month.

PREM3 Premium consumer would be willing to pay on the sales price of the home

See consumer model groups 1 and 2 above for definitions of explanatory variables.

Table D-8: Consumer Regression Analysis – Model Group 4

Explanatory Variable	Dependent Variable	
	EED10A	PREM3
INTERCEP	0.173 (.797)	-5453.10 (-2.053)
FIRSTHM	0.145 (2.871)	454.02 (1.535)
EDUYEARS	0.007 (.680)	98.92 (1.663)
PEOPLE	0.026 (1.654)	69.00 (.702)
AGE1	-0.014 (-.804)	-48.42 (-.457)
Log(CENTKWH)	--	2348.14 (1.984)
CENTKWH	0.016 (1.042)	
STANDARD	0.028 (.435)	
CA	0.113 (1.282)	-678.25 (-1.241)
R-square	0.043	0.027
Adj R-square	0.032	0.013
Prob>F	0.0002	0.072

T statistics are included in parentheses.