Final Report: Baseline Characterization

Market Effects Study of Investor-Owned Utility Whole House Retrofit Programs in California

California Public Utilities Commission
Prepared by KEMA, Inc.
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Table of Acronyms

AHU	Advanced Home Upgrade
ARRA	American Recovery and Reinvestment Act of 2009
BPI	Building Performance Institute
CAEATFA	California Alternative Energy and Advanced Transportation Financing Authority
CATI	Computer Aided Telephone Interview
CDD	Cooling Degree Days
CPUC	California Public Utilities Commission
CSG	Conservation Services Group
DHW	Domestic Hot Water
DIY	Do it yourself
DNREC	Delaware's Department of National Resources and Environmental Control
DSIRE	Database of State Incentives for Renewable Energy (DSIRE)
E*	ENERGY STAR
EEGA	Energy Efficiency Groupware Application
EUC	Energy Upgrade California
FERC	Federal Energy Regulatory Commission
GHG	Green House Gases
HDD	Heating Degree Days
HERS	Home Energy Raters
HP	Home Performance
HVAC	Heating, Ventilation, Air Conditioning
IDSM	Integrated Demand Side Management
IOU	Investor Owned Utilities
LIPA	Long Island Power Authority
MMBTU	One million British Thermal Units
MSA	Metropolitan Statistical Area
NAICS	North American Industry Classification System
NATE	North American Technician Excellence
NYSERDA	New York State Energy Research and Development Authority
OOS	Out of State
PG&E	Pacific Gas and Electric

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RDD	Random Digit Dial
RECS	Residential Energy Consumption Survey
REN	Bay Area Regional Energy Network
RESNET	Residential Energy Services Network
SCE	Southern California Edison
SIC	Standard Industrial Classification
SoCalGas	Southern California Gas
TVA	Tennessee Valley Authority
WAP	Weatherization Assistance Program
WH	Whole House

Executive Summary

This is the Final Report of the Baseline Characterization of the market for Whole House Retrofit (WH) and Home Performance (HP) services in California. The Baseline Characterization is the first phase of a planned two-part study to assess the effect of programs sponsored by the California Investor-Owned Utilities (IOUs) on the market for WH and HP services. For the purposes of this report we define those services as follows.

- **Whole House Retrofit:** An approach to planning and executing energy efficiency improvements in a home so as to maximize energy savings. Generally, this involves following a "loading order" of measures whereby thermal loads are decreased through air sealing, duct sealing, insulation and other shell measures, followed by changes to energy supply systems such as space heating, water heating, and cooling to most efficiently meet the reduced load.
- **Home Performance Services:** A suite of pre- and post-installation services designed to identify cost-effective measures, inform customer decisions regarding the selection and sequencing of implementation, and assure the quality and effectiveness of the measures installed. These services include home energy assessments or audits, diagnostic testing of shell elements and heating and cooling equipment, and post-installation testing to ensure that measures are working properly.

The objectives of this phase of the study are to characterize the structure and current volume of activity in the WH/HP service market in California and in a comparison area that has not been served programs funded by public goods charges that promote those services, and to summarize the findings in a set of quantitative market indicators. The follow-up phase will re-estimate the value of the market indicators using essentially the same methods applied in the Baseline Characterization. The difference between California and the comparison areas in the pace of change of the market indicators will serve as the primary measure of the market effects of the IOU programs. Also, the comparison between California and the non-program on the current values of market indicators provides some insights into the early effects of EUC.

Program Overview

The California IOUs initiated delivery of programs to promote the delivery and purchase of WH/HP services as part of the 2010 – 2012 program cycle. At roughly the same time, state and local government agencies began to offer similar programs with the support of the U. S. Department of Energy, using economic stimulus funding made available under the American Recovery and Reinvestment Act of 2009. In early 2010, these efforts were consolidated at the statewide level under the rubric of Energy Upgrade California (EUC). In late 2012, by Commission Decision, the EUC brand, logo and name was expanded from being solely a whole house brand to being California's new clean energy/integrated demand side management brand.

For this reason, the IOUs changed their whole house program names to Advanced Home Upgrade and Home Upgrade in 2013. Some IOU marketing of whole house programs using the EUC brand continued in 2013 during this transition period, but as of 2014, the EUC brand is expected to be devoted to marketing and awareness for California's larger Integrated Demand Side Management (IDSM) and clean energy statewide goals and campaigns. From here forward in this document, we refer to the Home Upgrade/Advanced Home Upgrade marketing programs when referring to IOU marketing of WH/HP concepts.

In addition to its energy savings objectives, the IOU's Home Upgrade/Advanced Home Upgrade is also designed to support "Transform[ation] of home improvement markets to apply whole house energy solutions to existing homes," a major goal identified in the *California Energy Efficiency Strategic Plan*. In its current form, the IOUs Home Upgrade/Advanced Home Upgrade programs offer the following incentives and services.

- **Customer Incentives.** The IOU's Home Upgrade/Advanced Home Upgrade (HU/AHU) program offers financial incentives up to $4,500 for whole house retrofits using two different approaches.
- **Contractor Qualification and Listing.** In order to receive incentives, customers must use contractors who have been qualified by the HU/AHU statewide program. Qualifying contractors program remain listed on the EUC statewide website and can be searched geographically.
- **Quality Assurance.** The IOUs' program delivery contractor reviews all applications and home energy assessments for completeness and compliance with technical procedures. The program delivery contractor also inspects a high percentage of completed projects.
- **Contractor Training.** All contractors who participate in the program are required to take training to orient them to program rules and procedures. The utilities and other program sponsors also offer a variety of technical and sales training options through their Workforce Education and Training portfolios.
- **Marketing.** EUC undertook extensive marketing activities in support of the program during 2011-2012, some ARRA- funded, some IOU- funded. These efforts included mass media, social media campaigns, public relations events, visibility at events such as home shows, and maintenance of the statewide web site. In 2014, marketing for whole house services began using the HU/AHU program name exclusively, with program materials remaining easily available on the expanded Energy Upgrade California brand clean energy website.
- **Project Financing.** The California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA) administers the Clean Energy Upgrade Financing

Program to facilitate the financing of energy retrofits on California properties. The IOU's HU/AHU programs provide referrals to customers as needed.

Participation and Savings. 6,315 projects were completed during the 2010 – 2012 program cycle: 4,330 through the advanced track and 1,985 through the prescriptive track. At the direction of the CPUC, the IOUs original *Program Implementation Plan* contained funding levels sufficient for 40,000 prescriptive projects during the first three-year cycle. During the first 13 months of the 2013 – 2014 cycle, 3,601 projects were completed, all but 190 of them through the Advanced track. While program participation has begun to accelerate somewhat, expenditures and *ex ante* savings have run consistently below plan since program inception. Virtually every other WH/HP program that we reviewed in the course of our literature review for this study has experienced similar difficulties in achieving planned levels of participation.

For the current cycle, the customer costs for projects completed under the Advanced Upgrade track averaged $14,050. Average tracking system *ex-ante* savings estimated through the energy assessment were estimated at 29 percent of pre-program annual energy use.1

Contractor Participation. Analysis of contractor lists on the EUC web site as of July/August 2013 found that 432 firms were qualified to provide services through the program out of roughly 13,000 firms that provide general home remodeling, HVAC, insulation, and specialty energy efficiency services in California.

Study Methods

To structure the research for this project, we identified three study areas. The California Program Area consisted of the full service territories of Southern California Edison, San Diego Gas & Electric, and SoCal Gas, as well as the counties in the PG&E service territory in which the initial roll-out of the program occurred. The California Comparison area consisted of counties in the PG&E service territory in which intensive program marketing had not been deployed during the study period. The Out-of-State (OOS) Comparison Area consisted of a set of Metropolitan Statistical Areas in North Carolina, South Carolina, Tennessee, and Texas which, taken together, corresponded to the climate, demographic, and housing market conditions found in the California Program Area to the extent feasible.

The primary research and analysis conducted for this study consisted of the following elements.

- **Homeowner Survey:** telephone survey of homeowners of single-family or two-family houses in the California Program and Comparison Areas. Respondents were screened for

[1] Ex ante savings are those projected or reported by IOU personnel, they have not been verified or approved by the CPUC. Personal correspondence with Nils Strindberg, California Public Utilities Commission

eligibility based on whether they had completed renovations in the past three years that cost more than $3000 to complete. We completed 500 interviews in the CA Program and OOS Comparison Area; 200 in the CA Comparison Area. We did not establish quotas for customers who had received support from energy efficiency programs in completing their home improvement projects. However, a large enough number of respondents in all three study areas reported that they had received such assistance, which enabled us to report results for some items separately for participants and non-participants. The survey was in the field from June 24 2013 through January 8, 2014.

- **Contractor Survey:** telephone survey of contractors active in the trades and specialties addressed by WH/HP programs. These include firms active in general home remodeling, heating and cooling equipment (HVAC) installation and maintenance, insulation, and residential energy efficiency improvements. We completed 90 contractor interviews in the CA Program Area; 74 in the OOS Comparison Area. This survey was not conducted in the CA Comparison Area due to inadequate populations of firms to support the sample. This survey was in the field from early September 2013 until January 8, 2014.
- **In-depth Interviews and Case Studies of High-Volume Contractors:** in-depth interviews and case studies of 6 high-volume contactors: 3 active in California and three active in other states. The case studies developed narratives of the firm's entry into the energy efficiency contracting market, their basic business model, strategies to address common challenges, and their assessment of the prospects for development of an unsubsidized market. These case studies were conducted in early 2013.

Due to the timing of the study, the research effort necessarily focused on characterizing conditions in California and the Comparison Areas during the period of early program implementation. Thus, the period does not strictly represent a baseline as defined by most evaluation guidelines. Findings from the California Program Area reflect some effects of the operation of the HU/AHU programs. The difference between the California Program Area and the Comparison Areas in the observed values for market indicators provides a sense of the magnitude of those effects. However, as discussed in Sections 3 and 4 below, there are many other factors that contribute to those differentials, such differences between the study areas in code requirements. The cross-sectional comparisons provided by this study do not, by themselves, provide a strong basis for attributing observed differences in market indicators to the HU/AHU programs versus other potential factors. We believe analysis of the difference between the study areas in the pace of change in market indicators over time, as well as other potential approaches that become available with two sets of observations, will provide the basis for more comprehensive and convincing analyses of program effects.

Summary of Findings

Table E1 displays the estimates of the market indicators selected to represent the current condition of the market for WH/HP services in the CA Program Area and the Comparison Areas. The values in E1 represent the entire population of customers who made major home improvements, regardless of their participation status. The key overarching observations based on the findings presented in Sections 3 through 5 are as follows.

- **As of early 2014, we find the level of unsubsidized adoption of the WH/HP approach to energy efficiency to be very low, both in the California Program Area or in the Comparison Areas.** Among non-participants, only 8 percent in the California Program Area and 6 percent in the Comparison Areas reported installing combinations of shell and air sealing measures. Only 3 – 4 percent reported installing combinations of shell and HVAC measures. Fourteen percent of non-participants in the CA Program area reported having a blower door test done as part of their project, as did 10 percent of non-participants in the Comparison Areas. None of the high-volume contractors interviewed in depth for the case studies attempted to market their services without subsidies. When questioned why, none believed that the services could be marketed profitably without program support.
- **Individual components of the WH/HP approach are available on the market, and are being incorporated into a relatively small portion of home improvement projects, including some competed without program support.** In the California program area, 65 percent of homeowners who recently completed home improvements incorporated at least one energy efficiency measure into their projects; 35 percent included two or more measures. Relatively few homeowners used combinations of measures and diagnostic tests associated with the WH/HP approach, but there were some non-participants among those who did. For example:
  - Combination of insulation and air sealing measures. Eight percent of all projects in the CA Program area included this combination of measures, as shown in Table E1, which displays results for the full sample of respondents in each study area, regardless of participation status.
  - Blower door tests for infiltration. Seventeen percent of all projects in the CA Program Area included this test. The portion of projects with blower door tests was significantly higher (p-value < .10) in the two California study areas than in the OOS Comparison area.
  - Duct leakage tests. Thirty-four percent of all projects involving improvements to heating and cooling systems in the CA Program Area included this test, as did 24 percent of heating and cooling improvements carried out in the California Comparison Area. By contrast only 12 percent of consumers who carried out heating and cooling upgrades in the Out of State Comparison Area reported have duct

leakage tests performed. This result likely reflects changes in California building codes that require duct leakage tests for permitted installations of residential heating and cooling equipment

These findings are consistent with results from the contractor survey regarding the share of projects on which various types of measures and tests are deployed. They suggest the presence of a small unsubsidized market for some components of the WH/HP approach, but not for the entire, integrated package.

Table E1: Market Indicators for WH/HP Services

Market Indicator	Full Sample		
	CA Program	OOS Comparison	CA Comparison
Consumer Market			
Percent of home improvement projects with multiple Energy Efficiency measures	38%	32%	31%
Percent of projects with combined shell and air sealing measures	10%	6%	6%
Percent of projects with combined shell and HVAC measures	5%	4%	4%
Percent of projects that include blower door tests	17%	12%	21%
Percent of HVAC projects that include duct leakage tests	34%	12%	24%
Percent of projects with main motivation of energy saving, improved comfort, or improved air quality	29%	24%	35%
Percent of customers making home improvements who are aware of WH/HP services	29%	13%	17%
Percent of customers who find their contractor through a utility or government energy efficiency program.	3%	2%	3%
Supply Chain			
Number of BPI-certified contractors per 10,000 occupied housing units	4.36	2.59	
Share of market represented by contractors who deliver combined shell and air sealing measures in all or most projects	18%	11%	
Share of market represented by contractors who deliver combined shell and HVAC measures in all or most projects	20%	17%	
Share of market represented by contractors who deliver energy audits in all or most projects	20%	11%	
Share of market represented by contractors who use blower door tests in all or most projects	15%	5%	
Share of market represented by contractors who use duct leakage tests in all or most projects	17%	12%	
Share of market represented by contractors aware of whole house retrofit concepts	75%	67%	
Share of market represented by contractors who can accurately describe WH/HP practices	33%	30%	
Share of market represented by contractors who are aware of WH/HP programs in their local markets	59%	44%	
Share of market represented by contractors who report that they currently deliver WH/HP services	12	4%	

Significantly different from the CA Program Area at the 90% confidence level

- **Low levels of awareness of the WH/HP value proposition and restricted contractor search practices are the major barriers to increased adoption of WH/HP practices among consumers.** Despite the marketing and publicity efforts that have supported the IOUs HU/AHU program, levels of customer awareness of WH/HP services and their value are relatively modest. In the California Program Area, 29 percent of sample customers who had carried out major home improvements in the last 3 years reported being aware of home performance programs after being read a detailed description of the services provided. In terms of adopting WH/HP practices, the effects of these modest levels of awareness are compounded by the restricted range of resources that customers access in finding a contractor. In 70 percent of cases customers used contractors whom they had employed on previous projects, found through word of mouth, or had previous personal relationships, regardless of study area or program participation status. High-volume WH/HP contractors interviewed for the case studies stressed the importance of personal selling in closing whole house projects, due to their complex value proposition. Given the restricted channels used to find contractors, it is difficult even for motivated contractors to insert themselves into the project specification process. Only 1 percent (OOS) to 2 percent (CA) of respondents reported using contractors found through energy efficiency programs.

  Many studies of WH/HP programs identify first costs as a major barrier to undertaking whole house retrofits. In this study we found that cost was not a major barrier for inclusion of energy efficiency measures into home improvement projects generally. No more than 7 percent of customers in any of the study areas reported that they were unable to complete all energy efficiency measures recommended to them by an audit or contractor due to financial constraints. A recent process evaluation estimated the share of customers who did not complete all recommended measures due to financial constraints at 28 percent. [2] The difference between the results for the general population of homeowners with improvements versus homeowners in the California AHU program is likely due to the fact that virtually all participants in the AHU program received a comprehensive audit recommending a wide range of measures.

- **Effective delivery of WH/HP services and participation in WH/HP programs requires a scale of contractor operations that is beyond the capability of the large majority of firms in the home improvement industry.** The case studies of high-volume WH/HP contractors demonstrate that success in this field requires investment in hiring and training staff to market the services, maintain consistency and quality of delivery, and manage a significant flow of technical and administrative work associated with completing home assessments, obtaining rebates, and assuring compliance with program rules. All but one of the six high-volume contractors employed

[2] SBW Consulting, Inc. 2013.

20 or more workers. By contrast, only 5 percent of the more than 13,000 California firms listed by the InfoUSA business establishment database in relevant residential contracting specialties employed 20 or more workers.[3] Eleven percent employ 10 or more workers. Thus, recruiting a significant portion of these larger firms into the program and encouraging their active marketing of its services is a critical step in growing WH/HP service delivery capacity and program participation.

- **Lack of understanding of WH/HP services and their potential business value is the major barrier to adoption of WH/HP practices and program participation among contractors.** Although contractors representing 75 percent of the home improvement market in the CA Program area reported being aware of WH/HP service concepts, only roughly half of those could accurately describe the WH/HP approach. When questioned whether it would be worthwhile to invest in developing WH/HP service delivery capability, 46 percent of all contractors in the California Program Area sample answered positively. Given the relatively small number of firms capable of delivering WH/HP services at scale, outreach and education to recruit and motivate contractors will be essential to achieving targeted levels of program participation and savings.
- **Progress in developing the California market.** Despite the challenges described above to the growth of WH/HP services and participation in programs that support them, the market indicators in Table E1 suggest that EUC, along with its predecessor retrofit programs, and related programs that support quality HVAC installation, are having a positive effect on the market. We note that a significantly higher (p-value < .10) percentage of who have recently undertaken major home improvements in the CA Program area have incorporated the following measures and procedures into their projects, versus their counterparts in the OOS Comparison Area:
  - Multiple energy efficiency measures in a single project;
  - Combination of air sealing and insulation measures; and,
  - Blower door tests.

  We also note that a significantly higher (p-value < .10) percentage of homeowners with projects in the CA Program Area report that they are aware of WH/HP services than their counterparts in either the OOS or CA Comparison Areas. The difference between the CA Program and OOS Comparison area on this indicator is sufficiently large (29 percent v. 13 percent) to suggest that it reflects the effects of the significant marketing effort surrounding WH/HP concept during the 2010-12 period, when this was primarily

[3] See infousa.com for a description of the establishment database and methods used to compile and maintain it.

ARRA-funded, and subsequently in 2013 when the IOUs spent heavily on EUC/ Home Upgrade/Advanced Home Upgrade marketing.

On the supply side of the market, the indicators of effects from programs to promote WH/HP services are less clear. Although contractors in the CA Program Area report offering and installing WH/HP components in a larger share of projects than their counterparts in the OOS Comparison Area, these differences are small and not statistically significant in most cases. We do observe two clear-cut differences between the study areas. First, the number of BPI-certified contractors, normalized for market size, is 70 percent higher in the CA Program Area than in the comparison area. Second, contractors representing 59 percent of the market in the California Program Area report being aware of WH/HP programs versus 44 percent in the Out-of-State Comparison Area, and the level of participation is nearly twice as high: 28 percent v. 14 percent.

Implications for EUC Program Operations

While the scope of this project did not include a thorough process evaluation of the IOU's HU/AHU programs, we believe the findings summarized above suggest general strategies for increasing program participation. These include the following:

1. **Continue and expand the consumer marketing and outreach campaign to inform customers and realtors of the value of WH/HP services**. The results of the household survey and the case studies suggest that messaging for program marketing should address the full range of program benefits, including:
   - Increased comfort and indoor air quality;
   - Upgrading and maintenance of key home systems;
   - Consumer protection elements, including contractor screening and inspections;
   - Reduction of search time and other transaction costs through contractor listing and administrative support in completing applications.

2. **Build contractor motivation and capacity to market and sell WH/HP services.** We understand that ARRA-funded EUC activities during the 2010-12 period put considerable effort into this objective. Some tactics to consider in this regard include the following.
   - Focus outreach to contractors in larger firms (those with 10 or more employees). Smaller firms will generally not have the capacity to build significant project volume or to hire sales and administrative personnel.
   - Develop intensive marketing sales training for contractor sales personnel.
   - Develop playbooks or other instructional material to provide guidance in building volume under the program.

   Conduct competitions for contractors on volume and quality of work delivered.

1. Introduction

This is the Final Report of the Baseline Characterization of the market for Whole House Retrofit (WH) and Home Performance (HP) services in California. The Baseline Characterization is the first phase of a planned two-part study to assess the effect of programs sponsored by the California Investor-Owned Utilities (IOUs) on the market for WH and HP services. For the purposes of this report we define those services as follows.

- **Whole House Retrofit:** An approach to planning and executing energy efficiency improvements in a home so as to maximize energy savings. Generally, this involves following a "loading order" of measures whereby thermal loads are decreased through air sealing, duct sealing, insulation and other shell measures, followed by changes to energy supply systems such as space heating, water heating, and cooling to most efficiently meet the reduced load.
- **Home Performance Services:** A suite of pre- and post-installation services designed to identify cost-effective measures, inform customer decisions regarding the selection and sequencing of implementation, and assure the quality and effectiveness of the measures installed. These services include home energy assessments or audits performed according to standard protocols, diagnostic testing of shell elements and heating and cooling equipment to refine estimates of potential savings and target improvements, post-installation testing to ensure that measures are working properly, and quality assurance inspection of the full completed project.

The objectives of this phase of the study are to characterize the structure and current volume of activity in the WH/HP service market in California and in a comparison areas that has not hosted programs funded by public goods charges that promote those services. On the demand side of the market, our research has focused on developing quantitative indicators of customer awareness and knowledge of WH/HP service concepts, and the adoption of practices associated with those concepts in recent home improvement projects. On the supply side of the market, we have focused on developing quantitative indicators of awareness, knowledge, and adoption of WH/HP service delivery practices among contractors who sell to the targeted market: general home remodelers, HVAC contractors, insulation contractors, and residential energy efficiency specialist contractors. The overall study plan specifies a follow-up study to be carried out 2 – 4 years from now, at which point researchers will re-estimate the value of the market development indicators using essentially the same methods used for the Baseline Characterization. The difference between California and the comparison areas in the pace of change of the market indicators will serve as the primary measure of the market effects of the IOU programs. Also, the differences between California and the comparison areas on the current values of market indicators provides some insights into the early effects of the IOUs Home Upgrade/Advanced Home Upgrade program.

The study has been shaped to a large extent by the observation that virtually all WH/HP programs have fallen far short of their participation goals. Halfway through the current program cycle, the IOU's programs have recorded *ex ante* electric savings equal to 18 percent of the goal for the period; 21 percent for gas savings. The longest-standing home performance program, the New York State Energy Research and Development Authority's Home Performance with Energy Star, served only 1 percent of eligible customers statewide over its first 12 years of operation. We have focused our research on how WH/HP service offerings fit with established patterns of behavior by customers and firms in the home improvement industry, in order to identify practical means by which demand for those services and the capacity to deliver them can be increased.

1.1 Program Overview

1.1.1 Program Description

The California IOUs initiated delivery of programs to promote the delivery and purchase of WH/HP services as part of the 2010 – 2012 program cycle. At roughly the same time, state and local government agencies began to offer similar programs with the support of the U. S. Department of Energy, using economic stimulus funding made available under the American Recovery and Reinvestment Act of 2009. The programs operated by local government and non-profit agencies completed roughly 2,000 whole house retrofit projects between 2009 and 2012. In early 2013, these efforts were consolidated at the statewide level under the leadership of the California Energy Commission using the rubric of Energy Upgrade California (EUC). In 2012, the California Public Utilities Commission directed that EUC would be expanded from a WH/HP program brand into California's clean energy and integrated demand side programs brand. As a result, in 2013, the IOUs changed their WH/HP program name from EUC to the Home Upgrade/Advanced Home Upgrade program.

At the same time, the CPUC funded local government partnerships – the Bay Area Regional Energy Network (REN), the Southern California REN, and the Marin Clean Energy Authority - to offer WH/HP programs for the 2013 -2014 program cycle. The Bay Area REN identifies its program as Home Upgrade/Advanced Home Upgrade; SoCal REN as Energy Upgrade California. The Marin program is small (total budget under $500,000) and focuses on providing loans. The total budget for these programs was $30 million. As of February 2014, the programs had expended roughly $5.9 million and had only recently begun to record installed projects in the Energy Efficiency Groupware Application (EEGA) tracking system.

In early 2014, the EUC statewide marketing and outreach platform re-launched and began promoting general clean energy awareness, starting with an information campaign about the "climate credit" available to consumers as a result of California's GHG Cap and Trade program. The EUC website address did not change during this transition, and continues to offer

information about the IOUs Home Upgrade/Advanced Home Upgrade program and general WH/HP information, as well as newly expanded clean energy content and demand side energy savings opportunities for homes and small businesses.

The *California Energy Efficiency Strategic Plan (2011 Update)* identifies the "Transform[ation] of home improvement markets to apply whole house energy solutions to existing homes" as one of its three major goals for the residential building sector. The importance of the whole house approach is further emphasized in a number of CPUC decisions on energy efficiency programs and policies.[4] The IOU's Home Upgrade/Advanced Home Upgrade program is the most visible and heavily funded program element for achieving that goal. In its current form, the program offers the following incentives and services to promote customer purchase of WH/HP services and to support the development of contractors' capacity to deliver those services.

- **Customer Incentives.** The HU/AHU program offers financial incentives for whole house retrofits using two different approaches. The Advanced Home Upgrade program requires the completion of a standardized home energy assessment by a qualified contractor to identify appropriate measures and estimate their savings. The incentive paid is gauged to the estimated savings for measures installed, with a minimum threshold of 10 percent of base line energy use and a maximum of 45 percent. The incentives range from $1,000 to $4,500. The Home Upgrade Program (Prescriptive track) track does not require a home energy assessment. Rather, individual measures are assigned points and incentives are paid based on the points for the measures installed, with a minimum threshold of 100 points. The customer must install at least two measures to achieve the minimum and the point system is constructed to induce customers to follow the loading order of measures mentioned above. Incentives available under the Home Upgrade track range from $1,000 to $2,500.
- **Contractor Qualification and Listing.** In order to receive incentives, customers must use contractors who have been qualified by the IOU'sHU/AHU statewide program. Basic qualification requires that contractors maintain appropriate licenses and minimum insurance coverage, and that they agree to abide by program rules. To receive incentives for the Advanced Home Upgrade track, the contractor must employ at least one analyst or technician who has been certified by the Building Performance Institute, an organization that provides technical support, training, and certification services to the residential energy efficiency industry. Qualifying contractors are listed on the EUC statewide website Home Upgrade/ Advanced Home upgrade page and can be searched geographically.
- **Quality Assurance.** In addition to the quality assurance elements built into contractor qualification, the IOUs' program delivery contractor reviews all applications and home

[4] D. 09-09-047, p. 110.

energy assessments for completeness and compliance with technical procedures. Applications which do not comply or present anomalies are referred back to the contractor and incentives are not paid until the technical or administrative issues are resolved. The program delivery contractor also inspects a high percentage of completed projects to ensure quality installation, and may call back contractors to address any problems with materials or workmanship that may have been identified.

- **Contractor Training.** All contractors who participate in the program are required to take a combination of on-line video and classroom training to orient them to program rules and procedures and to provide strategies for selling WH/HP services with the support of the program. The utilities and other program sponsors also offer a variety of technical training options through their Workforce Education and Training portfolios.
- **Marketing.** During 2010-2013, both ARRA- and IOU-funded EUC efforts included extensive marketing activities in support of the IOU's HU/AHU program including mass media and print advertising, social media campaigns, public relations events, visibility at related events such as home shows, multiple points of access on the Internet, outdoor advertising, direct mail and email marketing, and maintenance of the statewide web site.
- **Project Financing.** The California Assembly has authorized the California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA) to administer a Clean Energy Upgrade Financing Program using up to $25 million to facilitate the financing of energy retrofits on California properties. The funds are used to provide loan loss reserves to private lenders, in return for offering advantageous terms to the borrower to finance projects developed through the HU/AHU program. The IOUs do not participate directly in the Clean Energy Financing program but provide referrals to customers as needed.

While the scope and specifics of the IOU's Home Upgrade/Advanced Home Upgrade program have been developed to fit the California market and policy environment, the basic elements of the program are similar to those used by sponsors of similar programs around the country.

1.1.2 Summary of Program Activity

Participation and Savings. Table 1 summarizes planned and tracked expenditures, *ex ante* energy, and demand savings for the 2010 – 2012 and first 13 months of the 2013 – 2014 cycle. 6,315 projects were completed during the first cycle: 4,330 through the advanced track and 1,985 through the prescriptive track. At the direction of the CPUC, the IOUs original *Program Implementation Plan* contained funding levels sufficient for 40,000 prescriptive Home Upgrade projects during the first three-year cycle. During the first 13 months of the 2013 – 2014 cycle, 3,601 projects were completed, all but 190 of them through the Advanced Home Upgrade track. Based on analysis of total market volume described above, we estimate that the 9,916 projects completed over the first 49 months of program activity represent roughly 1.9 percent of all home

improvement projects with costs over $3,000 undertaken by single family home owners in the three IOU service territories.

Although the figures in Table 1 suggest that program participation has begun to accelerate somewhat, expenditures and *ex ante* savings have run consistently below plan since program inception, and continue to do so.[5] Virtually all other WH/HP programs reviewed for this study have experienced similar difficulties in achieving even modest planned levels of participation. See Section 2 for more details on this issue.

Table 1: Summary of Program Spending and Tracking System Savings: Program Inception through January 2014

	Expenditures $ Million	MWh/Yr	MW	M Therms/Yr
2010 - 2012 Planned (Revised)	$83.0	39,249	27.0	5,275
2010 - 2012 Reported	$39.2	4,738	6.6	1,857
Reported as % of Planned	47%	12%	21%	35%
2013 - 2014 Planned	$70.3	25,090	26.2	2,522
Reported through 1/2014	$21.1	3,558	4.7	536
Reported as % of Planned	30%	14%	18%	21%

Average project costs and savings. In the current cycle, 96 percent of all projects completed through the IOU Whole House programs come through the Advanced Home Upgrade track. The customer costs for projects completed under the Advanced Upgrade track averaged $14,050. Average ex-ante savings estimated through the energy assessment were estimated at 29 percent of pre-program annual energy use.[6]

Contractor Participation. Analysis of contractor lists on the EUC website Home Upgrade/ Advanced Home Upgrade page as of July/August 2013 found that 432 firms were qualified to provide services through the program. Many of these contractors provided service in more than one utility service territory. The individual utilities showed significant differences (p-value < .10) in patterns of contractor participation. For example, in the PG&E service territory, 157 of 173

[5] See reports available at California Energy Efficiency Statistics, http://eestats.cpuc.ca.gov/Views/Documents.aspx

[6] Ex ante savings are those projected or reported by IOU personnel, they have not been verified or evaluated by the CPUC. Personal correspondence with Nils Strindberg, California Public Utilities Commission

qualified contractors (91 percent) submitted project applications, versus 35 of 66 (53 percent) in SoCal Gas territory and 17 of 64 (27 percent) in San Diego Gas & Electric territory. The average number of projects completed per participating contractor ranges from 6 for SoCal Gas to 84 for PG&E. Some of this variation is likely due to the difference in the return on customer investment in whole house retrofits in northern versus southern California, but the difference is still notable.

1.2 Overview of Analytic Approach and Methods

1.2.1 Program Theory Framework

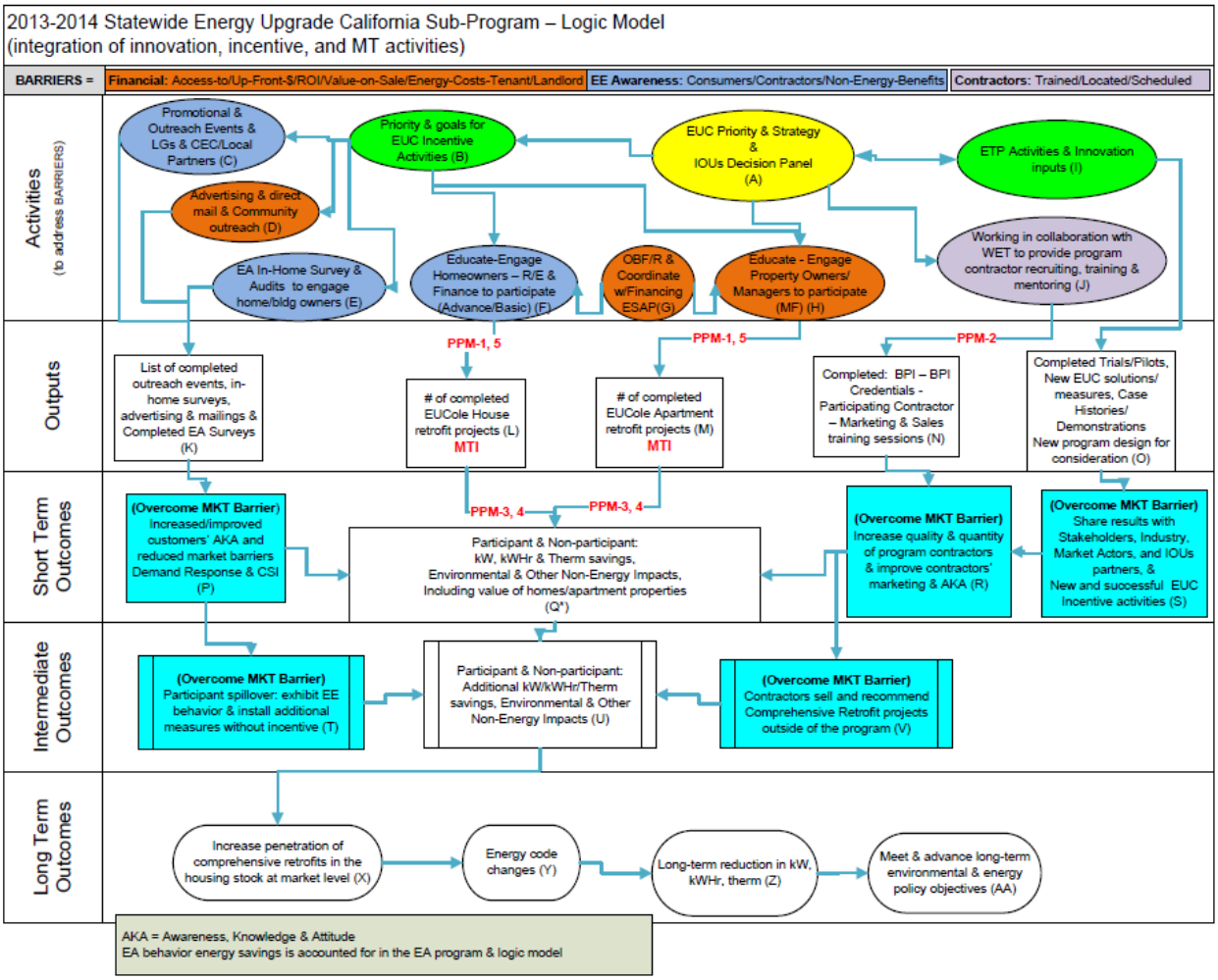
Whole house retrofit and home performance programs have claimed a market transformation agenda since their first introduction in New York State in the year 2000. Their key market transformation objectives have been to:

- Build customer demand for the services through consumer education, incentives and other supports for early adopters, and fostering growth through diffusion channels such as word of mouth and marketing communications; and,
- Build delivery capacity through technical training and marketing support for contractors who undertake to offer the service.

After a period of time, a sufficiently large number of customers will become familiar with the value proposition offered by WH/HP services that some portion will be willing to purchase them without subsidy, at which point contractors will intensify efforts to market and streamline the delivery of services so that they can deliver them profitably to an unsubsidized market segment. The IOUs' program logic model, shown in Figure 1 reflects this basic approach, and incorporates the market transformation goals of building customer awareness, knowledge and adoption of WH/HP services, as well as the number and capabilities of contractors who can deliver the service.[7]

[7] Pacific Gas & Electric Company. 2013. *2013 – 2014 Energy Efficiency Portfolio Statewide Program Implementation Plan: Residential Program*. April 23, 2013, Revised.

Figure 1: EUC Program Logic Model



The Program Implementation Plan identifies a number of specific barriers to customer and contractor adoption that program is to address, including:

- High first costs for comprehensive energy upgrades
- Lack of "market awareness" of the non-energy benefits of comprehensive upgrades.
- Low customer awareness of the value proposition for WH/HP services.
- Lack of well-developed delivery infrastructure among contractors.
- Lack of common home rating protocols and a "vernacular for the market to assign value to homes which undergo comprehensive energy upgrades".

Figure 2 summarizes the application of WH/HP program theory to the typical components of program operation, based on published plans and evaluations of a number of programs.[8]

Figure 2: Barriers to Market Acceptance of WH/HP Services and Typical Program Elements that Address Them

Barrier	Program Elements
Lack of customer awareness of WH/HP services and their value	• Advertising and publicity campaigns • Direct marketing • Event-based marketing • Social media and other web-based marketing • Development of sales materials and strategies for participating contractors
High first cost of comprehensive retrofits	• Rebates • Arrangement for dedicated and potentially reduced-interest lending facilities
Customers' time and transaction costs for learning about the service offering, identifying qualified contractors, and so forth.	• Contractor qualification process • Contractor listing service • Customer education materials and web sites
Customer's perceived risks concerning the appropriateness, effectiveness, and quality of measures installed.	• Contractor qualification process • Requirements for standardized home assessments • Quality control of assessments and applications • Inspections of completed projects
Lack of contractor awareness of WH/HP techniques and related information search costs	• Training in home performance techniques
Lack of contractor familiarity with WH/HP service sales and marketing	• Training in selling WH/HP services • Financial incentives to the customer

The Baseline Characterization and development of market indicators presented in this report focus on those elements of the market that characterize its current condition and prospects for development that are emphasized in the program theory discussed above. These elements are:

Supply Side of the Market

- Awareness and knowledge of WH and HP technology and delivery methods among firms in the home improvement market.

[8] See, for example, Summit Blue Consulting, LLC. 2009. *New York Home Performance with Energy Star Program: Market Characterization and Market Assessment Evaluation*. Albany, NY: New York State Energy Research and Development Authority.

- The capacity of firms in the market to sell and deliver WH and HP services, as indicated by investment in training, specialized equipment and software, marketing and sales processes, and administrative capacity to support participation in WH/HP programs.
- Adoption of WH/HP practices such as provision of home energy assessments, diagnostic testing, packaging of multiple measures, and use of the "loading order" in the full range of business activity, including services delivered "outside" of WH/HP programs.
- Development of viable business models to support longer term development of WH/HP delivery capacity.
- Development of private sector infrastructure to support contractors in the market, including building science research and development, contractor training and certification, financing models and facilities, and advocacy for industry support through government policies and regulated program designs.

Demand Side of the Market

- Awareness and knowledge of WH and HP technology and benefits among homeowners, and particularly among homeowners in the market for major improvements.
- Homeowner understanding of the value of WH/HP services, including non-energy benefits such as improved air quality and comfort.
- Adoption of WH/HP practices and services in home improvement projects.

1.2.2 Research and Analysis Methods

Figure 3 summarizes the research and analysis tasks undertaken for the Baseline Characterization. We recommend that the second phase of the study essentially repeat all of these activities using similar methods in order to ensure comparability of results. Given the relatively slow pace of uptake for WH/HP methods documented in Sections 2 and 3, we recommend that the follow-up phase of the study be undertaken as late as possible, given IOU and CPUC regulatory and program planning schedules. Given the results of this study, we would not expect to see significant changes in market indicators until 2016 – three years after the completion of the data collection for this report. Ideally, the study would be carried out in close coordination with IOU-sponsored process evaluations and CPUC-sponsored impact evaluations, both to reduce burden on survey respondents and to ensure that the individual evaluation efforts can make use of the findings from the others. The following paragraphs summarize key elements of the research methods, beginning with the definition and selection of the comparison areas. We provide additional methodological detail in Appendix B.

Figure 3: Research Activities in Support of Baseline Characterization

	Sample Sizes	
Data Collection Effort/Key Topics	**CA**	**Comp-arison**
OVERARCHING MARKET ISSUES AND TRENDS		
National Industry Associations, Training and Certification Bodies (BPI), Government Programs, and Program Implementation Contractors: Overview and history of the WH/HP industry, current trends and issues	6	
Review of Secondary Literature, American Housing Survey Data and Program Evaluations	x	
Analysis of CA Program Databases and Process Evaluations	x	
CUSTOMER SIDE OF THE MARKET		
Survey of Customers with Recent Major Home Improvement Projects (> $3,000): scope and cost of projects, incorporation of energy efficiency measures, awareness and use of HP services, program participation, interest in WH/HP services, barriers and motivations to purchase WH/HP services	500	Out of State: 500 Inside CA 200
SUPPLY CHAIN		
Contractor Survey: Practices in regard to energy efficiency, awareness and adoption of WH/HP practices, program participation, interest in WH/HP	90	74
Case Studies of High Volume WH/HP Contractors: Business models & strategies, perceptions of customer response, required investments, perceptions of program impacts and importance	3	3

Definition and selection of comparison areas. We used the following criteria to identify potential comparison areas for the EUC program area in California.

- **Absence of significant WH/HP programs funded by public goods or system benefits charges.** The specific objectives of this study are to characterize the market baseline for WH/HP services in California against the backdrop of the ongoing IOU Home Upgrade/ Advanced Home Upgrade program. This program is a centerpiece of a highly visible and well-funded component of the California's energy efficiency policy that started with both ARRA- and IOU- funded WH/HP activities from 2010- 2012. As discussed in Section 2, whole house retrofit programs sponsored primarily by state and local government agencies proliferated in 2009 – 2010 with support from the U. S. Department of Energy, funded by one-time economic stimulus expenditures. Thus there

are few major population centers in the United States that have not had at least some exposure to this kind of programming. However, most of these local programs have been relatively small-scale and short-lived. Their effects in the market also appear to be relatively short-lived. Therefore we did not disqualify a region for use as a comparison area if it had been served by a stimulus-funded project in the past few years.

- **Similarity to California in terms of non-program factors that affect home retrofit decisions.** Based on the results of previous studies and the advice of IOU staff and other experts, we identified two basic sets of non-program factors that affect home retrofit decisions.
  - **Climate conditions.** Given the focus of whole house retrofit techniques on thermal end uses, local climate conditions and resulting demands on heating and cooling systems strongly affect the economic return to customer investments in energy efficiency measures. On average Californians face low costs for heating, cooling and hot water compared to customers in either the cold climate zones represented in Table 2 by Massachusetts or hotter areas represented by Texas.

Table 2: Customer Expenditures on Thermal End Uses: California v. Massachusetts

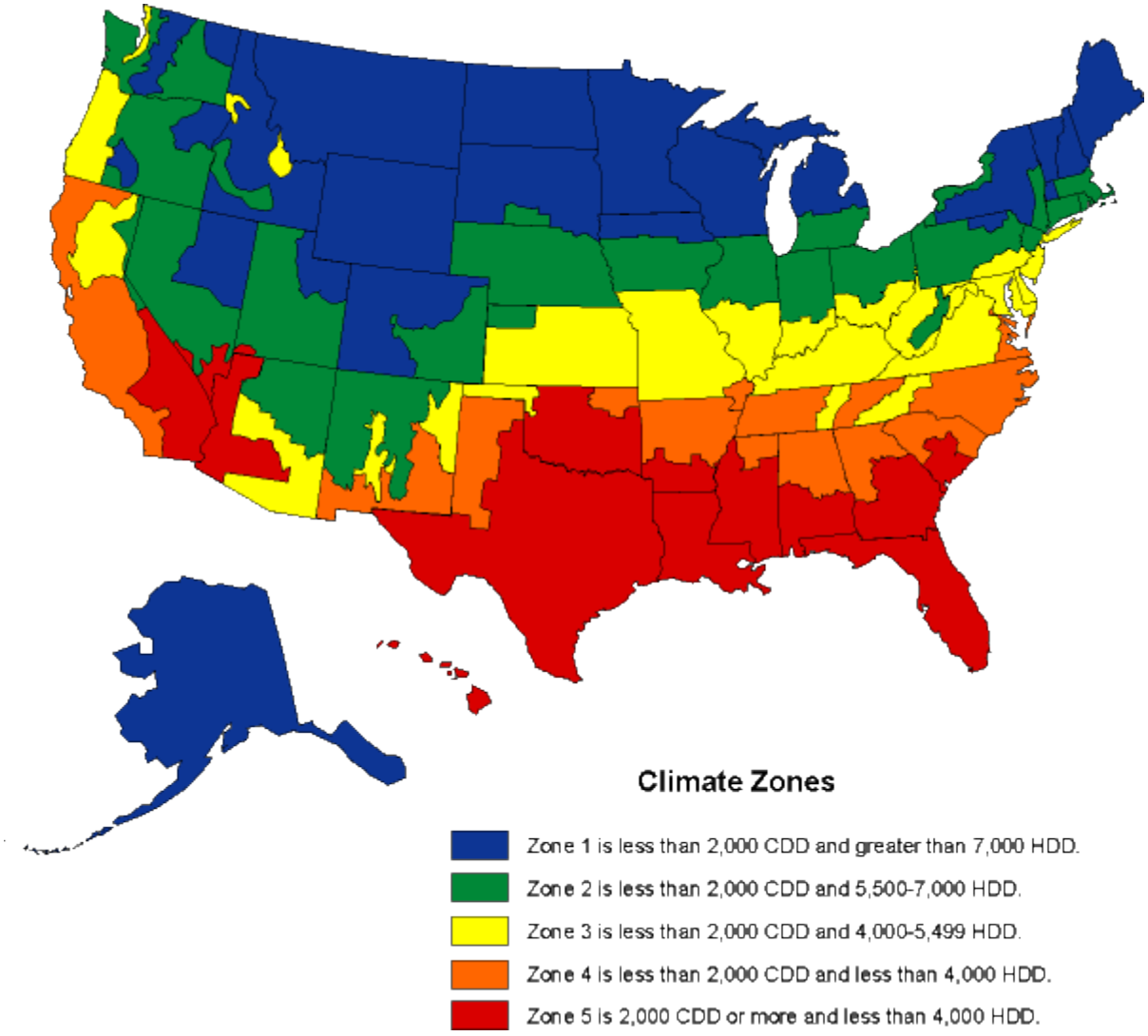
	Average Annual Expenditure: RECS 2009[9]			
	Space Heating	Water Heating	Space Cooling	Total Thermal Uses
California	$257	$186	$194	$637
Massachusetts	$1,083	$320	$51	$1,454
Texas	$310	$286	$541	$1,137

In addition to differing from other states, climate conditions are extremely diverse within California. We identify two major climate zones for structuring comparison areas. The first are the coastal counties stretching from San Diego in the South to Sonoma in the North. These counties contain 61 percent of the state's population, and are characterized by mild weather that avoids extremes of hot and cold. The number of average annual heating degree days in these counties ranges from 928 in Los Angeles to 2,862 in San Francisco. Average annual cooling degrees range from 142 in San Francisco to 1,506 in Los Angeles. The second major climate zone is the Central Valley running approximately from Sacramento to Bakersfield. These areas average between 2,000 and 2,700 annual heating degrees and between 1,500 and 2,300 annual cooling degree, and are characterized by a larger number of very hot days. As can be seen in the climate zone map prepared by the U. S. Energy Information Administration (Figure 4), the

[9] U. S. Department of Energy, Energy Information Administration. *2009 Residential Energy Consumption Survey*. Tables CE7 – CE10.

climate in the coastal areas corresponds at least somewhat to the climate in North Carolina, South Carolina, parts of Tennessee, and Arkansas. The climate in the central portion of California is closer to more southern states, such as Texas.

Figure 4: United States Climate Map



– **Demographic and housing conditions.** In addition to differing in climate, the coastal and central areas of California also display differences in demographic and housing conditions that are associated with spending on home improvement and interest in energy efficiency. Table 3 displays on demographic characteristics of selected Metropolitan Statistical Areas in the coastal and central zones that numerous studies have shown to be associated with spending on home energy efficiency and home improvements in general. These are household income,

educational attainment and home value. Generally, the coastal areas show a higher demographic profile than the central areas, with the differences in education and home value being particularly strong.

Table 3: Demographic Characteristics of California MSAs

City	Median Income	% of persons over 25 completed HS	% of persons over 25 completed College	Median Home Price
Example Central California MSAs				
Bakersfield	$54,656	78%	20%	$160,000
Fresno	$43,440	75%	20%	$152,500
Sacramento	$50,781	82%	29%	$155,000
Example Coastal California MSAs				
San Diego	$63,739	86%	41%	$370,000
Oakland	$51,144	80%	37%	$315,000
Los Angeles	$50,028	74%	31%	$376,500
San Francisco	$72,947	86%	51%	$747,000
San Luis Obispo	$42,528	92%	45%	$501,000

Based on these general observations we developed a basic strategy of constructing a comparison area from MSAs in states with no large WH/HP programs that resembled either the coastal or central areas in terms of climate and demographic characteristics to the extent possible. We proposed this approach to the CPUC and other stakeholders in the project. After review of this initial proposal, representatives of the IOUs observed that there were no close analogs to the coastal areas of California in terms of mild climate, diversity of population, and general high level of affluence. The IOU representatives proposed that areas within California in which the Home Upgrade/ Advanced Home Upgrade program had not been heavily promoted would provide a more appropriate comparison area than out-of-state MSAs for the areas of California in which the program was first rolled out. After discussion of the issue, the CPUC project manager, CPUC consultants, and IOU representatives agreed to develop comparison areas within California as well as outside the state. The following summarize the approach used to select those areas.

- **Comparison areas inside California.** Selection of comparison areas within California was driven primarily by the manner in which the whole house program was deployed. In line with the theory advanced by staff of the IOUs, areas within California that had not been targeted by early marketing for the IOU Home Upgrade/ Advanced Home programs were sought for inclusion in this group. Sparsely populated at significantly less than 100 persons/square mile and mostly rural counties such as Shasta, Imperial, and Madera are eliminated from consideration as comparison areas. The final list of non-program comparison areas inside CA selected for this research includes the

following counties: Stanislaus, Butte, Merced, El Dorado, Nevada, and Kings. The remaining counties in California were included in the Program Area.

- **Comparison Areas Outside of California.** The selection process for out-of-state (OOS) comparison areas involved first eliminating states with significant public benefits charge programs and then narrowing this range of areas based on climate characteristics. This resulted in the identification of the following states for further investigation: North Carolina, South Carolina, Arkansas, Tennessee, and Texas. Because only a small number of states cleared the broad program and climate screens, we needed to break those down into subareas for further analysis. We chose the Metropolitan Statistical Area (MSA) level, largely because it is at that level of disaggregation that key housing, demographic, and climate data are reported. Finally, a cluster analysis is used to identify MSAs within North Carolina, South Carolina, Arkansas, Tennessee and Texas that map closely to various regions within the program area in CA. The cluster analysis was based on a mix of climatic and demographic data such as heating degree days (HDD), cooling degree days (CDD), level of education, home price to income ratio, home ownership rates, and population density. The analysis identified the following out-of-state comparison areas:
  - Central Area: Memphis, Corpus Christi, and Dallas-Fort Worth-Arlington, and San Antonio MSAs
  - Coastal Area: Charlotte NC, Greensboro-Highpoint NC, Raleigh NC, and Charleston SC MSAs

Primary Data Collection. The project included the following major primary data collection efforts.

- **Homeowner Survey.** DNV GL conducted a Computer Aided Telephone Interview (CATI) survey of homeowners of single-family or two-family houses in Program and Comparison Areas to understand the customer side of the market for Whole House Retrofit services. We used random digit dial (RDD) methods to develop the sample with the following quotas: 500 completes in the California program area; 500 completes in the out-of-state comparison area; 200 completes in the within-state comparison area. The survey was fielded from June 28, 2013 to Aug 19, 2013. Respondents were screened for eligibility based on whether they had completed renovations in the past three years that cost more than $3000 to complete. Twenty-one percent of the respondents contacted qualified to be included in the survey under the screening. We completed interviews with roughly 19 percent of qualifying respondents. Table 4 shows the distribution of the homeowner survey sample by study area and program participation status.

Table 4: Distribution of Homeowner Survey Sample by Area and Reported Program Participation

	Program	Comparison	
	CA	OOS	CA
Number of Completed Interviews	501	501	200
Reported receiving assistance from energy efficiency programs for projects (Participants)	93	72	25
Non-Participants	396	422	172
Don't Know	11	7	3

Weighting Adjustments. In reviewing the results of the survey, we found that a much higher portion of respondents in all three study areas reported that they had received assistance from an energy efficiency program run by a utility, government agency, or non-profit organization than would be expected from a random sample of homeowners, even after taking into account that homeowners making major improvements would be more likely than average to use such a program. Specifically, we found that 19 percent of respondents in the CA Program area reported having received such assistance (over a three year period), as did 14 percent in the OOS Comparison Area and 13 percent in the CA Comparison Area. By contrast, analysis of tracking system records suggest that less than one percent of residential customers participate in a utility energy efficiency program of any kind in the course of a year. Given that program participants are by definition more interested in energy efficiency and more disposed to implement energy efficiency measures than non-participants, we felt it was necessary to weight the responses of self-identified participants to match their share of the population. To implement this weighting we estimated the total number of single and two-family homeowners in California who would have qualified for inclusion in the sample, that is: they undertook specified types of home improvements valued at $3,000 or more over the three years prior to the survey. We then estimated the number of participants in whole house retrofit, single measure retrofit, and efficient HVAC incentive programs offered by California IOUs and other organizations over the three years prior to the survey. Assuming that all of those participants would have been eligible for inclusion in the homeowner survey sample, we calculated the ratio of program participants to the population eligible for the survey at 1.9 percent. We divided that fraction by the percentage of sample customers who reported having received program support for their projects (18.6 percent) to arrive at a down weighting factor of 10 percent. We applied this factor to the population weights for the sample homeowners who reported participating in energy efficiency programs to take into account our best estimate of the representation of program participants among customers who completed major home improvements, as defined for this study. Table 5 summarizes these calculations.

Table 5: Estimation of the Fraction of Energy Efficiency Program Participants in the Population of Homeowners with Major Home Improvements

	Quantity	Source/Calculation	
1	Number of occupied housing units in CA ('000s)	American Community Survey 2012	12,466
2	Number of owner-occupied housing units ('000s)	American Community Survey 2012	6,978
3	Percent of owner-occupied: 1 -2 family	American Community Survey 2012	89.3%
4	Number of owner-occupied units in 1 -2 family homes ('000s)	Row 2 * Row 3	6,231
5	Housing units with home improvements > $3000 in past three years	Homeowner Survey Screening	21%
6	Number of owner-occupied 1 – 2 family housing units with home improvements >$3,000 ('000s)	Row 4 * Row 5	1,308
7	% of total housing units with improvements over 3 years	Row 6/Row 1	10.5%
8	Number of residential customers of IOUs ('000s)	FERC Form 861, 2012	10,064
9	Number of residential customers with projects	Row 7 * Row 8	1,056
10	Number of participants in programs supporting residential retrofits ('000s)	Energy Efficiency Groupware Application, Program Evaluations	20
11	Percent of customers with projects who participated in energy efficiency programs	Row 10/Row 11	1.9%
12	Fraction of homeowner sample that reported participating their project was supported by energy efficiency programs	Homeowner Survey	18.6%

Comparability of Homeowner Samples in the Study Areas. Studies of customer response to energy efficiency programs commonly find that homeowners in the 45 – 65 year age range are more interested in energy efficiency and participate in programs more frequently than older or younger homeowners. Income and educational attainment are also typically associated with higher levels of interest in energy efficiency and program participation. National studies find that spending on home improvements is associated with higher home prices, although this result may be confounded by the effects of education and income. We note that there are very few areas in the United States with home prices as high as the California program area, whether those are represented as absolute values or values as a percentage of median income.

The key similarities and differences between the study areas in regard to age of homeowner, education, income, and home prices are as follows.

- **Age of respondent.** There were very few differences in the age distribution of survey respondents from the three study areas. The share of respondents over 65 was

significantly higher (p-value < .10) in the CA Program (34 percent) and Comparison Areas (36 percent) versus the OOS Comparison Area (26 percent).

- **Educational Attainment.** There were relatively few differences between the three areas in the distribution of respondents by level of educational attainment. The portion of respondents in the OOS Comparison area who had completed college or some graduate school (76 percent) was significantly higher (p-value < .10) than the corresponding figure in the CA Program Area (67 percent) and the CA Comparison Area (54 percent).
- **Household Income.** The distribution of the respondents by reported household income varied between the study areas, but none was consistently higher or lower than the others. The CA Program and CA Comparison areas had a higher concentration of respondents with annual incomes under $75,000 (20 and 23 percent respectively) versus 12 percent for the OOS Comparison Area. The share of respondents with incomes over $150,000 was higher in the CA Program and OOS Comparison Areas (29 and 24 percent respectively) versus the CA Comparison Area (15 percent)
- **Home Prices.** Reflecting the unique conditions of the coastal California housing market, 71 percent of respondents in the CA Program Area reported that their houses were valued at over $400,000, versus 34 percent in the OOS Comparison area and 35 percent in the CA Comparison Area.

See Appendix B for additional details on this issue.

- **Contractor Survey.** We conducted a CATI survey of contractors active in the trades and specialties addressed by WH/HP programs. These include firms active in general home remodeling, heating and cooling equipment (HVAC) installation and maintenance, insulation, and residential energy efficiency improvements. We narrowed our focus on these firms based on the results of previous evaluations, broader studies of the remodeling market, and the results of the homeowner survey, which found that the four specialties mentioned above accounted for roughly 70 percent of all projects over $3,000.

  We used a number of information resources to develop the sample frame, including the commercial business establishment database InfoUSA, membership lists for trade and industry associations, and lists of contractors who participated in the HU/AHU program. We established quotas for selection based on numbers of workers employed by the various specialties. Population weights were based on the percentage of total firms in the target market represented by the various quotas. In order to take account of large variation among the firms in the number of home improvement projects they completed each year, we used their reported number of completed projects in a ratio estimation process to calculate the project volume-weighted market share of various practices, such as installing energy-efficient heating and cooling equipment or air sealing measures.

In order to boost response and mitigate non-response bias, we offered contractors an incentive for completion of the interview. We completed 90 interviews in the program area of California and 74 surveys in the out-of-state comparison area. The population of contractors in the within-state comparison area was too small to generate a sufficient sample, given screening criteria. The survey elicited information on contractors' inclusion of energy efficiency measures and pre-installation services such as energy audits in their work, their familiarity with whole house and home performance concepts, and their assessment of their commercial interest. The survey was fielded from Oct 15, 2013 to Dec 20, 2013.

- **In-depth Interviews and Case Studies of High-Volume Contractors.** As discussed above, one of the key challenges to success for Energy Upgrade and related programs involves the development of scale. Because the Home Performance model generally requires that contractors obtain training and certification beyond what is needed for licensure in their trades, and because the diagnostic procedures and measures themselves can be expensive, it generally takes a great deal of time and program expenditure to develop volume in operations. One of the most interesting findings from the evaluations of the New York program is that 6 of the 100+ participating contractors accounted for 42 percent of completed projects over the first 8 years of the program (and this pattern has continued to the present).[10] Similar patterns are apparent in program records for the IOU's Home Upgrade/ Advanced Home Upgrade program. For example, the contractor with the highest number of applications for the PG&E program accounted for five percent of all applications.

  In the fall of 2012 e conducted in-depth interviews and developed case studies of 6 high-volume contactors: 3 active in California and three active in other states. Our criterion for selection was that the firm needed to have completed at least 50 WH/HP installations in the previous year. We identified potential contractors through contacts with WH/HP program managers and industry association officials. The case studies developed narratives of the firm's entry into the energy efficiency contracting market, their basic business model, strategies to address common challenges such as marketing, sales, and quality service delivery, their response to local programs, and their assessment of the prospects for development of an unsubsidized market.

1.3 Structure of the Report

The remainder of this report is structured as follows.

- **Section 2: Development of Whole House Retrofit/Home Performance Programs in the U.S.** presents a short history of this program approach, which

[10] Summit Blue Consulting, op. cit.

provides important background for understanding the current level of market adoption of WH/HP services.

- **Section 3: The Consumer Market for Whole House Retrofit/Home Performance Services** assesses customer awareness of the elements of WH/HP services, the value they attach to those service elements, and the extent to which they purchase them when completing major home improvement projects.
- **Section4: The Supply Chain for Whole House Retrofit/Home Performance Services** assess contractor awareness of WH/HP techniques and the extent to which they incorporate them into their current sales and service delivery practices.
- **Section 5: Integrated Analysis and Conclusions** synthesizes the findings reported in the previous three sections to provide a view of the current development of the market for WH/HP services and draws the implications of that view for the structure of current program efforts. We also comment on the appropriateness of the research techniques deployed and the likely effectiveness of applying them in the second phase of the study.
- **Appendices.** Appendix A contains a full listing of references for the study. Appendix B presents details of the analysis performed to select the comparison areas.

2. Development of Whole House Retrofit/Home Performance Programs in the United States

This section presents a brief history of the origins and development of Whole House Retrofit and Home Performance Programs in the United States. We include this information to provide a framework for interpreting the findings in Sections 3 and 4 on the current state of market acceptance for WH/HP services. As reported below, government and utility programs have guided and paid for many key elements in the development of WH/HP services, including:

- Commissioning of basic building science research to identify best practices in energy retrofit of existing homes;
- Establishment of consistent technical and service delivery practices and tools;
- Provision of training and certification to contractors;
- Promotion of WH/HP as a business opportunity to home improvement contractors of various types that serve the residential market; and,
- Promotion of WH/HP services to customers through a wide range of marketing and financial incentive strategies.

For these reasons, it is easy to construe the programs as part of the market. However, for the purposes of this study, the publicly-funded WH/HP programs and the private-sector supply chain that delivers the services (including private non-profit certifying bodies) need to be treated as entirely separate in order to assess the effects of the program on the market.

2.1 Origins and Early Development

Utilities have offered programs that combine delivery of a home energy assessment or audit, incentives for multiple energy efficiency measures, and some form of quality assurance since the late 1970s.[11] The development of home performance as a body of technical and professional practice was initiated by the New York State Weatherization Assistance Program (WAP) in 1993, primarily as an effort to increase the level of energy savings achieved and durability of projects installed through the federally-funded program. Among the first steps taken was to develop a Building Performance Field Manual and a certification process for field technicians. Over the next three years, the program developed training curricula, testing procedures, and test

[11] CEE, Inc. 2013. *Overview of Residential Existing Homes Programs in the United States and Canada.* http://library.cee1.org/sites/default/files/library/10910/CEE_ExistingHomesProgramOverview_Aug2013.pdf

facilities. In 1996, the program was established as an independent non-for-profit organization named the Building Performance Institute (BPI) and issued its first certifications for WAP energy auditors and installation personnel. BPI continued to service the WAP provider community exclusively until 1999, when the New York State Energy Research and Development Authority hired BPI and the program delivery contractor Conservation Services Group (CSG) to develop standards and certification procedures for contractors working in the private market. In 2001, the U. S. Environmental Protection Agency developed standards for home performance programs under the Home Performance with Energy Star® rubric, with BPI developing standards and certification procedures for whole house retrofit contractors to participate in qualifying programs. That same year, NYSERDA launched the first Home Performance with Energy Star program.

Figure 5: Timeline of Key Events in the Development of WH/HP Programs and Related Organizations in the U.S.

Year	Key WH/HP Program and Industry Events
1993	Building Performance Institute started as a program of New York State to improve standards of performance for weatherization programs
1996	BPI incorporated and issues first auditor certifications
1999	NYSERDA hires BPI and CSG to develop certification and delivery protocols for private sector contractors
2001	EPA develops standards for Home Performance with Energy Star programs. Hires Consortium for Energy Efficiency (CEE) and North American Technician Excellence (NATE) to develop standards and certification for HVAC installation; BPI to develop standards and certification for whole house contractors NYSERDA launches first Home Performance with Energy Star program
2004	EPA, DOE, and HUD hire CSG and BPI to promote national expansion of Home Performance programs
2008	Terms of stimulus funding for energy efficiency discussed
2009	ARRA funding released for home performance programs under three programs ~$500 million nationwide
2010	ARRA programs in the field **Number of whole house programs listed in DSIRE database: 126**
2011	ARRA programs in the field
2012	ARRA programs wind down
2013	ARRA programs closed out except for some loan funds **Number of whole house programs listed in DSIRE database: 91**

Green shading represents period of ARRA program funding

2.2 Expansion and the Influx of Stimulus Funds

Through the middle of the 2000s, roughly 50 utilities and other organizations around the country implemented programs that qualified for the Home Performance with Energy Star designation. In early 2009, the federal government identified energy efficiency programs as a major vehicle for the distribution of stimulus funds appropriated through the American Recovery and Reinvestment Act of 2009 or ARRA. The major channel for the flow of stimulus funds to residential retrofit efforts was the Better Buildings Neighborhood Program, which was operated by the U. S. Department of Energy. This program offered financial and technical assistance to local sponsors – primarily local governments and not-for-profit organizations – to

establish and operate programs that targeted deep retrofits in residential properties. The prescribed program approach contained many of the elements of the WH/HP model, including:

- Provision of energy audits, including diagnostic testing, to guide projects;
- Incentivizing the installation of multiple measures;
- Screening of contractors for participation, and provision of some program-related training to contractors[12];
- Provision of project financing options;
- Quality control through "testing out" of completed jobs and inspection of completed projects by program sponsors.

Moreover the program theory for Better Buildings incorporated many of the market transformation elements of the program theories common to efforts funded by public goods charges. Specifically, the U. S. Department of Energy posited that participating contractors would develop skills and appreciation for the business benefits of delivering whole house retrofit services. They would use these skills and experiences to continue offering whole house retrofit services, supported by the project financing facilities put in place through the program. Similarly, customers who participated in the programs would contribute to the diffusion of the whole house concept through word of mouth and referrals of contractors.

Altogether, awards in the amount of $508 million were made to 41 local program sponsors or grantees across the U.S., with the intention that the money be spent by the end of 2012. This influx of boosted the number of whole house retrofit programs listed in the DSIRE database to 126 in 2010.[13] Between the third quarter of 2010 and the second quarter of 2012, the grantees completed 27,596 upgrades nationally. The productivity of the programs varied widely. The top 10 in terms of upgrades completed accounted for 65 percent of all projects. The bottom 12 accounted for less than 10 percent of completed projects. In some cases, as in California, the potential effect of these programs has been prolonged by using some funds to establish special financing facilities.

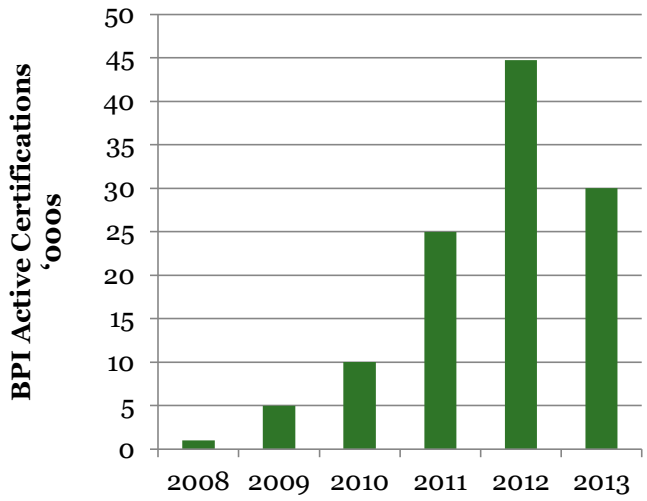
In the course of our secondary research for this project, we have identified some evidence that suggests that the effect of the Better Buildings effort on the national level of whole house retrofit activity may be transitory. Between 2010 and 2014, the number of whole house retrofit

[12] NOTE: Unlike Home Performance with Energy Star, Better Buildings did not require technical training similar to BPI's curriculum. But some grantees required or encouraged it as part of their delivery model.

[13] LeBaron, Robin and Kara Saul-Rinaldi. 2013. *Bringing on the Boom and Beating the Bust.* Washington, D. C.: National Home Performance Council. April 2013.

programs listed in the DSIRE program database has decreased from 126 to 91. As Figure 6 shows, the number of technicians in the U.S. with active BPI certifications rose from 5,000 in 2009 to nearly 45,000 in 2012, but fell to 30,000 in the next year.

Figure 6: Number of Technicians with Active BPI Certifications[14] in United States



2.3 Current Issues and Challenges

In conducting background research for this project, we reviewed all of the publicly available impact and process evaluations of WH/HP programs that we could find. These evaluations[15] consistently surfaced two sets of issues that prevented most of the programs from reaching their energy savings goals:

- Low levels of participation relative to goals; and,
- Low realization of gross savings relative to engineering-based planning estimates and/or audit results.

Table 6 summarizes the results of the nine evaluations reviewed. Assessment of the reasons for the generally low gross savings realization rates shown in Table 6 is beyond the scope of this report. The evaluations we reviewed, including an early assessment of savings for targeted

[14] www.bpi.org and personal correspondence with BPI staff.

[15] For a complete set of references to these evaluations see Appendix A.

marketing commissioned by PG&E,[16] identified the following factors that contributed to low realization rates:

- Systematic overestimation of savings built into assessment tools and procedures;
- Inconsistent implementation of assessment methods in the field;
- Inconsistent implementation of diagnostic test and measure installation procedures;
- Poor quality installations.

Table 6: Summary of Participation and Gross Savings Results
Nine Evaluations of WH/HP Programs

		Participation		Verified	Realization Rate		Verification Method		
Sponsor	Years Covered	Received Audits	Installed Measures	Sav. % of Baseline	Electric	Heating Fuels	Bill Anal	M&V	Sim-ulation
NH Utilities	'09 – '10	n/a	1,628	19%*	53%	92%	◆	◆	
MA Utilities	'10 – '11	~68,000	~27,000	9%*	n/a	57% - 86%	◆	◆	◆
Delaware NREC	'10 – '11	n/a	3,887	35%*	34%	47% - 101%		◆	
WI Focus on Energy	'01 – '09	n/a	7,286	26%*	98%	99%		◆	
LIPA	'10 – '11	n/a	1,710	12%*[1]	62%	67%	◆	◆	
NYSERDA	'01 – '13	n/a	42,457	9%	35%	65%	◆		
Energy Trust of Oregon	'10 – '11	582	513	n/a	n/a	47%	◆		
Efficiency Maine	'10 – '11	5,026	3,667	~40%*	96%	88%		◆	
TVA	'10 – '11	n/a	9,148	9%[1]	n/a	n/a		◆	◆

* Calculated using the U. S. Energy Information Administration's Residential Energy Consumption Survey (2009) state average consumption in MMBTU. [1] Program targeted electric end uses.

The evaluation findings of greater relevance to this study concern reasons identified for low levels of participation. Most WH/HP programs have barely progressed beyond the pilot stage. After 14 years of operation, the longest standing program in New York State has served only one percent of eligible customers outside of a special low-income track. As discussed in Section 1, Home Upgrade / Advanced Home Upgrade program participation levels have been consistently below plan.

[16] Opinion Dynamics Corp. 2013. *PG&E Whole House Program: Program Targeting and Marketing Research Overview of Research and Analysis Results*. Draft. San Francisco: Pacific Gas & Electric Co.

The recent program targeting and process evaluation studies[17] of the whole house retrofit program commissioned by Pacific Gas & Electric examine those issues in detail, and their findings mirror to a large extent those of other evaluations. From a program design and operation standpoint, the two key challenges are first, to inform customers of the program and encourage them to apply and, second, to encourage them to move forward with upgrades once they have received an assessment. In regard to encouraging participation and completion of upgrades, the key hurdles to be overcome include the following:

- **Lack of awareness of the value of home energy improvements.** Among a sample of 264 non-participants interviewed for the PG&E program targeting study, 17 percent were categorized as having full intent to implement energy efficiency upgrades within 2 years; 66 were categorized as having limited intent, and 17 percent were categorized as having no intent. One of the principal differences between these groups was their level of awareness of the potential value of efficiency improvements in terms of comfort, financial return, and benefits to the environment.
- **Financial and time constraints on action.** The non-participants with limited or no intention to undertake upgrades were strongly distinguished from those with full intent (and from participants) in terms of access to resources or lack thereof. The 83 percent of non-participants in the limited and no intent categories ranked much lower than the other groups in terms of income and education. Additional constraints frequently mentioned in surveys conducted for other studies include lack of time to be present for assessments and to organize contractor services for measure installation.
- **Lack of program awareness.** While customer awareness of utility programs and whole house programs is by no means negligible, it is not sufficiently high to generate the stream of applications needed to meet program participation and savings goals. Thirty-four percent of the respondents to the customer surveys conducted for the PG&E process evaluation reported being aware of the program. Similarly, we found that 29 percent of customers with recent home improvement projects in the program areas of California reported being aware of whole house programs available to them, after the interviewer read a description of such programs.
- **Complexity of the WH/HP value proposition.** A common theme among successful contractors interviewed for the case studies is that it takes a great deal of personal sales effort to convince prospective customers to follow through on projects. The effort is required because there are many elements in the WH/HP value proposition, including increased comfort, improved indoor air quality, financial savings, preservation of home value, and environmental stewardship, and because it is unclear which of those will have

[17] Opinion Dynamics Corp., op. cit. and SBW Consulting, Inc. 2013. *2010–2012 PG&E Whole House Retrofit Program Phase II Process Evaluation Study*. San Francisco: Pacific Gas & Electric Co.

most resonance with the individual customers. Therefore, it is not surprising to find that virtually every process evaluation of WH/HP programs recommends providing higher levels of marketing, customer education, and sales training for participating contractors or their sales staff as a means to improve participation levels.

These themes will be repeated in many forms in Sections 3 and 4, which provide a broader view of the home improvement market in which whole house retrofit and home performance projects operate.

3. The Consumer Market for Whole House Retrofit and Home Performance Services

For purposes of this study we define the consumer market for whole house retrofit and home performance services as single-family homeowners who undertake home improvement projects of sufficient size and scope to accommodate at least two of the energy efficiency measures included in the roster of measures supported by WH/HP programs, regardless of the motivation for those improvements. Using this definition, we can estimate the size of the market during a given time period and share of relevant projects in which WH/HP approaches have been applied.

We operationalized the market definition through the screening conditions used to qualify respondents to the customer surveys. In order to qualify for the survey, the respondent needed to report that they had completed a home improvement project within the three years prior to the survey that met the following criteria.

- **Scope.** The included at least one of the following elements:
  - Breaking through an outside wall (to add rooms, or extend a room, or raise part of the roof)
  - Replacing windows
  - Installing a new furnace or boiler
  - Adding insulation to the home
  - Adding a new Central Air Conditioning unit
  - Add/Replace water heating equipment
  - Finishing a basement
  - Remodeling or upgrading the kitchen
  - Finishing a room above the garage
  - Adding a pool or spa[18]
- **Cost.** The project cost more than $3,000 to complete.

In the sub-sections that follow, we assess the size of the potential market for WH/HP services, the share of projects that incorporate elements of the WH/HP approach, customer motivations for undertaking the projects, their awareness of WH/HP concepts and programs, and the value they place on various elements of the WH/HP service package. We use this information to develop indicators of WH/HP market development in the California Program Area as well as in the California and Out-of-State (OOS) Comparison areas. We draw most of the data used for this

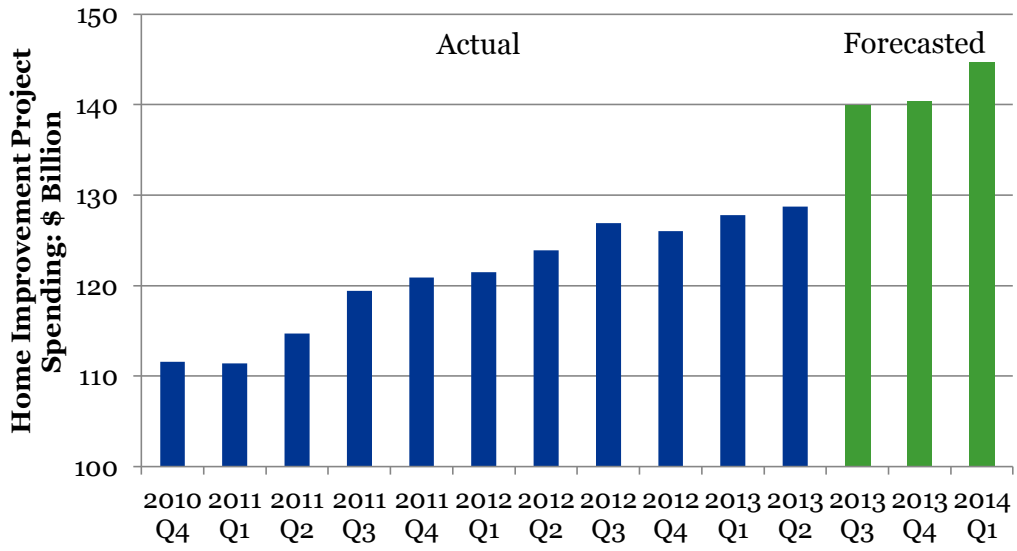
[18] This item was included for consistency with surveys being carried out in support of the impact evaluation of the whole house program.

assessment from the homeowner survey conducted for this project, and supplement those data with results from the contractor survey, the contractor case studies, and various secondary sources. We begin with a brief overview of the consumer market home improvement services at the national level, based primarily on surveys carried out the U. S. Bureau of the Census.

3.1 The Consumer Market for Home Improvement Services: Trends in Volume and Spending

The Census Bureau tracks consumer spending on home improvement services through the American Housing Survey and through analysis of more detailed data gathered in the decennial Census. During the most recent 4 quarters for which actual data (ending 2013 Q2), U. S. households reported spending a total of $509 billion on home improvement projects, most of them carried out by contractors. [19] As **Figure** 7 shows, quarterly spending on home improvement projects has increased steadily since the beginning of 2011. Annual spending in 2013 is forecasted to be 15 percent higher than it was in 2011. Spending on remodeling and on residential construction as a whole is highly correlated with general economic conditions, although spending on home improvements is less volatile than new construction outlays.

Figure 7: Quarterly Spending on Home Improvement Projects
U. S. Q4 2010 through Q1 2014



[19] Joint Center for Housing Studies of Harvard University, *Leading Indicators of Remodeling Activity*. http://www.jchs.harvard.edu/leading-indicator-remodeling-activity-lira

The Joint Center for Housing Studies of Harvard University periodically undertakes comprehensive analyses of the home improvement/remodeling market, using primarily untabulated data from the American Housing Survey and other Census surveys of households and businesses. The most recent of these studies was published in 2011 and covers the period 2007 – 2009, the depths of the recent recession.[20] Key findings from this study for framing the methods used in our homeowner were as follows.

- On average, 20 percent of single-family homeowners undertook home improvement projects each year, with an average cost per project of $9,605.
- On average, 8 percent of homeowners undertook projects costing more than $3,000 each year. The screening process for the homeowner survey found that 21 percent of respondents reported undertaking such projects over a three year period, for an annual rate of 7 percent. Given the additional restrictions we placed on the scope of the projects, we believe our survey produced a good match to the Census data.
- The Joint Center study found that forty-four percent of the reported projects cost $10,000 or more, which puts them in the range of typical costs for a whole house retrofit project. The homeowner survey conducted for this study found that 50 percent of reported projects cost $10,000 or more. After taking inflation over the five years since the data collection for the Joint Center study and the overall increase in home improvement spending, the survey findings regarding the distribution of projects by cost are very consistent the analysis of the much larger U. S. Census data set.
- Seventy-seven percent of all reported projects were carried out by hired contractors. The remainder were do-it-yourself projects.

3.2 Motivations for Home Improvement Projects

Table 7 summarizes sample homeowners' responses to questions regarding their motivations for undertaking their home improvement projects. These results reflect the responses for all respondents regardless of their self-reported participation in energy efficiency programs. Not surprisingly the most frequently mentioned primary motivation was to repair or replace old or failing equipment. However, for this study the most important finding is that large portions of respondents in all three study areas identified objectives associated with WH/HP services as the primary motivation for their projects. Nearly 26 percent of respondents in the CA Program Area mentioned without prompting motivations related to WH/HP benefits – namely reduced energy costs (15 percent), improved comfort (10 percent), and improved indoor air quality (1 percent). An even higher portion of sample homeowners in the CA Comparison (33 percent) Area

[20] Joint Center for Housing Studies of Harvard University. 2011. *A New Decade of Growth for Remodeling*. Cambridge, MA: Harvard University.

identified WH/HP-related objectives as their major motivation for undertaking their projects. Homeowners in the Out-of-State (OOS) Comparison reported those three motivations at a rate of 25 percent, which may be viewed as a relatively high rate in light of findings regarding participation in WH/HP programs reported in Section 2.

Table 7: Motivations for Home Improvement Projects

	Main Motivation			Other Motivation		
	Program	Comparison		Program	Comparison	
	CA	OOS	CA	CA	OOS	CA
n=>	*501*	*501*	*200*	*501*	*501*	*200*
Reduce energy use or costs	**15%**	**14%**	**15%**	**16%**	**11%**	**12%**
Improve comfort [e.g. stop drafts]	**10%**	**9%**	**14%**	**18%**	**16%**	**17%**
Improve indoor air quality	**1%**	**2%**	**5%**	**6%**	**8%**	**8%**
Replace old or failing equipment	24%	37%	23%	17%	17%	20%
Modernize kitchen and/or bath	17%	10%	14%	9%	8%	12%
Add or reconfigure living space	6%	5%	7%	3%	6%	5%
Repair or replace exterior of the house	6%	3%	3%	6%	5%	7%
Repair or replace interior elements	8%	9%	7%	12%	7%	11%
Qualify for program rebates	0%	0%	0%	4%	2%	3%
Increase the value of the home	4%	3%	2%	12%	12%	17%
Repair/Renovate due to damage, disaster	0%	2%	1%	21%	21%	19%
Upgrade/modernize	3%	2%	3%	4%	0%	2%
Other/Don't Know	4%	4%	5%	2%	2%	2%
Motivations related to WH/HP Programs	**26%**	**25%**	**33%**	**41%**	**35%**	**37%**

Significantly different from the CA Program Area at the 90% confidence level

A substantial portion of sample customers named WH/HP related objectives as secondary motivations for undertaking their project: 41 percent in the CA Program Area, 37 percent in the CA Comparison Area, and 35 percent in the OOS Comparison Area. The portion in the CA Program Area was significantly higher (p-value < .10) than that in the OOS Comparison Area.

Given the short period of time that EUC in its current form has been in the field, it would be difficult to attribute these differences to effects of that program. However, the difference between the California and Out-of-State areas in reported motivations for home improvements may be associated with the long history of utility and government promotion of energy efficiency in California, as well as the effect of building codes.

3.3 Energy Efficiency Measures in Home Improvement Projects

Table 8 summarizes the energy efficiency measures that sample homeowners reported installing as part of their home improvement projects. The key findings from this table are as follows.

- **Inclusion of energy efficiency measures.** Roughly two-thirds of sample homeowners in all three study areas reported implementing at least one energy efficiency measure as part of their home improvement project. The portion of respondents who reported installing at least one energy efficiency measure was slightly higher in the OOS Comparison Area (70 percent) than in the CA Program Area (65 percent), which was, in turn, slightly higher than the portion in the CA Comparison area (60 percent). Although these differences were small they were statistically significant at the 90 percent confidence level.

Table 8: Summary of Energy Efficiency Measures Included in Home Improvement Projects

	Program	Comparison	
Measures Installed	**CA**	**OOS**	**CA**
n=>	*501*	*501*	*200*
Installed At Least One Measure	65%	70%	60%
Multiple Measures Installed	35%	30%	32%
Whole House Combinations			
Combination of air sealing and insulation	8%	6%	6%
Combination of shell with HVAC measures	3%	3%	4%
Individual Measure Types			
Insulation	37%	36%	30%
Air Sealing	16%	11%	18%
ENERGY STAR Heating Equipment	6%	2%	3%
ENERGY STAR Cooling Equipment	26%	42%	26%
Heating Pipe Wrap/Duct Sealing	16%	9%	9%
Domestic Hot Water Pipe Insulation	22%	13%	16%
Solar Photovoltaic	3%	2%	6%
Diagnostic Tests			
Blower Door	17%	10%	18%
Duct Leakage (% of projects with heating or cooling equipment)	34%	12%	24%

Significantly different from the CA Program Area at the 90% confidence level

- **Inclusion of multiple energy efficiency measures.** Thirty-five percent on homeowners in the CA Program Area reported installing two or more energy efficiency measures as part of their home improvement project. The corresponding percentages in the OOS and CA Comparison areas are 30 and 32 percent, respectively. The difference between the CA Program Area and the OOS Comparison Area on this indicator is statistically significant at the 90 percent confidence level.
- **Inclusion of combinations associated with the whole house approach.** The portion of customers who implemented combinations of measures that fit with the loading order prescribed by whole house retrofit practice was relatively low in all three of the study areas. Eight percent of participants in the CA Program Area implemented a combination of air sealing and insulation measures associated with whole house techniques, versus 6 percent in the OOS and CA Comparison Areas. Only 3 - 4 percent

implemented combinations of building shell and HVAC measures in any of the study areas.

- **Inclusion of individual measure types.** Homeowners in the CA Program Area generally installed measures addressing single building systems or end uses at a higher rate than their counterparts in the other two study areas. The one exception to this pattern is Energy Star cooling equipment. However, we note that 53 percent of customers in the OOS Comparison Area included replacement of central air conditioning systems in their project, versus 31 percent in the CA Program Area. Thus roughly equal proportions of homeowners who reported installing new air conditioning systems as part of their projects selected Energy Star labeled equipment: 83 percent in the CA Program Area and 78 percent in the OOS Comparison Area.
- **Inclusion of diagnostic tests.** The use of post-installation diagnostic tests for air and duct leakage is a characteristic component of the WH/HP approach. We asked all respondents whether they had received a blower door test as part of their projects. Questions on duct sealing were posed only to respondents who reported undertaking a heating and cooling system measure. The portion of customers who reported receiving a blower door test was significantly higher (p-value < .10) in both California study areas than in the OOS Comparison Area: 17 percent in the CA Program Area v. 10 percent in the OOS Comparison Area. The difference between California and the OOS Comparison Area was even greater for duct leakage testing. Thirty-four percent of respondents who undertook heating and cooling system improvements in the CA Program Area reported that they received a duct leakage test after installation v. 12 percent in the OOS Comparison Area. These differences likely reflect the recent revision to California's Title 24 building code requirement that duct leakage tests be conducted for all permitted installations of furnaces, heat pumps, and central air conditioners. .

3.4 Effect of Program Participation on Use of Energy Efficiency Measures in Home Improvement Projects

It is reasonable to hypothesize that at least some of the differences in energy efficiency measure implementation between the CA Program Area and the Comparison Areas is due to the effects of the relatively higher level and longer history of utility and government activity in the Program Area. A sufficient number of respondents in all three study areas reported receiving assistance from utility or government energy efficiency programs to examine this hypothesis in some detail.

Table 9 shows the percentage of self-identified program participants and non-participants in the three program areas who reported including various measure types and measure combinations in their home improvement projects. For non-participants, there was virtually no difference between the study areas in the portion that implemented multiple measures or combinations of

thermal and HVAC measures that are associated with the WH/HP approach. For participants, the differences between the study areas were more pronounced, but statistically significant only in the case of the combination of air sealing and insulation. Similarly, the differences between study areas in the portion of homeowners who included individual measures associated with the WH/HP approach, such as air sealing and duct sealing are much larger among participants than among non-participants. These findings can be taken as evidence that the IOU programs have had an effect in steering participants towards implementing measures that they would not otherwise been aware of or considered.

Table 9: Summary of Energy Efficiency Measures Included in Home Improvement Projects by Program Participation Status

	PROGRAM PARTICIPANTS			NON-PARTICIPANTS		
	Program	Comparison		Program	Comparison	
	CA	OOS	CA	CA	OOS	CA
n=>	*93*	*72*	*25*	*408*	*429*	*175*
Received assistance from a utility or government program in implementing an energy efficiency measure	**19%**	**14%**	**13%**			
Multiple Measures Installed	52%	41%	31%	35%	30%	32%
Whole House Combinations						
Combination of air sealing and insulation	19%	8%	4%	7%	6%	6%
Combination of shell with HVAC measures	13%	6%	4%	3%	3%	4%
Individual Measure Types						
Insulation	44%	49%	28%	37%	36%	30%
Air Sealing	27%	14%	24%	16%	11%	18%
ENERGY STAR Heating Equipment	11%	3%	0%	6%	2%	3%
ENERGY STAR Cooling Equipment	36%	63%	42%	26%	41%	26%
Heating Pipe Wrap/Duct Sealing	32%	18%	9%	15%	9%	9%
Domestic Hot Water Pipe Insulation	24%	17%	8%	22%	13%	16%
Solar Photovoltaic	13%	4%	4%	3%	2%	6%
Diagnostic Tests						
Blower Door	27%	14%	24%	14%	10%	16%
Duct Leakage (% of projects with heating or cooling equipment)	41%	22%	35%	29%	15%	26%

Significantly different from the CA Program Area at the 90% confidence level

3.5 Project Costs and Use of Project Financing

Figure 8 shows the distribution of reported projects by cost category for all respondents across the three areas. We note that roughly one-half of the reported projects cost at least $10,000, which is at the lower end of the range of reported costs for WH/HP projects.

Figure 8: Distribution of Reported Project Costs - All Respondents

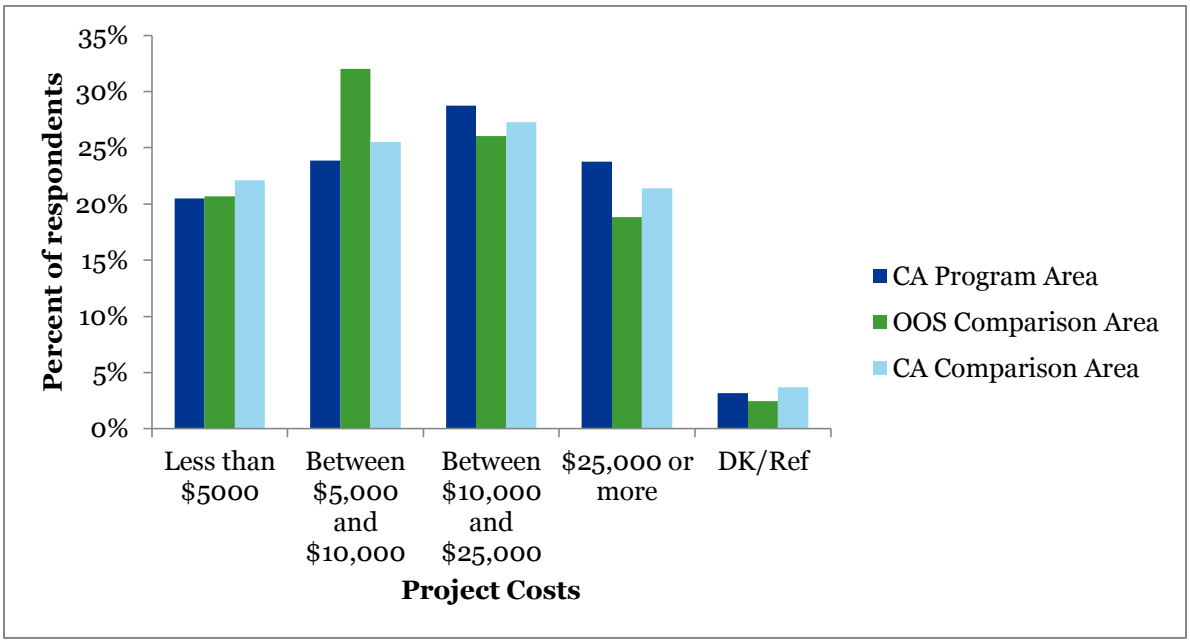
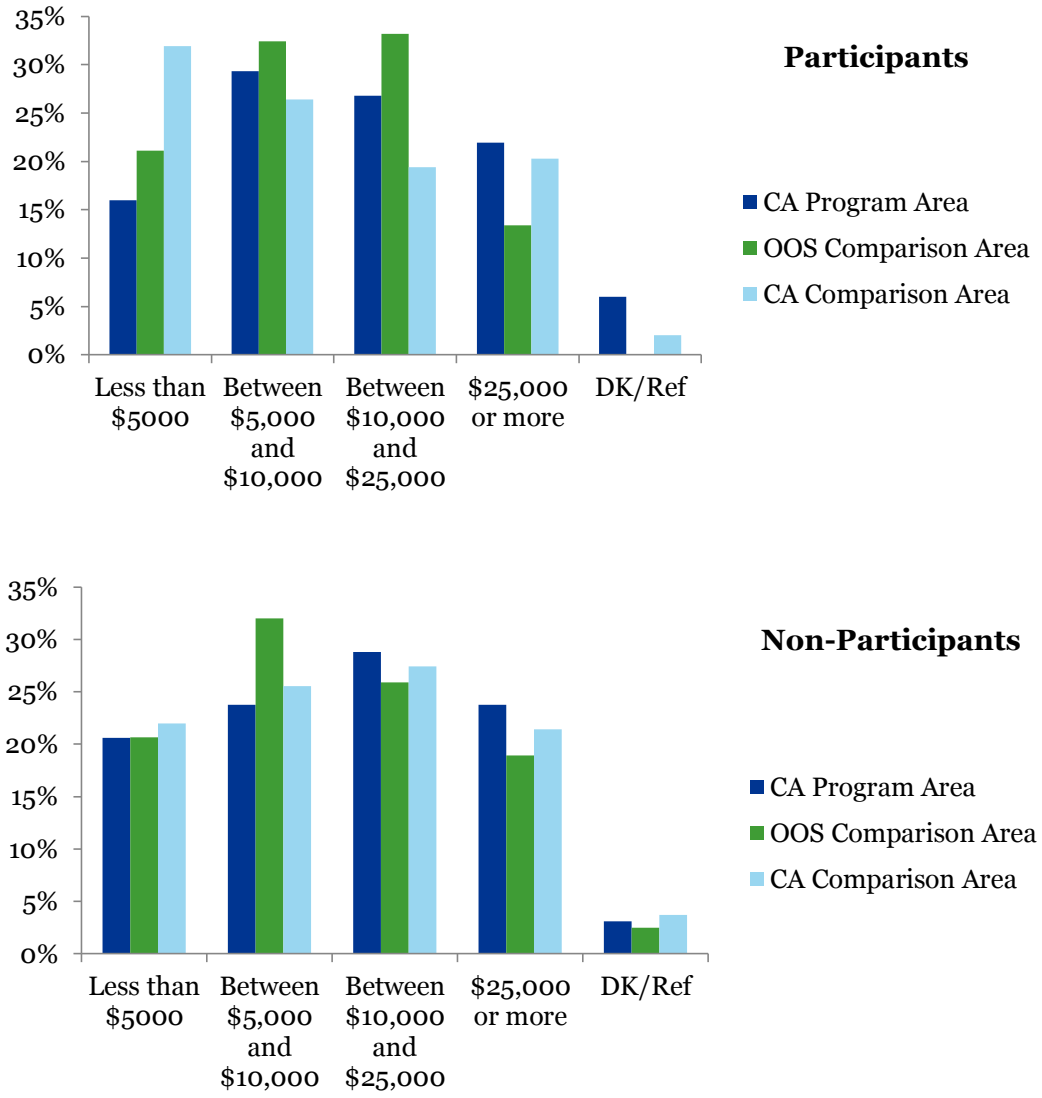


Figure 9 displays the distribution of project costs by participation status across the three areas.. A significantly higher (p-value < .10) proportion of respondents have self-reported project costs of $25,000 or more in the CA program area versus the OOS comparison area at 24 percent versus 19 percent. This holds true irrespective of participation status. Within the study areas, participation had relatively weak association with reported project costs. It should be noted that the lower/higher absolute project costs could be confounded with higher costs of living in CA relative to the OOS comparison areas included in this research.

Figure 9: Distribution of Reported Project Costs



Nineteen percent of homeowners in the CA Program Area reported borrowing money to finance their projects, as did 23 percent of respondents in the OOS Comparison Area and 25 percent of homeowners in the CA Comparison Area. Table 10 displays the percentage of home improvement projects that were financed by cost category across all study areas.

Table 10: Percentage of Home Improvement Projects Financed

Cost of Project	Percent of Projects in Cost Category That were Financed
Less than $5,000	12%
Between $5,000 and $10,000	22%
Between $10,000 and $25,000	22%
Between $25,000 and $50,000	31%
Between $50,000 and $75,000	15%
Between $75,000 and $100,000	23%
$100,000 or more	42%
Total	**22%**

These findings suggest that the majority of homeowners who undertake significant home improvements would be capable of paying for whole house retrofits without financing, although special financing may well be needed by a significant segment of customers with lower incomes or limited access to credit. In addition, we queried respondents to identify those who did not install all of the measures recommended either by an energy audit or by the contractor with whom they worked. We then asked those customers what was the main reason they did not complete all of the recommended measures. Table 11 displays the results from those questions. The percentage of customers who reported that they did not complete all of the measures that were recommended to them ranged from 6 percent in the CA Comparison Area to 13 percent in the California Program Area. The percentage of total respondents who did not complete all measures recommended due to financial constraints ranged from 5 – 7 percent in the three study areas.

Table 11: Reasons for Not Completing All Recommended Energy Efficiency Measures

	Program	Comparison	
Measures Installed	**CA**	**OOS**	**CA**
n=>	*501*	*501*	*200*
Did not install all recommended measures	13%	7%	6%
Reasons for not installing all measures (multiples accepted)			
Could not afford to do more/ran out of money	7%	5%	5%
Did not think the savings justified the costs	2%	2%	1%
Did not fit with other aspects of the overall project	1%	0%	0%
Was not convenient to do the measure at that time	2%	1%	1%
Other	10%	4%	5%

However, other findings from the process evaluation and targeting studies conducted for the IOUs found that a larger percentage of program participants identified lack of funds as a constraint on participation or completion of recommended measures. As discussed earlier, the targeting analysis identified a statistical association between respondents' socioeconomic characteristics, such as income and education, and their intended or actual participation in the HU/AHU program. Similarly, the process evaluation found that roughly half of [sample] participants (52%) only took some of the recommendations from the assessment. When asked why they did not do all of the recommendations, half of them (54%) said they could not afford all of the recommendations. That is, roughly 28 percent of the participants interviewed reported implementing only some of the recommended measures from the audit due to cost constraints.[21] The difference between these findings and those from the homeowner survey conducted for this project may lie in the fact that HU/AHU participants were likely presented with a longer list of recommended measures than customers who did not go through a WH/HP process.

Among high-volume energy efficiency contractors interviewed for the case studies, we found a wide range of views on the importance of financing in gaining customer acceptance for whole house retrofit services. Three believed that availability of low-cost, long-term, dedicated financing was essential to the success of their operations. As one said, "All of our customers get financed. We wouldn't be able to do any projects without financing in place." This contractor used the services of a credit union that has developed a product specifically to finance WH/HP projects. Two felt that lack of financing was not a limiting factor for most of their customers. Several characterized the availability of financing primarily as another vehicle for sales and

[21] SBW Consulting, Inc. 2013.

consumer education, for example: "When I give them the [loan contract] and ask if they want me to set up the financing, they often decide just to pay up front, but the financing got them thinking that it [paying the full project cost in cash] wasn't too big a deal to begin with."

Clearly, there is a segment of customers who are deterred from using or thinking about WH/HP services by high first costs. Contractors interviewed for the case studies and for the IOU-sponsored process evaluation report that there are customers who are deterred from participation by the assessment fee. We note that for these customers and others who face cost constraints, a designated reduced-interest loan program is available. In 2011, 50 percent of the participants in PG&E's program used loans; only 21 percent in 2012. The findings from the customer survey suggest that there is a large pool of customers who are spending considerable sums on home improvement projects which include energy efficiency measures who are not participating in the HU/AHU program. On the basis of that finding and others discussed in Section 2 and 3, we believe that lack of awareness and understanding of the WH/HP value proposition constitutes a more decisive barrier to participation in the HU/AHU program than consumers' financial constraints.

3.6 Contractor Selection and Customer Experience of Energy Efficiency Service Sales and Delivery

The WH/HP program model incorporates a number of interventions into the contractor selection process and management of the customer's experience with the contractor. These include contractor qualification and listing services, training of contractors on personal sales of energy efficiency services, and quality assurance inspections of completed jobs. In this section we present information from the homeowner surveys and case studies to characterize the range of approaches and criteria that customers use to select contractors, as well as their experience of contractor sales and delivery of energy efficiency services. This information can be used to help assess the potential value of the contractor qualification and training elements of the WH/HP program model.

3.6.1 Contractor Selection

Type of Contractor. Table 12 summarizes the survey respondents' characterization of the type of contractor that carried out their project. In the CA Program Area and CA Comparison area, respondents named general home remodeling contractors most frequently among all categories with 41 and 33 percent of total mentions respectively. In the OOS Comparison Area, heating and cooling contractors were mentioned most frequently, at 40 percent of total mentions. Taken together, general contractors and heating and cooling contractors accounted for 60 to 70 percent of all reported projects in the three study areas. The four specialties included in the contractor survey accounted for 67 percent to 73 percent of all reported projects in the three study areas. Self-described energy efficiency contractors accounted for only 4 percent of projects

in the CA Program and Comparison areas, and 3 percent in the OOS Comparison Area. This finding suggests that such contractors have some business outside of program-subsidized projects, which account for roughly 2 percent of home improvement projects in California. However, the share of energy efficiency specialists in the overall flow of home improvement projects remains relatively small.

Table 12: Characterization of Contractor with Primary Project Responsibility

Contractor Specialty	All respondents		
	CA Program Area	OOS Comparison Area	CA Comparison Area
n=>	***501***	***501***	***200***
Specialties included in the Contractor Sample			
General Home Remodeling contractor	41%	30%	33%
Heating/Cooling contractor	25%	40%	27%
Insulation contractor	2%	1%	4%
Energy Efficiency contractor	4%	3%	4%
Subtotal	***71%***	***73%***	***67%***
Other Specialties			
Kitchen or bath remodeling specialist	8%	4%	11%
Homebuilder	2%	5%	1%
Windows	5%	2%	3%
Did not use contractor (self, friend/family)	4%	4%	8%
Other[22]	3%	7%	4%
DK/Ref	6%	5%	5%

Significantly different from the CA Program Area at the 90% confidence level

Association of Program Participation and Type of Contractor. Table 13 disaggregates the respondents' characterization of the type of contractor by program participation status. The most important finding in this view of the data is that 21 percent of participants in the CA Program area report that the contractor who undertook their project identified him or herself as an Energy Efficiency specialist versus 5 percent of participants in the OOS Comparison Area and 14 percent in the CA Comparison Area. In our view, this finding provides evidence of the effect of California programs on the development of a contractor infrastructure that is taking advantage of the programs to build sales revenues versus the OOS comparison area in which the presence of Energy Efficiency specialists remains extremely limited.

[22] Other includes mentions of pool/spa contractors, electricians, plumbers, electricians, floor/tile specialists etc.

Table 13: Characterization of Contractor by Program Participation

Contractor Specialty	Participants			Non-Participants		
	CA Program	OOS Comparison	CA Comparison	CA Program	OOS Comparison	CA Comparison
n=>	***93***	***72***	***25***	***408***	***429***	***175***
General Home contractor	18%	30%	24%	41%	30%	33%
Heating/Cooling contractor	37%	53%	28%	25%	40%	27%
Insulation contractor	2%	3%	2%	2%	1%	4%
EE contractor	21%	5%	14%	3%	3%	3%
All other contractor types	10%	6%	28%	19%	17%	20%
Did not use contractor	6%	0%	4%	4%	4%	8%
Don't Know/Refused	6%	3%	0%	6%	5%	5%

Significantly different from the CA Program Area at the 90% confidence level

Contractor Selection Process and Criteria. Roughly one-half of respondents in all three study areas reported that they contacted more than one contractor in regard to carrying out their projects. Table 14 shows that around 50 percent of respondents say they found a contractor for their project through word of mouth and/or from previous work the contractor had done for them. This is invariant with regard to either program participation or study area. Referrals from other tradesmen or vendors are a distant second channel used to find contractors. Only 3 percent of respondents reported using more than one channel to identify potential contractors. Referral from a utility or government program is uniformly higher for all program participants across all areas at around 8 percent versus around 2 percent for non-participants. However there is no difference among participants in the three study areas in regard to the percentage of customers who had contractors referred by utility programs.

Table 14: Channel Used to Find Contractor by Respondent Participation Status

Channel	Participants			Non-Participants		
	CA Program	OOS Comparison	CA Comparison	CA Program	OOS Comparison	CA Comparison
n=>	*93*	*72*	*25*	*408*	*429*	*175*
Used for previous work	10%	17%	24%	16%	20%	10%
Word of mouth	38%	31%	23%	38%	39%	42%
Yellow Pages/Internet Directories	9%	16%	6%	13%	8%	17%
Advertising in newspapers or other general media	8%	8%	16%	5%	9%	7%
Referral from other tradesmen or vendors	7%	10%	11%	10%	8%	7%
Referral from a utility or government program	7%	9%	6%	2%	1%	2%
Relationship w/person who did work prior to project	10%	1%	6%	10%	4%	12%
Contractor contacted me	8%	3%	0%	2%	1%	0%
Other[23]	4%	3%	5%	4%	4%	6%
Don't Know/Refused	2%	3%	7%	7%	3%	7%

Significantly different from the CA Program Area at the 90% confidence level

Participants in the CA program area have relatively the highest mentions of being contacted by the contractor at 8 percent versus 3 percent and 0 percent for participants in the OOS and CA comparison areas. This may be an indicator of push marketing or a supply side trigger that could be tracked as the market for whole house services matures.

Contractor Selection Criteria. Table 15 shows the reasons that respondents reported for selecting their contractor by area. Respondents could provide multiple reasons. Relatively few homeowners mentioned criteria having to do with energy efficiency, such as the contractor's reputation for using energy-efficient or environmentally friendly materials and practices or certification for energy efficiency. Only 7 percent of respondents in the CA Program Area mentioned these reasons, v. 9 percent in the OOS Comparison Area and 15 percent in the CA Comparison area. Only 1- 2 percent of the respondents in each of the study areas mentioned referral from a utility or government program as a reason for contractor selection. Three criteria

[23] Other includes mentions of referrals from retailer/manufacturer, Insurer/warranty, and using specific criteria such as past work, license, and area where contractor operated etc.

received the highest share of mentions: satisfaction with previous work, good recommendations from others, and price. These accounted for 72 to 80 percent of all selection criteria mentioned in the three study areas. These findings are consistent with those summarized in Table 14 which identified previous experience, word of mouth, and personal relationships with the contractor as the principal channels for identifying contractors. They are also consistent with findings of the case studies of high-volume contractors that emphasize the importance of personal selling in generating WH/HP projects.

Table 15: Reasons for Contractor Choice (Multiples Accepted)

Reasons for contractor choice	All respondents		
	CA Program	OOS Comparison	CA Comparison
n=>	***501***	***501***	***200***
Satisfied with previous work	24%	29%	18%
Good recommendations from others	27%	24%	26%
Best price	26%	27%	28%
Best approach to meeting my needs	13%	11%	8%
Reputation for using energy efficient equipment and practices	4%	6%	10%
Reputation for using environmentally friendly materials and practices	2%	2%	4%
Contractor was certified by BPI, government, utility, etc.	1%	1%	1%
Referral from utility or government program	2%	2%	1%
Personal relationship or reason for selecting the vendor (family, religion, etc.)	10%	8%	4%
Other[24]	4%	4%	6%
DK/Refused	3%	4%	7%

Significantly different from the CA Program Area at the 90% confidence level

3.6.2 Contractor Promotion of WH/HP Values

In the homeowner survey we asked respondents whether their contractors had raised a list of energy-related issues in the course of planning their project. As Table 16 shows, there were only very small differences between the study areas in the percent of customers who reported that contractors brought up the various issues related to the benefits of WH/HP projects. This pattern persists even after disaggregating by participation. Taken at face value, the results

[24] Other includes mentions of trust/honesty, homeowner/DIY project, selected through retailer/manufacturer/insurer, timing/ availability, local etc.

summarized in Table 16 suggest that a large majority of contractors in all three study areas discuss issues related to energy-savings options and project impact on energy costs, comfort, and safety in the course of planning projects with customers. Moreover, a relatively large portion brings up potential project effects on indoor air quality and mitigation of mold problems. These findings are consistent with contractors' characterizations of their sales practices. However, the relatively low uptake of air sealing and mechanical ventilation measures reported by both homeowners and contractors suggest that efforts to sell those measures into projects have not been effective.

Table 16: Energy-Related Issues by Contractors in Planning the Respondent's Home Improvement Project

Issues	All respondents		
	CA Program	OOS Comparison	CA Comparison
n=>	***501***	***501***	***200***
Impacts of the project on your energy costs	46%	55%	50%
Energy savings options for equipment or construction practices	33%	36%	35%
Effect of renovations on comfort, such as eliminating drafts and hot or cold spots in the home	30%	32%	25%
Effect of renovations on indoor air quality	24%	26%	21%
Effect of renovations on safety of heating and cooling equipment	25%	24%	20%
Effect of renovations on controlling mold	15%	21%	12%

Significantly different from the CA Program Area at the 90% confidence level

3.7 Program Recognition and Participation

3.7.1 Types of Services Received and Customer Assessment of their Value

Table 17 displays the portion of self-identified program participants in the sample who reported receiving various types of program services.

Table 17: Assistance Provided by Energy Efficiency Programs

Assistance provided by program	Participants		
	CA Program	OOS Comparison	CA Comparison
n=>	*93*	*72*	*25*
Financial incentives or rebates	83%	82%	88%
Loans	7%	6%	10%
In-home assessment of energy efficiency opportunities, sometimes known as energy audits	54%	35%	47%
Other kinds of information and guidance	2%	19%	11%
Referrals to contractors	7%	11%	14%
Inspections of completed work	15%	23%	14%
Other (Specify)	6%	4%	8%
Combination of audit and inspections of completed work	6%	12%	11%

Significantly different from the CA Program Area at the 90% confidence level

There were few differences between the study areas in terms of the types of program services that participants reported receiving.

- **Financial assistance.** Between 82 and 88 percent of program participants in the three study areas received rebates. An additional 7 to 10 percent received loans.
- **Audits and Inspections.** Overall, 17 percent of participants report that they received energy audits and 18 percent state that they received inspections of completed work, but only 9 percent received the combination of audits and quality control inspection of finished work associated with home performance services. A lower share of participants in the CA program area report receiving inspections of completed work versus participants in the OOS Comparison Area, but the difference is not statistically significant. Similarly, 12 percent of participants in the OOS Comparison area reported receiving a combination of audits and inspections versus 6 percent in the CA Program Area.

Table 18 summarizes program participants' ratings of the importance of the various program components to which they were exposed in "encouraging [the customer] to plan and complete the project." The "n" column contains the number of respondents from all study areas who reported that the program in which they participated offered the service or component listed on the row. Sample sizes at the study area level are small; we therefore do not provide significance tests for those results.

The most interesting finding to be gleaned from Table 18 is that program participants who were exposed to service elements associated with the WH/HP approach – energy audits, contractor referral, and post-installation inspections – generally rated them as highly as rebates in terms of their importance in "encouraging [the respondent] to plan and complete the project". Respondents found loan offers and customer education materials to be less helpful in that regard.

Table 18: Importance of Program Services in Encouraging Project Planning and Completion

		Rate Services as Important (8 – 10 on 10 point scale)			
Service	**n**	**All Participants**	**CA Program**	**OOS Comparison**	**CA Comparison**
Rebates	171	49%	56%	41%	46%
Audit/Assessment	109	44%	47%	35%	54%
Contractor Referrals	113	52%	50%	51%	70%
Inspection of Completed Work	113	50%	59%	42%	42%
Loan Offers	91	31%	28%	36%	25%
Customer Education Materials	190	27%	28%	28%	24%

3.7.2 Program Effect on Measure Implementation Decision

The homeowner survey contained two "free ridership" type questions designed to assess the effects of programs on participants' energy efficiency measure implementation decisions. As the results in Table 19 show, the share of the sample homeowners in the OOS Comparison Area who reported that they would have undertaken their energy efficiency measures in the absence of the program was much higher than the corresponding shares in either the CA Program or Comparison Areas.

Table 19: Results of Free Ridership Questions

Free Ridership Items	Participants		
	CA Program	OOS Comparison	CA Comparison
n=>	93	72	25
Likely to have carried out the energy efficiency improvements same time you did in the absence of the program (score of 8 – 10 on a 10-point scale)	38%	72%	37%
Likely to have installed all of the energy efficiency measures you did in the absence of the program (score of 8 – 10 on a 10-point scale)	32%	69%	41%

Significantly different from the CA Program Area at the 95% confidence level

This outcome is surprising because the California respondents, particularly those in the Program Area, had a somewhat higher socio-economic profile than their counterparts in the OOS Comparison Area, particularly in regard to home prices. One possible explanation for this finding is that financial incentives for retrofits available to California homeowners during the study period were particularly high during the study period. From 2010-2012 the combination of utility and ARRA-funded programs made it possible to obtain up to $10,000 in rebates for a single project. Incentives available in other areas were much lower. Similarly, the suite of services through the IOU Home Upgrade / Advanced Home Upgrade programs was much more intensive than those offered elsewhere.

3.8 Non-participant Awareness and Interest in WH/HP Services

Awareness. The percentage of targeted customers who are aware of the service offering in question is a key indicator of market development. In this survey, we asked non-participants whether they were aware of WH/HP programs after reading a detailed description of a typical program. Table 20 summarizes the responses to those questions. Twenty-nine percent of non-participants in the CA program area reported that they were aware of programs that fit the

description compared 13 percent and 17 percent in the OOS and CA Comparison areas respectively. Seventeen percent reported being aware of the program prior to undertaking their project in CA program area compared to less than 10 percent in OOS and CA comparison areas. Some form of whole house retrofit program was available in each of the three study areas. These differences may reflect the results of the high level of marketing effort supporting the IOUs' Home Upgrade / Advanced Home Upgrade program since 2010, a large portion of which was funded via ARRA monies.

Table 20: Non-Participant Awareness of WH/HP Concepts and Programs

Awareness of Program	Non – Participants		
	CA Program	OOS Comparison	CA Comparison
n=>	*408*	*429*	*172*
Aware of WH/HP program/program concepts	29%	13%	17%
Aware of WH/HP program prior to undertaking project	17%	8%	9%

Reasons for not participating in programs. Among non-participants who reported that they were aware of the programs, the most frequent reasons given for not participating were the following:

- They did not have enough time to become involved with the program.
- They did not have enough money to implement the recommended measures.
- They had trusted that the contractor they had selected would use energy-efficient methods.
- They did not believe that the energy savings would be large enough to justify getting involved

In our experience, this is the typical range of reasons that non-participants give for not participating in programs they claim to be aware of.

Interest in WH/HP Services. Homeowners who had not participated in programs were asked a short series of questions regarding their interest in elements of the WH/HP approach, the results of which are summarized in Table 21. Roughly half of the respondents reported that they would have sought an assessment of energy savings opportunities in their homes if they had been aware of the WH/HP programs in their areas prior to undertaking the project. In this series we also tried to assess homeowners' willingness to add costs to their projects in order to realize energy savings. Among customers who reported that they would have sought an energy assessment, roughly half (or one quarter of all non-participants in the sample) reported that they would have been willing to add $5,000 to the cost of their project to implement energy efficiency measures that paid back that amount in energy savings over five years.

Table 21: Non-Participants Interest in WH/HP Services

Perceptions of and Interest in Program	Non – Participants		
	CA Program	OOS Comparison	CA Comparison
n=>	*326*	*395*	*159*
Would have sought an assessment of energy savings opportunities if they had been aware of program prior to project.	49%	38%	53%
Would have incorporated energy saving measures that cost an additional $5000 and with a payback period of under 5 years (as a % of those willing to seek assessment of energy savings opportunities)	49%	57%	52%

3.9 Conclusions

The assessment of the consumer market for WH/HP services presented above identifies a number of fundamental market conditions and trends that are favorable to the programs that promote those services. These include the following.

- At the national level, consumer spending on contractor services for home improvements has increased steadily since the trough of the most recent recession, climbing to 15 percent or more in the past two years.
- Nearly one-third of home improvement projects in the three study areas were motivated by objectives emphasized by WH/HP programs: reducing energy costs, increasing comfort, and improving indoor air quality.
- Nearly two-thirds of major home improvement projects in the three study areas include at least one *bona fide* energy efficiency measure, and 35 percent include multiple measures.
- Half of the homeowners in the three study areas who report undertaking major home improvement projects spent over $10,000, enough to incorporate the home assessments and multiple measures associated with the WH/HP approach.
- Consumers in the three study areas report that they value the combination of reduced transaction costs, quality assurance, and technical guidance that the WH/HP approach offers.
- Consumers in the three study areas report that contractors discussed the effects of their home improvements on energy costs in roughly half of the projects identified in the sample. Contractors discussed comfort in under one-third of the projects identified in the sample.

In the CA Program Area we find evidence that the high level of marketing and program delivery effort behind the IOU's Home Upgrade/Advanced Home Upgrade program is having some effect on customers. In particular:

- Among non-participants, 29 percent are aware of WH/HP programs in the CA Program Area v. 13 percent in the OOS Comparison are and 17 percent in the CA Comparison area.
- A significantly higher (p-value < .10) share of homeowners in the CA Program Area included multiple energy efficiency measures in their projects versus those in the Comparison Areas.

Despite these developments, participation in HU/AHU program remains well below planned levels, as it does for virtually every other WH/HP program around the country. Given the relative newness of the WH/HP program and service concepts, this result is not entirely surprising. Key contributing factors to low participation identified in the consumer research for this study include:

- **Low levels of awareness.** Although awareness of WH/HP programs and concepts is higher in the CA Program Areas than in the Comparison areas, fewer than one-third of homeowners who undertook major home improvement projects in the CA Program Area were aware of the program. Given that only 7 percent of single and two-family homeowners make improvements totaling more than $3,000 each year, the awareness level is sufficiently low to place a barrier to achievement of the participation goals established for the 2013-2014 cycle.
- **Restricted contractor selection process.** The distribution of the channels that homeowners used to identify home improvement contractors was virtually the same in all three study areas. They rely primarily on channels that require little time to access and that have built into them at least some informal quality check based on personal experience. Use of contractors employed in previous projects, word of mouth from friends and relatives, use of friends, and referrals from other vendors accounted for roughly 70 percent of all projects in all three of the study areas, regardless of the respondents' program participation status. Customers who rely heavily on these channels are unlikely to learn much about energy efficiency through their contractor search. Even among program participants in the CA Program Area, only 7 percent of respondents reported finding their contractor through referrals from a utility or government agency. Similarly, the criteria that customers used in selecting contractors seldom had anything to do with their capabilities and offers in regard to energy efficiency.

These findings are consistent with the results of process evaluations of WH/HP programs and with the stress that high-volume contractors place on personal selling, as discussed in the next section. They also highlight the importance of continuing marketing support and sales training

for contractors to the success of the IOUs Home Upgrade / Advanced Home Upgrade program and similar programs.

4. The Supply Chain for WH/HP Services

In this section, we characterize baseline conditions on the supply side of the market for WH/HP services in the three study areas. We focus on the assessing the extent to which contractors who serve the home improvement market are aware of WH/HP services and the extent to which they incorporated elements of those services into their marketing, sales, and service delivery practices.

We preface this broad characterization of the supply chain with a summary of findings from the case studies of six high-volume WH/HP contractors, which were completed during the fall and winter of 2012. While these firms take a variety of approaches to addressing sales and service delivery challenges, they share many characteristics in terms of organization of sales and service delivery activities, use of program resources, and approach to customer service. The characteristics and practices of these firms, which have established successful business models within the WH/HP program framework, provide useful context for assessing progress in the market as a whole.

4.1 Characteristics and Practices of High Volume WH/HP Contractors

In this section, we briefly profile six firms from around the country that delivered 50 or more WH/HP projects in 2012. We identified these firms through review of program evaluations and personal interviews with WH/HP program managers. Table 22 presents selected details about the six profiled contractors. Four of the firms were founded between 2006 and 2009 expressly to deliver energy efficiency services in areas where public goods charge-funded WH/HP programs were active. The other two are long-established residential and small commercial HVAC contractors who entered the market primarily to deliver new services to an existing customer base. The profiles focus on the strategies the firms have used to market WH/HP services, the investments they have made in equipment, training, and other service delivery assets, their perceptions of the value customers obtain from their services, the impact of WH/HP programs on the market and on their own operations, and recommendations for making programs more effective.

Table 22: Selected Characteristics of WH/HP Contractors Profiled in Case Studies

	Areas Served	Years Founded/ Started HP	Primary Business	# of Employees	# of HP Projects 2012	Average Project Cost	Range of Services Offered
1	Arizona/So. California	2009/ 2009	Residential Energy Eff.	50	1,200	$14,000	HP, HVAC, Solar PV, DHW Meas.
2	Bay Area, California	2006/ 2006	Residential Energy Eff.	36	>200	$10,000 - $15,000	HP, HVAC, Solar PV, DHW Meas.
3	Maryland	2006/ 2006	Residential Energy Eff.	7	~100	$8,000	HP, HVAC, Solar PV, DHW Meas.*
4	Southern California	2009/ 2009	Residential Energy Eff.	20	~50	$17,000	HP, HVAC, Solar PV, DHW Meas.
5	New Jersey, NY, DE	1948/ 2007	Res & Sm. Com. HVAC	250	500	$16,000 - $18,000	HVAC sales & maintenance, HP
6	Upstate New York	1984/ 2007	Res & Sm. Com. HVAC	~100	400	$9,000	HVAC sales & maintenance, HP

* Most installation work subcontracted

4.1.1 Business Strategies and Value Propositions

The four firms that started up expressly to deliver energy efficiency services through WH/HP services all identified their capacity to act as a "one stop shop" for energy efficiency and solar installations as the primary differentiator from their competitors in neighboring trades. In terms of business strategy, this approach enabled them to generate much higher revenues per project than would be available from installing single measures. Coupled with significant project volumes, this approach can generate sufficient gross margin to support the investments in training, equipment, and administrative capacity required to serve WH/HP programs. The proprietors of the two established HVAC contractors profiled were both personally very interested in energy efficiency as a social issue and corporate mission. From a business standpoint, they viewed the WH/HP service offering as a way to increase the value of services they deliver to their customers, thereby increasing revenues and customer retention. As one of the HVAC contractors put it:

> *Today, it doesn't take a very savvy homeowner to …go on the Internet and buy [a] furnace for the exact same cost you can go to your wholesaler and buy it for. So there's no real margins on equipment and you are trying to sell your quality of installation and your service after the sale and your warranties and all of those things, which is fine, but it becomes more and more difficult when you limit service to just HVAC.*

In terms of value to the customer, all six firms stressed the importance of non-financial (or non-energy) as well as financial benefits, particularly in temperate climates. As one California contractor noted:

> *If we had bigger weather extremes, I think we'd be much busier. When we talk to homeowners that are only focused on return on investment, I say this program probably isn't for you. We live in paradise for a reason. … The main motivating factors for clients are comfort and safety. I can make every room in their house no more than two degrees temperature difference no matter what floor it is. And that's a pretty big selling point to people.*

All of the contractors who entered the market to provide efficiency services have also attempted to tap customer interest in "getting off the grid" by selling solar installations.

4.1.2 Approaches to Key Business Challenges

Marketing and sales. The value proposition for WH/HP services is complex, and all of the profiled contractors reported that only direct customer contact and intensive customer education are effective in making sales. The contractors reported using a wide range of direct selling methods including door-to-door solicitation in select neighborhoods, appearances at home and hobby shows, direct mail and email, referral incentives for past customers. The HVAC contractors report that their repair and sales technicians inform customers about their WH/HP services on every call. They view their established customer base as an asset, but both also conduct direct marketing to homes that they do not service for HVAC.

Energy audit as consumer education tool and deposit on installation fees. The representatives of all six companies viewed the energy audit primarily as a consumer education tool to clarify the WH/HP value proposition. As one manager noted, "We have learned over the last seven years that WH/HP is difficult to understand and explain, particularly in the brief time you get to capture the homeowner's attention." He endorsed the audit requirements of his local program, which requires that all energy saving, health, and safety issues be addressed. "Once you get in their home and use the blower door and thermal imaging camera, then you can explain to them – 'we've calculated your building airflow, and here's our target number and how much leakage your home has' – you just totally wow them. From there, if you can get them financed you can usually make the sale."

The contractor representatives differed sharply, however, on whether the customer should be charged for the audit, which cost $500 to $1,200 to deliver, depending on program rules and the nature of the home. Half believed it was worthwhile to eat the cost of the audit in order to gain face time with the customer.

We say everybody gets a no-cost audit. If a potential customer makes half a million dollars, I'm okay with sitting at his kitchen table doing an audit even if I'm not getting paid for it because that is a great opportunity to be sitting at his kitchen table.

The other three contractors believed that the audit fee was best used as a deposit against the costs of the retrofit installations. Without it, it was too easy for the customer to walk away from the job, leaving the contractor with no way to recover audit delivery costs.

Financing as sales tool and investment facilitator. The WH/HP professionals interviewed held a range of views on the importance of financing. Three believed that availability of low-cost, long-term, dedicated financing was essential to the success of their operations. As one said, "All of our customers get financed. We wouldn't be able to do any projects without financing in place." This contractor used the services of a credit union that has developed a product specifically to finance WH/HP projects. Two felt that lack of financing was not a limiting factor for most of their customers. Several characterized the availability of financing primarily as another vehicle for sales and consumer education, for example: "When I give them the [loan contract] and ask if they want me to set up the financing, they often decide just to pay up front, but the financing got them thinking that it wasn't too big a deal to begin with."

Investment in service delivery and program participation. Entry into the WH/HP business requires considerable investment. As one contractor put it, "Being part of the rebate program is a huge part of our business, but it also creates a great deal of overhead." The major costs called out included:

- **Equipment and materials.** The firms that volunteered information on investment costs, estimated the costs of testing equipment at roughly $10,000 - $20,000 per crew. Additional equipment and materials costs specific to WH/HP services included licensing fees for audit software and mobile computing facilities.
- **Workforce education and training.** All of the contractors interviewed were certified by the Building Performance Institute and provided BPI training to crew managers and auditors. Most also purchased training from other sources including the U. S. Green Building Council, NATE, and the Residential Energy Services Network (RESNET).
- **Administrative Staff.** All but one of the firms reported employing at least one full time worker to manage participation in utility and government programs. That person was responsible for preparing reports, ensuring compliance with program rules, preparation of rebate applications, and tracking of paper work. Many of the firms also report employing a full time technician to run the audit models and produce audit reports. In other firms, that role falls to a field technician.

Clearly, project volume and revenues must be sustained at a level high enough to cover these expenses while providing for profitable operation. None of the case study subjects identified the

costs of equipment, training, and administrative support as a barrier to entering the WH/HP market. The opposite side of that coin is that concern to avoid loss of sunk costs in training and equipment does not appear to be much of a deterrent to exiting the business, as the rapid decline in active BPI certifications after the ARRA influx attests.

Marketing of WH/HP Services outside of Programs. We asked each of the case study subjects whether they marketed or attempted to sell HP services – that is, audit and diagnostic-driven retrofits – to customers who were not participating in local programs. The answer was no in all cases. Several of the subjects pointed out that marketing their services without reference to the program would run counter to their business model, since they had already invested in the staff resources required for program participation. There was no reason not to use the incentives to their advantage (and the customer's) in every case. After one contractor went through an elaborate example of making a project "cash neutral" using favorable financing assumptions, our interviewer followed up by asking, "And so even without incentives, there's the chance to sell [HP services] with financing?"

> *RESPONDENT: Yeah. If you just want to sell to rich people.*
>
> *INTERVIEWER: Is that something that your company has thought about doing?*
>
> *RESPONDENT: And if you know where I can get a mailing list for that, I'd appreciate it.*

4.1.3 Assessment of Current Programs

All of the contractors interviewed were enthusiastic supporters of their local programs. As one said, "I'm as big an advocate as you can get for [the program]. It's been the catalyst to spur my business to where it is. It's definitely needed." While all agreed that subsidies were required at this point in the market development, they also agreed that rebates in and of themselves would not lead to the development of the market. Several mentioned quality assurance inspections and contractor certification as having high value in reducing customers' transaction costs and perceptions of performance risk.

One contractor credited the programs as a catalyst for developing capabilities that his firm applied in other markets:

> *Energy Upgrade California is operating on the whole house approach where Arizona still operates on individual measure rebates, you can do air seal or duct seal independent of each other. …That is a big difference. The program requirements have made us better in California. We've had to adapt to the whole house perspective and now we use that same model in Arizona.*

One contractor operating in New York and one in California mentioned that programs which support single retrofit measures, such as insulation or HVAC improvements, pose difficulties for

marketing whole house programs, primarily because customers are much more familiar with the value proposition for single measures. As the New York firm put it:

> *The Home Performance with Energy Star program through NYSERDA, requires that we take the complete high road on everything we do. Everything is involved with health and safety including the complete energy audit. The test-out inspections have a third-party inspector that tests, and, 10% to 20% of your jobs randomly get tested. So there's a constant quality control, which I'm very much in favor of, but then we find ourselves competing with the local utility companies that just come out with quick, easy rebates and no quality control.*

Another contractor operating in California appreciated the flexibility offered by multiple programs for dealing with extremely varied housing stock in his market area.

Virtually all contractors concluded their interviews by stating that the most important task facing the industry was to educate consumers to the value of the WH/HP approach. As one put it:

> *The most important thing that I think will come out of the rebate programs is educating the public to think about their homes in this new way. If that happens then once the rebates are gone, we still have an educated public that is thinking about energy efficiency and wants to upgrade their homes.*

4.2 Population of Contractors and the Contractor Survey Sample

4.2.1 The Population of Home Improvement & Remodeling Contractors

The population of home improvement and remodeling contractors is made up primarily of very small firms. The most recent comprehensive national characterization of that population by the Joint Center for Housing Studies summarized market conditions in 2007.[25] At that time, 67 percent of the establishments that earned the majority of their receipts from work on existing homes were self-employed individuals. Moreover, those firms received most of their revenues through subcontracting or general contracting for new construction projects. Annual revenues for general contracting establishments active in the remodeling market were $1.3 million compared to $900,000 for HVAC contractors and $1.2 million for insulation contractors. Concentration in the industry was modest. Only 15 percent of the firms in the industry had

[25] Joint Center for Housing Studies of Harvard University, op. cit.

annual revenues over $1 million, and they accounted for 65 percent of total revenues among contractors active in the home improvements industry for work in existing homes. Not surprisingly, given this size distribution, the rate of failure was high. Thirty-six percent of the firms that had been active in remodeling in 2003 were no longer in business in 2007. We note that all but 1 of the 6 high-volume contractors profiled in the case studies were very much at the high end of the size distribution for the home improvement industry.

4.2.2 The Contractor Survey Sample

As discussed earlier, we decided on the basis of review of process evaluations, our case studies, and the results of the homeowner survey to focus the contractor study on four specialties: general contracting for existing homes, HVAC installation and maintenance, insulation, and residential energy efficiency.

We used the commercial business listing InfoUSA as the starting point for developing the sample list for the contractor survey. InfoUSA collects and collates information on business establishments from a wide range of sources, and attempts to verify that information through direct contact with the business. The first step in developing the list was to identify the SIC categories for which data were available and to select those we believed best fit the trades that might adopt whole house retrofit business and technical practices. Most of the categories identified were six-digit codes, and most were listed under residential construction. The SIC codes included in our sample were as follows:

152103 – General Contractors (Residential)
152105 – Home Improvements
152112 – Home Builders
152124 – Attic and Basement Finishing
152130 – Construction-building Contractors
152139 – Remodeling & Repairing Building Contractors
152299 – General Contractors – Residential Buildings
171101 – Heating Specialties
171101 – Solar Heating Contractors
171117 – Air Conditioning Contractors & Systems
171120 – Ventilating Contractors
171124 – Duct Systems – Air Conditioning & Heating
171131 – Energy management & Products
174205 – Insulation Contractors – Cold & Heat

Our previous work with InfoUSA resources and Whole House program materials suggested that listings for energy efficiency contractors would not be complete based on solely InfoUSA listings. We therefore supplemented the InfoUSA data with more specialized lists of self-identified residential energy efficiency service providers using information from certifying bodies,

membership groups, and whole-house programs, such as the IOU's Home Upgrade/ Advanced Home Upgrade programs. The combined sample from various sources yielded a list of 28,186 contractors. Additionally, the list as selected above was further refined by excluding contractors whose business focus was new construction rather than existing homes as indicated by the associated NAICS codes. This resulted in a list of 16,439 contractors across the areas of our study. This merged list from various sources was cleaned to account for any potential overlap. We ended up with 15,691 unique listings. Of those, only 530 were in the CA Comparison area. After attempting to conduct interviews among this group, it became apparent that we could not complete a sufficient number to reliably characterize contractors in the CA Comparison Area due to the difficulties in obtaining responses. After consideration by the CPUC project manager, we, therefore, focused our efforts on completing interviews in the CA Program and OOS Comparison Areas. Table 23 summarizes the total population and the number of completed surveys by contractor type and study area.

In computing the survey results, we weighted by the number of firms in each category within the individual areas. In order to support comparability between the customer and contractor survey results, and to provide estimates of the share of total projects delivered by contractors who had adopted WH/HP practices, we weighted individual contractor responses by the number of home improvement projects they undertook in the year prior to the survey, using a ratio estimation approach. See Appendix B for more detail on this computation procedure.

Table 23: WO54 Whole House Contractor Survey - Population and Sample Counts

High Level Grouping	Population		Completed Surveys	
	CA Program Area	OOS Comparison Area	CA Program Area	OOS Comparison Area
General Contractors & Remodelers	2,086	2,229	24	25
HVAC Contractors	4,016	4,138	35	37
Insulation Contractors & Others	194	340	5	3
Self-Described Energy Efficiency	1,682	476	26	9
Total	7,978	7,183	90	74

4.3 Energy Efficiency Measures Installed in Home Improvement Projects

Table 24 shows the distribution of measures installed by all contractors and the proportion of jobs on which these services are provided by area. While measure installation practices are largely comparable between the contractors in the CA Program and OOS Comparison areas, there are a few significant differences that should be noted.

- **Whole House Combinations.** While the proportion of contractors offering a combination of air sealing and insulation measures is nearly equal in the CA Program and OOS Comparison Area, the share of contractors who install the combination of insulation and air sealing in all or most cases was 18 percent in the CA Program Area v. 11 percent in the OOS Comparison Area. There was no significant difference between the CA Program and OOS Comparison area in terms of the share of contractors who offered or installed a combination of shell and HVAC measures.
- **Air Sealing and Duct Sealing.** Contractors in the CA Program Area generally reported installing air and duct sealing at higher rates than contractors in the OOS Program Area, although differences are not statistically significant.

Table 24: Measure types installed - All contractors

Measures offered	CA Program Area			OOS Comparison Area		
	Offer Service (y/n)	Install on all (≥ 90%) jobs	Install on most (≥ 50%) jobs	Offer Service (y/n)	Install on all (≥ 90%) jobs	Install on most (≥ 50%) jobs
n=>	*90*			*74*		
Shell = Air Seal AND Insulation (any of attic, floor, wall)	22%	14%	4%	19%	5%	6%
Shell AND HVAC = Shell and (E* heating or cooling or Duct Sealing)	21%	16%	4%	16%	11%	6%
Attic Insulation	32%	10%	9%	37%	6%	4%
Wall Insulation	29%	5%	7%	30%	4%	7%
Floor Insulation	30%	5%	9%	36%	4%	8%
Air Sealing	24%	10%	4%	23%	5%	4%
Duct Sealing	81%	31%	20%	74%	22%	13%
Energy Efficient Windows	34%	9%	7%	27%	7%	4%
Energy Efficient Water Heater	39%	2%	8%	23%	1%	0%
Solar PV	15%	2%	1%	4%	0%	1%
Energy Star Heating/Cooling	85%	25%	35%	79%	35%	28%
Programmable thermostats, lighting controls - advanced controls	90%	56%	18%	82%	32%	23%

Significantly different from the CA Program Area at the 90% confidence level

- **Energy-Efficient Water Heaters.** Thirty-nine percent of contractors in the CA Program Area report that they install energy-efficient water heaters versus 23 percent in the OOS Comparison Area. This difference is statistically significant (p-value < .10).
- **Programmable thermostats, lighting controls - advanced controls.** Contractors in the CA program area offer advanced controls such as programmable thermostats and lighting controls at a higher rate than contractors in the OOS comparison areas at 90 percent versus 82 percent. While the provision of this service is high in both areas, actual implementation/installation rates are significantly higher (p-value < .10) with 56 percent of CA program area contractors stating that they install this on all jobs versus 32 percent of contractors in the OOS comparison areas.

- **Solar Photovoltaic.** While the installation rates are comparable in the CA program area and OOS comparison area, the proportion of contractors who offer this service is significantly higher (p-value < .10) in the CA program area at 15 percent versus 4 percent respectively. This could be an indicator of the program effect of the combined efforts of Energy Upgrade California and the California Solar Initiative.

4.4 Home Performance Service Offerings

Table 25 displays the share of total home improvement projects carried out by contractors who offer energy audits and diagnostic services associated with the WH/HP approach, and the share of projects on which these services are actually deployed. In both the CA Program and OOS Comparison Areas, ¼ to 1/3 of contractors report that they offer the four key diagnostic services: energy audits, blower door tests for air infiltration, duct leakage testing, and combustion testing for heating equipment. However, in both study areas, a far lower percentage of contractors report deploying these capabilities in all or most of their projects. Only in the case of energy audits and blower door tests do Contractors in the CA Program Area deploy home performance-related services significantly more (p-value < .10) frequently than their counterparts in the OOS Comparison Area.

Table 25: Home Performance-Related Services Offered

	CA Program Area			OOS Comparison Area		
Measures offered	**Offer Service (y/n)**	**Deploy on all (≥ 90%) jobs**	**Deploy on most (≥ 50%) jobs**	**Offer Service (y/n)**	**Deploy on all (≥ 90%) jobs**	**Deploy on most (≥ 50%) jobs**
n=>	***90***			***74***		
Energy audits	31%	9%	11%	22%	2%	9%
Blower door test for air infiltration	26%	8%	7%	18%	5%	0%
Duct leakage testing	31%	12%	5%	23%	10%	2%
Combustion efficiency for heating equipment	26%	9%	7%	23%	8%	5%
Refrigeration diagnostics for air conditioning equipment	23%	11%	7%	28%	14%	6%
Radon test	2%	0%	1%	4%	1%	2%

Significantly different from the CA Program Area at the 90% confidence level

The number of contractors with active BPI certifications also provides a measure of the capacity of firms in the study areas to deliver WH/HP services. According to contractor lists obtained from BPI, the number of BPI-certified contractors in California is 4.36 per 10,000 occupied housing units, versus 2.59 per 10,000 occupied housing units in the states containing the OOS Comparison Areas.

4.5 Contractor Awareness and Knowledge of WH/HP Concepts

The contractor survey used a short series of questions to probe respondents' awareness, knowledge, and attitudes in regard to WH/HP services. The first simply asked whether the respondent was aware of "whole house retrofit concepts for energy efficiency". Those who claimed to be aware were then asked to describe those concepts without prompting or guidance. If the respondent's description contained references to any of the following, they were characterized as having knowledge of the whole house concept:

- Combination of energy audits and retrofits;
- Combinations of air sealing, insulation, and HVAC measures;
- Use of diagnostic tests to guide retrofits;
- Approaching the house as a system.

As part of their description of whole house concepts, many respondents offered unsolicited endorsements or criticisms of the approach. Table 26 displays the market share of the contractors offering those opinions, as well as response to the awareness and knowledge items.

Table 26: Contractor Awareness, Knowledge, and Attitudes in Regard to Whole House/Home Performance Concepts

Description of Indicator	CA Program Area	OOS Comparison Area
n=	*90*	*74*
Awareness: Report being aware of "whole house retrofit concepts for energy efficiency"	75%	67%
Knowledge: Accurately describe WH/HP services in response to open-ended question.	32%	27%
Positive Predisposition: Endorse WH/HP concepts in response to open-ended question but do not display accurate knowledge.	24%	19%
Negative Predisposition: Express skepticism or criticism of WH/HP concepts in response to open-ended question	6%	6%

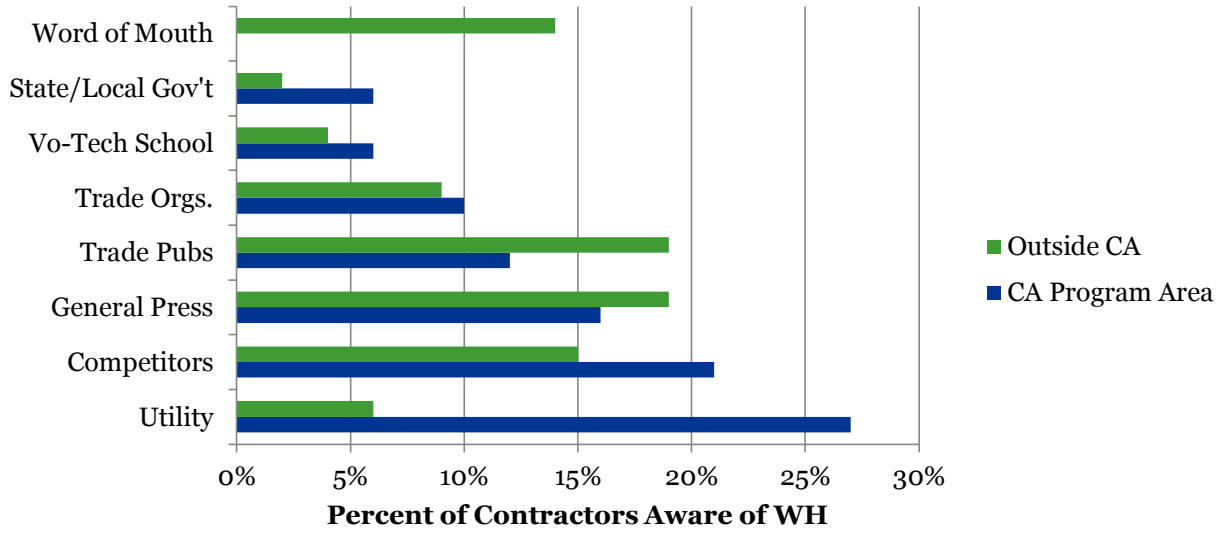
Levels of reported awareness and knowledge of whole house concepts were nearly equal in the CA Program Area and the OOS Comparison Area, as were the levels of reported positive and

negative predisposition towards the concepts. Of particular interest is the difference between the market share accounted for by contractors who said they were aware of whole house retrofit concepts and the share accounted for by contractors who accurately described those concepts. Contractors representing only 32 percent of the market in the CA Program Area and 27 percent in the OOS Program Area were able to provide an accurate description of the whole house approach, and we did not set a particularly high bar for accuracy.

We also note that the share of market represented by contractors with a positive predisposition to the whole house retrofit concept far outweighs the share represented by contractors with a negative predisposition. The extent of this difference is somewhat underrepresented in the table, because many of the accurate descriptions contained an implicit endorsement of the logic and value of the concept.

Figure 10 displays the channels that sample contractors identified for their information about WH/HP services. Contractors in the CA Program Area identified utility and government agencies much more frequently than their counterparts in the OOS Comparison Area. This finding can be interpreted as evidence of the effectiveness of EUC in reaching contractors with information about the WH/HP approach.

Figure 10: Sources of Information on WH/HP Services (Multiples Accepted)



4.6 Contractor Interest in Investing in WH/HP Delivery Capability

The contractor survey asked respondents whether they believed it would be worthwhile to invest in developing the capability to deliver WH/HP services (based on a standard description of those services that was read to them immediately preceding the question). Those contractors who said they were interested or may be interested were asked whether they believed they could deliver those services with their current employees. **Table** 27 summarizes the responses to those questions.

The key findings from this table are as follows.

- Twelve percent of contractors in the CA Program Area report that they currently deliver WH/HP services v. 4 percent in the OOS Comparison Area. This difference is statistically significant (p-value < .10).
- There are no large or statistically significant differences between the CA Program Area and the OOS Comparison area in the share of market represented by contractors who say that they are or may be interested in investing in WH/HP service delivery capacity, or in the share represented by contractors who believe they could deliver those services with their current staff.

Table 27: Contractor Interest in and Current Capacity to Deliver WH/HP Services

	CA Program Area	Outside CA
n =	90	74
Would it be worthwhile for your company to invest in developing WH/HP delivery capability		
Already provide	12%	4%
Yes	46%	47%
Maybe	14%	15%
No	25%	32%
Do you think you could market and deliver this kind of service with current employees? (Among those who believe WH is or may be a worthwhile investment.)		
Market and deliver w current employees –yes	41%	52%
Market and deliver w current employees –no	14%	7%
Market and deliver w current employees -maybe	4%	0%

Significantly different from the CA Program Area at the 90% confidence level

4.7 WH/HP Program Awareness, Participation, and Response

Table 28 summarizes information that sample contractors provided concerning their awareness of and participation in WH/HP programs active in their market areas. Contractors in the CA Program Area reported a higher level of awareness and participation in WH/HP programs than their counterparts in the OOS Comparison Area. Specifically:

- Contractors representing 59 percent of the market in the CA Program area were aware of programs that support WH/HP services v. 44 percent in the OOS Comparison Area. This difference is statistically significant (p-value < .10).
- Contractors representing 28 percent of the market in the CA Program area reported that they had completed at least one whole house retrofit project through a utility or government program v. 14 percent in the OOS Comparison Area. This difference is statistically significant (p-value < .10).
- The average number of audits and projects completed through the project was virtually the same in both study areas. However, the sample sizes for these calculations are very small. The low n's for these items also suggest that it was the larger contractors in the study areas who reported participation in the programs.

Table 28: Contractor Awareness of and Participation in Local Programs that Support WH/HP Services

Description of Indicator	CA Program Area	OOS Comparison Area
n=	*90*	*74*
Awareness: Aware of programs in the local market area that offer financial incentives for whole house retrofits?	59%	44%
Participation: Completed at least one project with the assistance of the program	28%	14%
[Self-Reported Program Participants] *n =*	***28***	***11***
Average number of energy audits completed	42	22
Average number of retrofit WH projects completed	13	12

When asked why they had participated in the program, contractors with completed jobs provided a list of motivations that aligned with those given by the subjects of the case studies. The most frequently mentioned reasons for participation were:

- Use of program incentives to support investment in expanding an existing business line.
- Customers were requesting the service.

- Use of program incentives to support investment in developing a new business line.
- Doing the right thing in terms of the environment.

Given the small number of sample contractors who participated, we cannot make meaningful comparisons between the study areas in terms of patterns of motivations. However, we will note that contractors representing 15 percent of those who participated in the CA Program Area identified "Helping the environment" as their main reason for participating in the program v. 0 percent in the OOS Comparison Area.

4.8 Conclusions

The case studies of high-volume WH/HP contractors suggest that success in this field requires investment in hiring and training staff to market the services, maintain consistency and quality of delivery, and manage a significant flow of technical and administrative work associated with completing home assessments, obtaining rebates, and assuring compliance with program rules. Moreover, it requires considerable margin from operations to sustain a business in which a significant number of formal leads (project applications) do not result in closed sales. Success therefore requires a scale of operation that is much larger than the typical general or specialty trades contractor in the home improvement and remodeling industry. This conclusion is driven home by evaluations of virtually all WH/HP programs, which find a high concentration of completed projects among a handful of contractors. The importance of high-volume contractors to the development of WH/HP programs and the market for those services is apparent in the early operation of the IOUs Home Upgrade / Advanced Home Upgrade program… For example, one contractor in the PG&E program was responsible for 706 (program to date) project applications, or 5.4 percent of the total. After eliminating 29 contractors who submitted only one project applications, the average number of applications submitted per participating contractor was 102. The average number of completed projects per contractor was for PG&E was 15 over the three year period covered by the records.[26]

The results of the case studies suggest that it requires a staff of at least 10 for a firm to deliver projects 50 or more projects per year. The savings goals for the 2013 – 2014 program cycle correspond to roughly 20,000 completed projects, or 10,000 per year. Thus it would require at least 200 firms of 10 employees or more working very efficiently in the WH/HP business to meet the goal. However, the number of firms of that size in the home improvement industry is very limited. InfoUSA lists 1,473 firms in California with 10 or more employees in the contractor specialties sampled for the contractor survey and 694 with 20 or more employees.

[26] Personal correspondence with Nils Strindberg, California Public Utilities Commission

The challenges that contractors face in identifying a business motivation to adopt WH/HP practices and to follow through on developing delivery capacity are reflected in the relatively low levels of adoption and awareness reported for those practices. Despite these challenges, the supply chain analysis presented above does contain some evidence that initiatives in California to promote WH/HP services are having some effect. The share of market represented by contractors in the CA Program Area who report awareness and adoption of WH/HP practices is higher than the share in the OOS Comparison Area along the following dimensions:

- Implement combination of air sealing and insulation on all projects: 14 percent v. 5 percent;
- Deliver energy audits on all projects: 9% v. 2%;
- Offer the full complement of WH/HP services: 12% v. 2%;
- Aware of WH/HP programs active in their area: 59% v. 44%;
- Completed at least one project through a WH/HP program: 28% v. 14 %;
- Found out about WH/HP services through a utility program: 16% v. 2%
- Report current delivery of WH/HP services: 12% v. 4%

5. Integrated Analysis: Market Indicators and Their Implications

In this section we distill the findings from Sections 3 and 4 into a set of market indicators that we propose to use to track the development of the WH/HP market over time and characterize the development of the markets in the study areas based on those indicators. We then trace the implication of those findings for market design and for the methods to be applied in the follow-up phase of the study.

5.1 Market Indicators and Summary of Market Development

Based on the analysis of the consumer market and supply chain presented in Sections 3 and 4, we have selected a set of indicators with which to track the development of the market for WH/HP services from the current baseline characterization through the follow-up phase of the study. The principal criteria applied in the selection of these indicators were:

- They clearly represented an element of market development identified by the program logic model introduced in Section 1;
- They were estimated using sampling, data collection, and computation methods that will be replicable at the time of the follow-up study.

Given the large scale of the IOU's Home Upgrade / Advanced Home Upgrade program, the research results summarized in Table 29 are very much in line with expectations. This is true both in terms of the level of market development the indicators denote and the apparent differences between the CA Program Area and the Comparison Areas. The figures in Table 29 reflect survey results for all respondents to the homeowner survey, regardless of their participation in energy efficiency programs. The key observations to be drawn from Table 29 and the supporting research presented above are as follows.

Table 29: Market Indicators for WH/HP Services

Market Indicator	Full Sample		
	CA Program	OOS Comparison	CA Comparison
Consumer Market			
Percent of home improvement projects with multiple Energy Efficiency measures	38%	32%	31%
Percent of projects with combined shell and air sealing measures	10%	6%	6%
Percent of projects with combined shell and HVAC measures	5%	4%	4%
Percent of projects that include blower door tests	17%	12%	21%
Percent of HVAC projects that include duct leakage tests	34%	12%	24%
Percent of projects with main motivation of energy saving, improved comfort, or improved air quality	29%	24%	35%
Percent of customers making home improvements who are aware of WH/HP services	29%	13%	17%
Percent of customers who find their contractor through a utility or government energy efficiency program.	3%	2%	3%
Supply Chain			
Number of BPI-certified contractors per 10,000 occupied housing units	4.36	2.59	
Share of market represented by contractors who deliver combined shell and air sealing measures in all or most projects	18%	11%	
Share of market represented by contractors who deliver combined shell and HVAC measures in all or most projects	20%	17%	
Share of market represented by contractors who deliver energy audits in all or most projects	20%	11%	
Share of market represented by contractors who use blower door tests in all or most projects	15%	5%	
Share of market represented by contractors who use duct leakage tests in all or most projects	17%	12%	
Share of market represented by contractors aware of whole house retrofit concepts	75%	67%	
Share of market represented by contractors who can accurately describe WH/HP practices	33%	30%	
Share of market represented by contractors who are aware of WH/HP programs in their local markets	59%	44%	
Share of market represented by contractors who report that they currently deliver WH/HP services	12	4%	

Significantly different from the CA Program Area at the 90% confidence level

- **As of early 2014, we find the level of unsubsidized adoption of the WH/HP approach to energy efficiency to be very low, both in the California Program Area or in the Comparison Areas.** Among non-participants, only 8 percent in the California Program Area and 6 percent in the Comparison Areas reported installing combinations of shell and air sealing measures. Only 3 – 4 percent reported installing combinations of shell and HVAC measures. Fourteen percent of non-participants in the CA Program area reported having a blower door test done as part of their project, as did 10 percent of non-participants in the Comparison Areas. None of the high-volume contractors interviewed in depth for the case studies attempted to market their services without subsidies. When questioned why, none believed that the services could be marketed profitably without program support.
- **Individual components of the WH/HP approach are available on the market, and are being incorporated into a relatively small portion of home improvement projects, including some competed without program support.** In the California program area, 65 percent of homeowners who recently completed home improvements incorporated at least one energy efficiency measure into their projects; 35 percent included two or more measures. Relatively few homeowners used combinations of measures and diagnostic tests associated with the WH/HP approach, but there were some non-participants among those who did. For example:
  - Combination of insulation and air sealing measures. Eight percent of all projects in the CA Program area included this combination of measures, as shown in Table E1, which displays results for the full sample of respondents in each study area, regardless of participation status.
  - Blower door tests for infiltration. Seventeen percent of all projects in the CA Program Area included this test. The portion of projects with blower door tests was significantly higher (p-value < .10) in the two California study areas than in the OOS Comparison area.
  - Duct leakage tests. Thirty-four percent of all projects involving improvements to heating and cooling systems in the CA Program Area included this test, as did 24 percent of heating and cooling improvements carried out in the California Comparison Area. By contrast only 12 percent of consumers who carried out heating and cooling upgrades in the Out of State Comparison Area reported have duct leakage tests performed. This result likely reflects changes in California building codes that require duct leakage tests for permitted installations of residential heating and cooling equipment

  These findings are consistent with results from the contractor survey regarding the share of projects on which various types of measures and tests are deployed. They suggest the presence of a small unsubsidized market for some components of the WH/HP approach, but not for the entire, integrated package.

- **Low levels of awareness of the WH/HP value proposition and restricted contractor search practices are the major barriers to increased adoption of WH/HP practices among consumers.** Despite the marketing and publicity efforts that have supported the IOUs HU/AHU program, customer awareness of WH/HP services and their value is relatively low. In the California Program Area, 29 percent of sample customers who had carried out major home improvements in the last 3 years reported being aware of home performance programs after being read a detailed description of the services provided. In terms of adopting WH/HP practices, the effects of these modest levels of awareness are compounded by the restricted range of resources that customers access in finding a contractor. In 70 percent of cases, customers used contractors whom they had employed on previous projects or found through word of mouth, regardless of study area or program participation status. High-volume WH/HP contractors interviewed for the case studies stressed the importance of personal selling in closing whole house projects, due to their complex value proposition. Given the restricted channels used to find contractors, it is difficult even for motivated contractors to insert themselves into the project specification process. Only 2 percent of respondents reported using contractors found through energy efficiency programs.

  Many studies of WH/HP programs identify first costs as a major barrier to undertaking whole house retrofits. In this study, we found that cost was not a major barrier for inclusion of energy efficiency measures into home improvement projects as a whole. Only 7 percent of customers in any of the study areas reported that they were unable to complete all energy efficiency measures recommended to them by an audit or contractor due to financial constraints. A recent process evaluation estimated the share of customers who did not complete all recommended measures due to financial constraints at 28 percent. [27]

- **Effective delivery of WH/HP services and participation in WH/HP programs requires a scale of contractor operations that is beyond the capability of the large majority of firms in the home improvement industry.** The case studies of high-volume WH/HP contractors suggest that success in this field requires investment in hiring and training staff to market the services, maintain consistency and quality of delivery, and manage a significant flow of technical and administrative work associated with completing home assessments, obtaining rebates, and assuring compliance with program rules. All but one of the six high-volume contractors employed 20 or more workers. By contrast, only 5 percent or roughly 700 of the more than 13,000 California firms listed by the InfoUSA business establishment database in relevant residential contracting specialties employed 20 or more workers. Only 11 percent employ 10 or more workers. Thus, recruiting a significant portion of these larger firms into the program and

[27] SBW Consulting, Inc. 2013.

encouraging their active marketing of its services is a critical step in growing WH/HP service delivery capacity and program participation.

- **Lack of understanding of WH/HP services and their potential business value is the major barrier to adoption of WH/HP practices and program participation among contractors.** Although contractors representing 75 percent of the home improvement market in the CA Program area reported being aware of WH/HP service concepts, only roughly half of those could accurately describe the WH/HP approach. When questioned whether it would be worthwhile to invest in developing WH/HP service delivery capability, 46 percent of all contractors in the California sample answered positively. Given the relatively small number of firms capable of delivering WH/HP services at scale, outreach and education to recruit and motivate contractors will be essential to achieving targeted levels of program participation and savings.
- **Progress in developing the California market.** Despite the challenges described above to the growth of WH/HP services and participation in programs that support them, the market indicators in Table 29 suggest that EUC, along with its predecessor retrofit programs, and related programs that support quality HVAC installation, are having a positive effect on the market. We note that a significantly higher (p-value < .10) percentage of who have recently undertaken major home improvements in the CA Program area have incorporated the following measures and procedures into their projects, versus their counterparts in the OOS Comparison Area:
  - Multiple energy efficiency measures in a single project;
  - Combination of air sealing and insulation measures; and,
  - Blower door tests.

We also note that a significantly higher (p-value < .10) percentage of homeowners with projects in the CA Program Area report that they are aware of WH/HP services than their counterparts in either the OOS or CA Comparison Areas. The difference between the CA Program and OOS Comparison area on this indicator is sufficiently large (29 percent v. 13 percent) to suggest that it reflects the effects of the significant marketing effort surrounding WH/HP concept during the 2010-12 period, when this was primarily ARRA-funded, and subsequently in 2013 when the IOUs spent heavily on EUC/ Home Upgrade/Advanced Home Upgrade marketing.

On the supply side of the market, the indicators of effects from programs to promote WH/HP services are less clear. Although contractors in the CA Program Area report offering and installing WH/HP components in a larger share of projects than their counterparts in the OOS Comparison Area, these differences are small and not statistically significant in most cases. We do observe two clear-cut differences between the study areas. First, the number of BPI-certified contractors, normalized for market size, is 70 percent higher in the CA Program Area than in the comparison area. Second, contractors representing 59 percent of the market in the California

Area report being aware of WH/HP programs versus 44 percent in the Out-of-State Comparison Area, and the level of participation is nearly twice as high: 28 percent v. 14 percent.

5.2 Implications of Findings for IOU Home Upgrade / Advanced Home Upgrade Program Operations

In accordance with the size of its budget, scope of operations, and importance to state energy policy, the IOUs Home Upgrade / Advanced Home Upgrade program has already undergone a great deal of study. The IOUs have commissioned two process evaluations that focused primarily on program operations, as well as a targeting study to support the development of more effective consumer marketing and outreach strategies. The CPUC has commissioned an impact evaluation, the final results of which are forthcoming as of this writing. Later this year, the IOUs will initiate an intensive planning process focused on further development of whole house programs.

While the scope of this project did not include a process evaluation, we believe the findings do suggest general strategies for increasing program participation. These include the following:

- **Continue and expand marketing and outreach to inform customers and realtors of the value of WH/HP services**. The results of the household survey and the case studies suggest that messaging for program marketing should address the full range of program benefits, including:
  - Increased comfort and indoor air quality;
  - Upgrading and maintenance of key home systems;
  - Consumer protection elements, including contractor screening and inspections;
  - Reduction of search time and other transaction costs through contractor listing and administrative support in completing applications.
- **Build contractor motivation and capacity to market and sell WH/HP services.** We understand that ARRA-funded market efforts from 2010-2012 put considerable effort into this objective. Some tactics to consider in this regard include the following.
  - Focus outreach to contractors on larger firms (those with 10 or more employees). Smaller firms will generally not have the capacity to build significant project volume or to hire sales and administrative personnel.
  - Develop intensive marketing sales training for contractor sales personnel.
  - Develop playbooks or other instructional material to provide guidance in building volume under the program.
  - Conduct competitions for contractors on volume and quality of work delivered.

5.3 Recommendations for Future Research

Generally speaking, we believe the methods that were developed and deployed for this study worked as intended. We have developed a concise set of market indicators that represent the state of market development in terms of the program theory and which can be estimated at a future date using replicable sampling, data collection, and computational procedures. That said, there are aspects of the data collection approach that could be improved. Moreover, our experience has alerted us to some potential risks that should be addressed in planning for the next stage. The following recommendations identify proposed methods to head off problems we encountered or ones we may anticipate.

- **Identification of Comparison Areas.** As discussed in Section 1, it was difficult to identify comparison areas that resemble the range of climate and demographic/housing market conditions present in California *and* which do not host large scale WH/HP programs. The areas we identified were sufficiently populous to provide adequate samples for the household survey, but we did encounter difficulties generating sufficient completes for the contractor surveys. As discussed below, this can be addressed in part by offering larger incentives for contractor interviews. However, if utilities serving any of the MSAs in the OOS Comparison Area implement large whole house projects, the overall size of the comparison areas may become too small to support adequate samples. As part of this study we identified MSAs that are within comparable climate zones to the CA Program Area. If needed, those MSAs can be analyzed to identify those with demographic and housing market profiles that are sufficiently close to their counterparts in the CA Program Area to be substituted, if needed.
- **Response to contractor survey.** It proved difficult to complete contractor surveys in a timely manner. Initially we offered only small incentives for completion, but later increased the incentive to $100. This seems to have been adequate to generate response. Given the overall low response rate, for the contractor surveys, we recommend offering an even higher incentive – up to $200. This will be especially important in the follow-up study where larger samples will be required to generate statistically significant estimates of differences between study areas in the rate of change.
- **Sample sizes for household surveys.** We recommend increasing the size of the household surveys to support statistically significant estimates of differences between study areas in the rate of change from one stage of the study to the next.
- **Follow-up Study Timing,** Given the relatively slow pace of uptake for WH/HP services documented in Sections 2 and 3, we recommend that the follow-up phase of the study be undertaken as late as possible, taking into account IOU and CPUC regulatory and program planning schedules. We recommend undertaking the second round of research no earlier than 2016. Ideally, the study would be carried out in close coordination with IOU-sponsored process evaluations and CPUC-sponsored impact

evaluations, both to reduce burden on survey respondents and to ensure that the individual evaluation efforts can make use of the findings from the others.

- **Application of baseline study findings in estimating savings from market effects.** The methods deployed for this study can be used to estimate the number of total projects undertaken in California which incorporate all or some of the elements of the WH/HP approach and the market share they represent within all major home improvement projects. Parallel analysis of reported home improvement activity in the Comparison Areas will provide baseline levels of adoption for WH/HP-related measures. Combined with information from impact evaluations, the savings associated with those measures or measure combinations and tracking system information on the number of projects supported by the HU/AHU programs, we should be able to estimate the number of projects with WH/HP elements undertaken "outside the program" and assess the share of those projects that can be considered as spillover from program activities. One very important set of issues to be addressed in implementing this approach will be to define what measures, pre- and post-installation services, and combinations thereof will count as a WH/HP "element".

  A survey of 100 participants conducted as part of the most recent process evaluation of PG&E's HU/AHU program found that 27 had installed energy efficiency measures without going through the program or applying for rebates from other programs after receiving their home assessment. Based on this information the study authors recommend that future impact evaluations collect information on spillover effects among participants. If this approach is taken, the market effects study contractor should consult with the impact evaluation contractor to ensure that definitions of WH/HP elements are carried through in the spillover estimates.

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B. Selected Methodological Issues

Construction of Comparison Areas

Introduction

This section presents the methods and results of analysis undertaken by DNV KEMA to non-program areas for the Whole House Retrofit Market Effects study. We identify the following three sets of criteria to be applied in identifying non-program areas.

- **Program criteria.** For the purposes of this study, we defined the "program" as whole house retrofit or home performance programs supported by public benefits charges. Comprehensive residential retrofit programs supported by stimulus funding are active in over 35 states. However, they are generally time-limited, and do not provide contractors with the assurance of long-term support. We therefore concluded that such programs were part of the national baseline condition and did not contaminate potential non-program areas.
- **Climate conditions.** Climate conditions – specifically the average number of heating and cooling degree days experienced in a given region – serve as a proxy for heating and cooling costs and for potential savings to the customer from program participation. Whole House and Home Performance programs primarily address these end uses.
- **Housing and demographic conditions.** Area characteristics such as income, education, and home prices are associated with rates of home improvement, participation in energy efficiency programs, and implementation of energy efficiency measures.

We acknowledge comments from utility program and evaluation staff to the effect that it is virtually impossible to find geographic areas that resemble the California program's market areas terms of climate, housing, and demographic conditions. The IOU representatives suggested that it would be more appropriate to seek non-program areas in California among counties and metropolitan areas that had not been targeted by focused program marketing efforts. We proposed to address this situation by pursuing two approaches to identification of program areas. First, we sought to identify areas outside California that best resembled the EUC market territory in terms of climate and housing and demographic characteristics, while meeting the program criterion defined above. Second, we sought areas within California that had not been targeted by early marketing for the IOU whole house programs, now consolidated under Energy Upgrade California. The remainder of this section details the methods and results of this work.

Selection process – Out-of-State areas

The selection process for out-of-state non-program areas proceeded in the following steps.

- Eliminate states with significant public benefits charge programs. Earlier research had identified a set of states in which there were no public benefits charge or whole house or home performance programs in force. We revisited this list before proceeding to analysis of climate, housing, and demographic characteristics. We found that Georgia Power had initiated a whole house program with Building Performance Institute support that covers more or less the whole state since the completion of our last round of research. Georgia was therefore eliminated from consideration.

  While the desired comparison areas need to be aligned along all relevant socioeconomic and climatic data, the first screening criterion is that these should not have any utility funded whole house programs. For example: Georgia is excluded from consideration as The states that meet this threshold requirement and have cities within that would be potentially be comparable to cities within the program area in California are as follows:
  - North Carolina
  - South Carolina
  - Arkansas
  - Tennessee
  - Texas

  Rather than the whole state, we identify cities in the above five states that are sufficiently large to form a reasonable home improvements market and potentially can be mapped to cities within the five counties of CA's program areas along socioeconomic and climatic factors. This leads us to larger cities/relatively more affluent areas of the state and coastal cities that come close to being comparable on weather in CA.

- **Assess candidate states for demographic and climate variables.** The next step in the selection process involved identifying the parameters that would be used to compare potential areas out of state.

Climatic Factors

- Heating Degree Days
- Cooling Degree Days

Demographic Factors

- Income
- Education
- Number of people in household
- Home size – number of rooms
- Home ownership rate
- Population Density
- Median Home Price

Table 30 below lists the out-of-state cities with climatic and demographic data as outlined. All data points for the cities except for HDD, CDD, and median home price are gathered from the census' American Fact Finder site. Median Home Price is based on recent home sales in the cities as listed by the real estate site Trulia. HDD and CDD are obtained from weather related sites. The cities below represent a subset that satisfies the broad criterion for HDD in the approximate range of 1000-3000/year.

Table 30: Demographic and climatic data for potential non-program area comparison sites

State	City	HH Income-Median	High School	Bachelor's	HH size	# of rooms - Median	Home ownership rate	Pop Density – Persons/sq mile	HDD	CDD	Home Price – Median	Home Price/ Income Ratio
TX	Corpus Christi	$45,267	80%	21%	2.7	5.0	60%	1,900	950	3,497	$45,250	1.0
TX	Dallas	$42,259	73%	29%	2.6	4.6	45%	3,518	2,370	2,568	$66,350	1.6
TX	San Antonio	$43,961	80%	24%	2.8	5.1	58%	2,880	1,573	3,038	$79,001	1.8
TX	Houston	$44,124	74%	28%	2.7	4.6	47%	3,502	1,525	2,893	$80,312	1.8
TN	Memphis	$37,072	82%	23%	2.6	5.2	53%	2,053	3,041	2,187	$89,900	2.4
TX	Austin	$51,596	86%	45%	2.4	4.6	46%	2,653	1,648	2,974	$128,190	2.5
NC	Charlotte	$53,146	88%	40%	2.5	5.4	59%	2,457	3,162	1,681	$170,000	3.2
SC	Florence	$42,719	86%	29%	2.5	5.5	60%	1,774	2,523	2,029	$138,000	3.2
SC	Columbia	$38,995	86%	39%	2.2	5.1	48%	978	2,594	2,074	$128,070	3.3
SC	Greenville	$40,925	86%	39%	2.1	4.9	46%	2,037	3,272	1,526	$135,000	3.3
AK	Little Rock	$44,392	89%	38%	2.4	5.2	57%	1,623	3,084	2,086	$163,500	3.7
NC	Raleigh	$52,819	91%	47%	2.4	5.2	55%	2,826	3,070	1,572	$198,000	3.7
SC	Charleston	$50,938	92%	47%	2.3	5.1	53%	1,102	1,755	2,473	$204,248	4.0
AK	El Dorado	$28,904	77%	21%	2.3	5.2	55%	1,161	2,580	2,127	$128,070	4.4

We gather similar information for selected cities within the program area as shown in the Table 31 below.

Table 31: Demographic and climatic data for select cities within the program area in CA

City	HH Income-Median	High School	Bachelor's	HH size	# of rooms - Median	Home ownership rate	Pop Density – Persons/sq mile	HDD	CDD	Home Price – Median	Home price/ Income ratio
Bakersfield	$54,656	78%	20%	3.1	5.4	59%	2,444	2,120	2,286	$ 160,000	2.9
Sacramento	$50,781	82%	29%	2.6	5.0	50%	4,763	2,666	1,248	$ 155,000	3.1
Emeryville	$69,274	96%	72%	1.8	3.5	36%	8,089	2,857	142	$ 230,000	3.3
Fresno	$43,440	75%	20%	3.1	5.1	49%	4,418	2,447	1,963	$ 152,500	3.5
San Diego	$63,739	86%	41%	2.6	4.6	49%	4,020	1,063	866	$ 370,000	5.8
Oakland	$51,144	80%	37%	2.5	4.5	42%	7,004	2,400	377	$ 315,000	6.2
Los Angeles	$50,028	74%	31%	2.8	4.2	38%	8,092	928	1,506	$ 376,500	7.5
San Francisco	$72,947	86%	51%	2.3	4.1	37%	17,179	2,862	142	$ 747,000	10.2
San Luis Obispo	$42,528	92%	45%	2.3	4.7	38%	3,531	2,138	476	$ 501,000	11.8

Mapping comparison sites to cities with program areas in CA

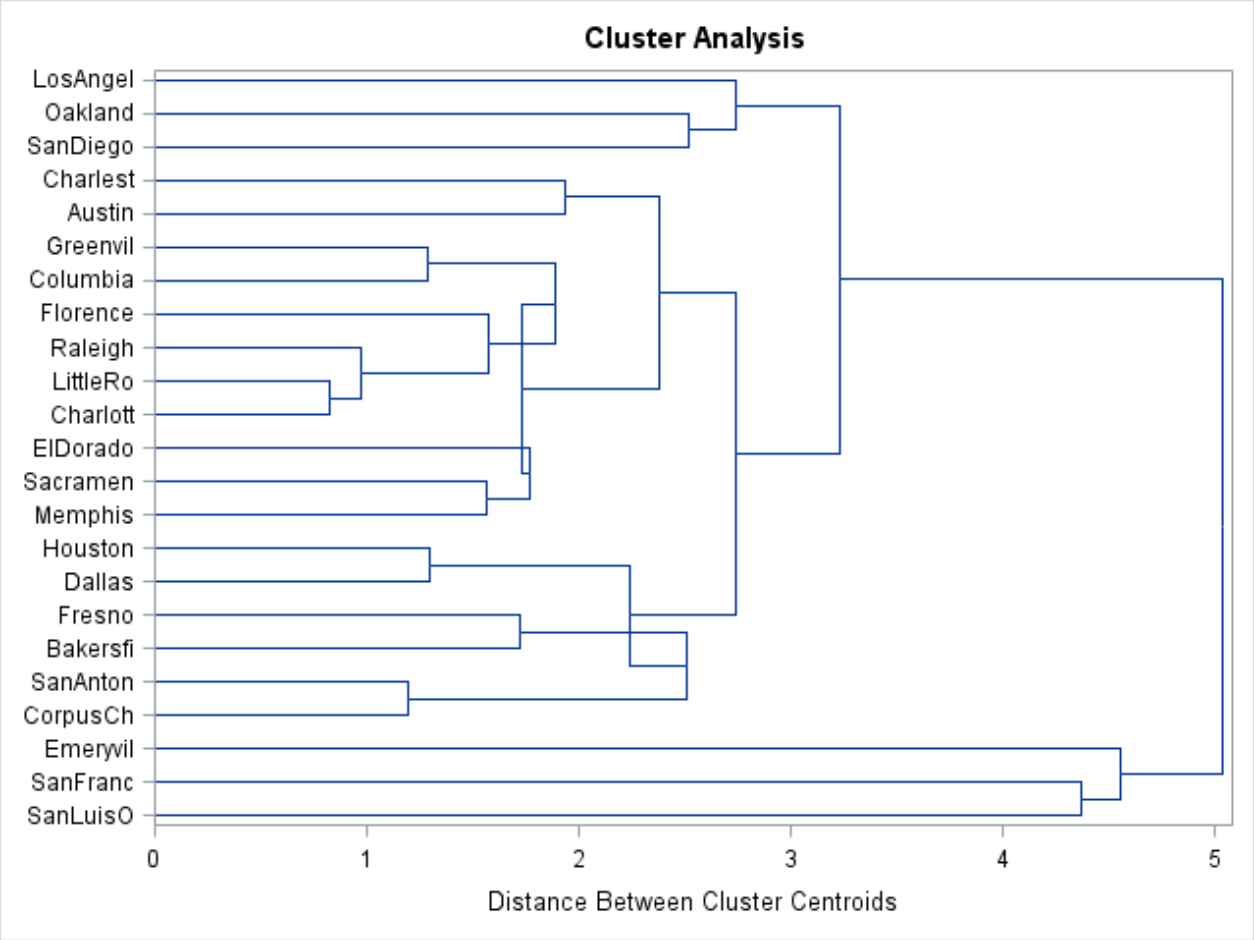
We conducted an exploratory cluster analysis to create groups of the above cities and the objective is to examine whether city groups contain at least one representative city from CA. Cluster analysis creates affinity clusters of observations that are more homogeneous within the group and heterogeneous without. The analytic technique uses a Euclidean distance based algorithm to agglomerate observations that have values that are similar/closer to each other.

SAS's Proc Cluster is used to identify a hierarchical cluster solution for four different runs that use different combinations of the variables in the tables above. Home price and income were always excluded and a ratio of home price to income was used instead as a proxy measure of purchasing power parity and to normalize the big differences in both these variables by geography.

- All variables except home price, income
- All variables except home price, income, HDD
- All variables except home price, income, CDD
- HDD & CDD only

The exploratory analysis was to determine how cities grouped if we considered a mix of factors, excluded select climatic factors, or used solely climatic factors. The results below in Figure 1 show that while some Texas cities could be mapped to Fresno and Bakersfield in CA, and the remaining cities to Sacramento, there is no close peer for cities like San Francisco, Oakland, Emeryville, LA, San Diego & San Luis Obispo in the non-program areas. Bigger cities that might be a close match like NY or Boston already have Whole House programs.

Figure 11: Dendogram from Cluster Analysis including both climatic (HDD, CDD) and demographic variables



The results can be explained by a quick comparison of Table 1 and Table 2 which shows that certain variables are orders of magnitude different for cities within the program area. For example: Population density is under 4,000 persons/sq mile for all the cities shown in Table 1 (non-program areas) versus 7 out of 9 CA cities that have population density over 4000 persons/sq mile. Some of the CA cities have double or, in the specific case of San Francisco, quadruple the population density compared to cities outside the program area that meet our criteria for not having a utility sponsored whole house program.

Selection process – Out-of-State areas

This section presents the methods and results of analysis undertaken by DNV KEMA to identify non-program areas within California for the Whole House Retrofit Market Effects study.

We identified the following sets of criteria to be applied in identifying non-program areas.

- **Program criteria.** For the purposes of this study, we defined the "program" as whole house retrofit or home performance programs supported by public benefits charges. Areas which had been targeted for intensive marketing of the Home Upgrade programs during the first years of implementation were excluded for consideration as non-program areas. DNV GL identified areas which had received intensive promotion of EUC or which were targeted for such promotion with the assistance of Home Upgrade program staff at the IOUs.
- **Housing and demographic conditions.** Area characteristics such as income, education, and home prices are associated with rates of home improvement, participation in energy efficiency programs, and implementation of energy efficiency measures. We also proposed to include population density in this mix as a proxy for available market size for local trades and retrofit contractors. We attempted to identify non-program areas that featured demographic and housing conditions similar to the program areas where EUC was deployed in the initial phase.

The coastal areas of California which account for the highest levels of participation in the state's whole house retrofit programs have no few climatic analogs in California. We have not tried to match areas on the basis of *both* climate and housing and demographic conditions. Rather, where we have found coastal areas that have not been targeted for heavy marketing of EUC, we have identified them for inclusion in the non-program area.

Based on these considerations we identified the following non-program comparison areas within California:

- El Dorado County
- Fresno County
- Monterey County
- Napa County
- Nevada County
- Placer County
- Riverside County
- Sacramento County
- San Benito County
- San Bernardino County
- San Luis Obispo County
- Santa Cruz County

- Shasta County
- Sonoma County
- Yolo County

The remainder of this memorandum details the methods and results of this work. Pending review and approval of the approach described below, we plan to develop samples of customers and contractors in the non-program areas identified.

Selection process – In-State areas

The selection process for in-state non-program areas proceeded in the following steps.

1. **Eliminate counties with significant public benefits charge programs and/or those that might have received promotion on EUC.**

The five counties where EUC was rolled out initially were San Francisco, San Mateo, and Alameda in Northern California and Los Angeles and San Diego in Southern California. The results and sample disposition of a survey of PG&E customers conducted for the 2010-2012 whole house retrofit process evaluation suggest that very low proportions of customers in Fresno and Placer County were aware of the program, compared to counterparts in other counties. From this, we impute that residents in Fresno and Placer counties, were not as exposed to EUC as residents in Santa Clara, for example.

Conversations with program managers from SoCalGas and SCE indicate that the program and related publicity was rolled out in one process across their full service territories. The program employed more general marketing and did not use any specific targeting. For example, EUC was not heavily promoted in the northern part of SoCal Gas territory; specifically, areas such as Fresno, Tulare etc., which could be described as having minimal number of contractors and considered more agricultural. Additionally, the SoCalGas program manager indicated that Orange County and a few other counties in the south would be the focus of their outreach in the next phase of the program.

Given the above, we eliminate the following counties before proceeding to the next step:

- San Francisco
- San Mateo County
- Alameda County
- Los Angeles County
- San Diego County
- Contra Costa County
- Marin County
- Santa Clara County
- Fresno County

- Orange County
- Santa Barbara County
- Ventura County

The list of eliminated counties can be described as counties that were either targeted in Phase 1 of EUC, potentially contaminated by their proximity to the larger counties targeted in phase 1, or slated for increased outreach/targeting in phase 2 of the EUC program.

1. **Narrow the range of areas considered based on real estate prices and other socioeconomic variables.** We use a real estate website to gather the median home sales price as of March 2013 across all cities within the counties retained on our list from step 1. We augment this information with demographics such as education, income, household size, home ownership rate, and population density using the census website's American Fact Finder tool, as shown in Table 32 below.

Table 32: Demographic data for potential non-program area comparison sites

County	City	High School %	Bachelors %	Home ownership rate %	Household size	Median HH income	3/1/2013 home price	Home Price/Income	Population Density – Persons/sq. mile
El Dorado	El Dorado Hills	97	51	85	3.0	$ 115,121	$472,500	4.1	869
Monterey	Monterey	93	50	34	2.1	$ 62,720	$381,500	6.1	3,285
Monterey	Pacific Grove	96	48	32	2.1	$ 70,211	$594,000	8.5	5,250
Napa	Napa	79	26	59	2.6	$ 62,642	$381,500	6.1	4,312
Napa	Yountville	91	44	71	2.0	$ 68,368	$652,500	9.5	1,915
Napa	Saint Helena	89	47	55	2.4	$ 68,404	$745,000	10.9	1,157
Nevada	Truckee	97	43	70	2.5	$ 68,173	$440,000	6.5	501
Placer	Granite Bay	96	52	92	3.0	$ 126,937	$500,000	3.9	948
Placer	Penryn	99	53	81	2.7	$ 87,604	$377,500	4.3	456
Placer	Loomis	95	26	80	2.9	$ 86,990	$401,000	4.6	885
Placer	Carnelian Bay	97	39	67	2.1	$ 47,900	$378,750	7.9	402
Placer	Tahoe Vista	86	43	63	2.3	$ 69,145	$601,250	8.7	528
Riverside	Indian Wells	99	55	83	1.9	$ 111,078	$633,500	5.7	346
Riverside	Rancho Mirage	95	39	82	2.0	$ 76,261	$440,000	5.8	704
Sacramento	Wilton	90	33	86	2.9	$ 87,000	$392,500	4.5	185
Sacramento	Herald	90	15	84	2.7	$ 82,639	$390,000	4.7	150
San Benito	Tres Pinos	91	44	61	2.0	$ 63,368	$490,000	7.7	132
San Bernardino	Chino Hills	92	43	82	3.3	$ 101,905	$432,500	4.2	1,674
San Bernardino	Upland	88	30	59	2.9	$ 67,449	$382,500	5.7	4,721
San Luis Obispo	Templeton	93	29	68	2.7	$ 70,820	$431,500	6.1	994
San Luis Obispo	Cambria	92	45	78	2.1	$ 76,271	$512,500	6.7	709
San Luis Obispo	Nipomo	85	23	76	3.0	$ 61,265	$429,000	7.0	1,125
San Luis Obispo	Arroyo Grande	93	34	69	2.5	$ 64,900	$464,000	7.1	2,957
San Luis Obispo	Grover Beach	87	21	43	2.5	$ 47,708	$393,500	8.2	5,695

San Luis Obispo	Pismo Beach	94	39	60	2.1	$	65,682	$648,250	9.9	2,127
San Luis Obispo	San Luis Obispo	92	45	38	2.3	$	45,528	$462,000	10.1	3,531
Santa Cruz	Scotts Valley	97	45	75	2.6	$	99,076	$549,000	5.5	2,520
Santa Cruz	Aptos	95	41	73	2.4	$	76,862	$593,750	7.7	979
Santa Cruz	Capitola	92	40	42	2.1	$	50,696	$549,750	10.8	6,226
Shasta	Palo Cedro	98	20	89	2.3	$	68,688	$397,500	5.8	338
Sonoma	Graton	89	35	72	2.5	$	77,574	$399,250	5.1	1,081
Sonoma	Petaluma	89	35	68	2.6	$	76,185	$397,500	5.2	4,029
Sonoma	Sonoma	94	39	59	2.1	$	63,262	$395,000	6.2	3,883
Sonoma	Healdsburg	86	31	62	2.5	$	63,666	$437,500	6.9	2,525
Sonoma	Penngrove	95	38	62	2.4	$	84,315	$626,500	7.4	627
Sonoma	Occidental	95	56	69	2.0	$	67,205	$525,000	7.8	225
Sonoma	Sebastopol	94	39	53	2.1	$	60,000	$545,500	9.1	3,982
Sonoma	The Sea Ranch	99	69	86	1.8	$	57,227	$522,000	9.1	81
Sonoma	Glen Ellen	95	26	41	1.8	$	45,558	$670,000	14.7	373
Yolo	Davis	96	69	45	2.7	$	61,182	$444,000	7.3	6,637

Table 33 juxtaposes demographic variable averages across select program and non-program areas and we note that we have a feasible proximate match for our non-program comparison areas within California using this approach. It should be noted that population density is significantly different, but due to the fact that our elimination criteria as laid out in Step 1 results in exclusion of the most populous regions, this is the closest match with the remainder of the counties.

Table 33: Comparison of demographic variables in program and non-program areas within CA

County	High School %	Bachelors %	Home ownership rate %	Household size	Median HH income	3/1/2013 home price	Home Price/Income	Population Density – Persons/sq. mile
Average: Select non-program areas	93%	40%	66%	2.41	$72,690	$486,988	7.1	1,977
Average: Select program areas	83%	38%	44%	2.56	$55,393	$334,111	6.0	6,616

Information for the following areas is included in the average shown for the program areas in the above table: San Francisco, Emeryville, Oakland, San Luis Obispo, San Diego, Los Angeles, Sacramento, Fresno, and Bakersfield. These have been selected to be representative of coastal and inland areas in the north, central and southern parts of the state that have been/will soon be touched by the effects of the whole house retrofit program.

Our final list of counties within the state that can be considered as non-program comparison areas are:

El Dorado County, Monterey County, Napa County, Nevada County, Placer County, Riverside County, Sacramento County, San Benito County, San Bernardino County, San Luis Obispo County, Santa Cruz County, Shasta County, Sonoma County, and Yolo County.

Ratio Estimation Method Used in the Contractor Survey

When analyzing data from contractors on adoption of WH/HP practices and delivery of individual energy-efficient products, it is useful to be able to express the results in terms that are directly comparable to other kinds of market share data, such as reported purchases from customers. The challenge in doing so lies in the range in the scale of contracting businesses. Table 34 shows the distribution of included in the California program area contractor sample frame. Clearly the size of the firm must be taken into account in estimating market shares from observations of individual contractors. Moreover, there is a great deal of variation in the fraction of a contractor's activities accounted for by activities in the relevant market. For some home improvements are the main line of work. Others may do more business in new construction, but we nonetheless need to take their remodeling activities into account in characterizing the market.

Table 34: Distribution of Establishments in the California Program Area Sample Frame by Size and Type

	Number of Employees in firm						
Row Labels	1 to 4	5 to 9	10 to 19	20 to 49	50 to 99	100 to 249	250 to 499
General Contractors	2633	605	304	152	46	25	3
Air Conditioning Contractors & Systems	2244	611	236	167	43	23	3
Home Builders	1839	142	73	64	25	7	1
Remodeling & Repairing Bldg	1123	81	59	14	2		
Home Improvements	684	48	23	11	2		
Heating Contractors	612	78	29	16	2	3	
Energy Management Systems & Products	130	225	20	12	3	2	2
Insulation Contractors-Cold & Heat	68	83	20	25	6	9	
Solar Heating Contractors	74	75	10	11		1	
General Contractors-Residential Bldgs	81	7		1	1		
Construction-Building Contractors	51	8	2	2		1	1
Duct Systems-Air Conditioning & Heating	13	4				1	
Radiant Heating & Cooling	4	5	2				
Ventilating Contractors		6					
Heating Specialties		1	1				1
Grand Total	**9556**	**1979**	**779**	**475**	**130**	**72**	**11**

To capture these differences among contractors, DNV GL has developed and deployed a ratio estimation method in which each contractor's survey responses are weighted to reflect the number of commercial lighting projects that they report having completed in the period prior to the survey as well as by the population weight of the size stratum from which the firm was drawn. Where the questionnaire seeks responses in the form of a number or percentage—say, the percent of projects on which a blower door test is used,—survey responses are summarized using the combined ratio estimator:

$$\hat{R}_c = \frac{\sum_h \frac{N_h}{n_h} \sum_i B_{h_i} x_i}{\sum_h \frac{N_h}{n_h} \sum_i x_i},$$

where

i = sample contractor,

N_h = number of contractors in the *population* in sample stratum *h,*

n_h = number of contractors in the *sample* in stratum *h,*

B_{h_i} = contractor *i*'s response (expressed as a number or percentage), and

x_i = number of projects that contractor *i* reported installed in the study period.

If the question elicits a categorical response (e.g., yes/no), a B_{h_i} will be created for each possible response. For the selected response, $B_{h_i} = 1$. For the response/s not selected, $B_{h_i} = 0$.

This procedure essentially weights responses by the reported number of projects completed by each sample firm, thus providing an explicit representation of market share. The use of the combined ratio estimator supports the estimate of a standard deviation and standard error for each variable. "Project-weighted" averages or proportions are specifically designed to describe the average share of a technology installed or the prevalence of certain installation or design practices. For summarizing the distribution of characteristics of firms in the sample, for example, their average number of employees or projects completed, it is more appropriate to use simple population-weighted means and proportions.

Comparability of Homeowner Samples from California and Out-of-State Comparison Areas

Table 35 summarizes the results of questions to sample homeowners regarding demographic and housing characteristics. For consistency with the rest of the report, the demographic and housing results are based on the weighting system employed to account for overrepresentation of program participants in the sample. Studies of customer response to energy efficiency programs commonly find that homeowners in the 45 – 65 year age range are more interested in energy efficiency and participate in programs more frequently than older or younger homeowners. Income and educational attainment are also typically associated with higher levels of interest in energy efficiency and program participation. National studies find that spending on home improvements is associated with higher home prices, although this result may be confounded by the effects of education and income. We note that there are very few areas in the United States with home prices as high as the California program area, whether those are represented as absolute values or values as a percentage of median income.

The key similarities and differences between the study areas in regard to age of homeowner, education, income, and home prices are as follows.

- **Age of respondent.** There were very few differences in the age distribution of survey respondents from the three study areas. The share of respondents over 65 was

significantly higher in the CA Program (34 percent) and Comparison Areas (36 percent) versus the OOS Comparison Area (26 percent).

- **Educational Attainment.** There were relatively few differences between the three areas in the distribution of respondents by level of educational attainment. The portion of respondents in the OOS Comparison area who had completed college or some graduate school (76 percent) was significantly higher than the corresponding figure in the CA Program Area (67 percent) and the CA Comparison Area (54 percent).
- **Household Income.** The distribution of the respondents by reported household income varied between the study areas, but none was consistently higher or lower than the others. The CA Program and CA Comparison areas had a higher concentration of respondents with annual incomes under $75,000 (20 and 23 percent respectively) versus 12 percent for the OOS Comparison Area. The share of respondents with incomes over $150,000 was higher in the CA Program and OOS Comparison Areas (29 and 24 percent respectively) versus the CA Comparison Area (15 percent)
- **Home Prices.** Reflecting the unique conditions of the coastal California housing market, 71 percent of respondents in the CA Program Area reported that their houses were valued at over $400,000, versus 34 percent in the OOS Comparison area and 35 percent in the CA Comparison Area.

Table 35: Demographic and Housing Characteristics of Homeowner Survey Respondents by Study Area

	Program	Comparison	
	CA	OOS	CA
Age of Respondent			
Under 25	0%	0%	0%
25 to 34	1%	2%	3%
35 to 44	12%	17%	11%
45 to 54	22%	21%	23%
55 to 64	27%	33%	26%
65 or over	34%	26%	36%
Refused	2%	2%	1%
Education Attainment of Respondent			
Less than high school	0%	0%	0%
High school graduate	3%	3%	8%
Some college, trade or technical school	21%	14%	24%
Completed business or technical school (2 year)	7%	6%	9%
College graduate (4 year)	27%	36%	24%
Post graduate work or advanced degree	40%	40%	30%
Refused	1%	1%	4%
Reported Household Income			
Less than $50,000	8%	5%	9%
Between $50,000 and $75,000	12%	7%	14%
Between $75,000 and $100,000	13%	12%	19%
Between $100,000 and $150,000	20%	25%	27%
$150,000 or more	29%	24%	15%
Don't Know	3%	4%	3%
Refused	15%	24%	14%
Reported Home Value			
Less than $300,000	10%	47%	44%
Between $300,000 and $400,000	13%	22%	24%
Between $400,000 and $500,000	17%	9%	13%
Between $500,000 and $600,000	11%	3%	5%
Between $600,000 and $700,000	9%	4%	1%
More than $700,000	31%	5%	4%
Don’t Know	6%	3%	3%

Significantly different from the CA Program Area at the 90% confidence level

Summary Tables: Homeowner Survey Results

Main motivation for undertaking project	Full Sample		
	CA Program Area	OOS Comparison Area	CA Comparison Area
n=>	501	501	200
Reduce energy use or costs	**15%**	**14%**	**15%**
Improve comfort [e.g. stop drafts; keep cooler in summer or warmer in winter]	**10%**	**9%**	**14%**
Improve indoor air quality	**1%**	**2%**	**5%**
Replace old or failing equipment	24%	37%	23%
Modernize kitchen and/or bath	17%	10%	14%
Add or reconfigure living space	6%	5%	7%
Repair or replace exterior of the house	6%	3%	3%
Repair or replace interior elements of the house	8%	9%	7%
Qualify for program rebates	0%	0%	0%
Increase the value of the home	4%	3%	2%
Repair/Renovate due to damage, natural disaster, vector infiltration	0%	2%	1%
Upgrade/modernize	3%	2%	3%
Building envelope (Windows etc.)	0%	0%	1%
Energy source-add or change (Solar panels)	0%	0%	1%
Personal-enjoyment/wanted to	1%	2%	3%
Maintain current structure	0%	0%	0%
Not renovation - new construction	0%	0%	1%
Pool - Repair/Replace/Add	0%	0%	0%
Other (Specify)	0%	0%	1%
Don't know	2%	1%	1%
EE Motivation	26%	25%	33%

Other motivations for undertaking project	Full Sample		
	CA Program Area	OOS Comparison Area	CA Comparison Area
n=>	501	501	200
Reduce energy use or costs	**16%**	**11%**	**12%**
Improve comfort [e.g. stop drafts; keep cooler in summer or warmer in winter]	**18%**	**16%**	**17%**
Improve indoor air quality	**6%**	**8%**	**8%**
Replace old or failing equipment	17%	17%	20%
Modernize kitchen and/or bath	9%	8%	12%
Add or reconfigure living space	3%	6%	5%
Repair or replace exterior of the house	6%	5%	7%
Repair or replace interior elements of the house	12%	7%	11%
Qualify for program rebates	4%	2%	3%
Increase the value of the home	12%	12%	17%
Repair/Renovate due to damage, natural disaster, vector infiltration	21%	21%	19%
Upgrade/modernize	4%	0%	2%
Building envelope (Windows etc.)	1%	0%	1%
Energy source-add or change (Solar panels)	0%	0%	0%
Personal-enjoyment/wanted to	0%	0%	1%
Maintain current structure	0%	0%	0%
Not renovation - new construction	0%	0%	0%
Pool - Repair/Replace/Add	0%	0%	0%
Other (Specify)	6%	3%	6%
Don't know	1%	1%	1%
EE Motivation	41%	35%	37%

Measures Installed			
	Full Sample		
	Program CA	OOS Comparison Area	CA Comparison Area
n=>	501	501	200
Average number of measures installed (of total 7 measures as specified below)	1.26	1.15	1.09
No Measures Installed	35%	30%	40%
Multiple Measures Installed	35%	30%	32%
Combination of air sealing and insulation	8%	6%	6%
Combination of shell with HVAC measures	3%	3%	4%
Insulation	37%	36%	30%
Air Sealing	16%	11%	18%
ENERGY STAR Heating Equipment	6%	2%	3%
ENERGY STAR Cooling Equipment	26%	42%	26%
Heating Pipe Wrap/Duct Sealing	16%	9%	9%
Domestic Hot Water Pipe Insulation	22%	13%	16%
Solar Photovoltaic	3%	2%	6%

Distribution of Reported Project Costs by Cost Categories	Full Sample		
	CA Program Area	OOS Comparison Area	CA Comparison Area
n=>	501	501	200
Less than $5000	20%	21%	22%
Between $5,000 and $10,000	24%	32%	26%
Between $10,000 and $25,000	29%	26%	27%
$25,000 or more	24%	19%	21%
DK/Ref	3%	2%	4%

Distribution of Reported Project Costs by Cost Categories	Participants			Non-Participants		
	CA Program Area	OOS Comparison Area	CA Comparison Area	CA Program Area	OOS Comparison Area	CA Comparison Area
n=>	93	72	25	408	429	175
Less than $5000	16%	21%	32%	21%	21%	22%
Between $5,000 and $10,000	29%	32%	26%	24%	32%	26%
Between $10,000 and $25,000	27%	33%	19%	29%	26%	27%
$25,000 or more	22%	13%	20%	24%	19%	21%
DK/Ref	6%	0%	2%	3%	2%	4%

A51 - Characterization of contractor with primary responsibility for project	Full Sample		
	CA Program Area	OOS Comparison Area	CA Comparison Area
n=>	501	501	200
General Home contractor	41%	30%	33%
Heating/Cooling contractor	25%	40%	27%
Insulation Contractor	2%	1%	4%
EE contractor	4%	3%	4%
Kitchen or bath remodeling specialist	8%	4%	11%
Homebuilder	2%	5%	1%
Did not use contractor (self, friend/family)	4%	4%	8%
Retailer or manufacturer	1%	0%	0%
Windows	5%	2%	3%
Plumbing	2%	2%	0%
Roofing	1%	0%	0%
Electrician	0%	0%	0%
Pool deck and spa	1%	2%	4%
Floor/tile	0%	1%	0%
Vectors and vermin	0%	0%	0%
Foundation	0%	0%	0%
Other	0%	0%	0%
DK	5%	4%	4%
Ref	1%	1%	1%

Did you shop around, Did the contractor mention receiving training	Full Sample		
A53, A56	CA Program Area	OOS Comparison Area	CA Comparison Area
n=>	501	501	200
Did you shop around	50%	47%	44%
Did the contractor mention receiving training	28%	29%	22%

	Full Sample		
A57 - %8-10 on statements about contractor who completed the project & the project itself	CA Program Area	OOS Comparison Area	CA Comparison Area
n=>	501	501	200
a. I felt confident that the contractor was capable of doing a good job on all components of the project.	86%	87%	89%
b. The project was worth the money it cost.	82%	81%	81%
c. The project used the highest quality materials and installation techniques.	76%	78%	80%
d. The project resulted in reduced energy costs for my household.	54%	56%	44%
e. The project increased the comfort of my home.	83%	82%	77%
f. I achieved more energy savings by installing a number of measures at once than I would have by installing them individually.	38%	39%	35%

Channel used to find out about contractor

A52 - % mentioned, multiple allowed	Full Sample		
	CA Program Area	OOS Comparison Area	CA Comparison Area
n=>	501	501	200
Used this contractor for previous work	16%	20%	10%
Word of mouth from family/friends	38%	39%	41%
Yellow pages	3%	4%	3%
Advertising in newspapers or other general media	5%	9%	7%
Referral from other tradesmen or vendors	10%	8%	7%
Referral from a utility or government program	2%	1%	2%
Internet or websites	6%	9%	5%
Relationship w/person who did work prior to project (self, family member, neighbor)	10%	4%	12%
Event	2%	2%	1%
Contractor/installer contacted me	2%	1%	0%
Referral from retailer, manufacturer	0%	1%	2%
insurer or warranty	0%	1%	2%
Homeowner selected service provider based on meeting criteria (seeing contractor's work, license, location etc.)	2%	2%	1%
Other	0%	0%	0%
DK	6%	2%	3%
REF	1%	1%	4%

Reported reasons for contractor pick

A54 - % mentions, multiple allowed	Full Sample		
	CA Program Area	OOS Comparison Area	CA Comparison Area
Unweighted n	501	501	200
Satisfied with previous work	24%	29%	18%
Good recommendations from others	27%	24%	26%
Best price	26%	27%	28%
Best approach to meeting my needs	13%	11%	8%
Reputation for using energy efficient equipment and practices	4%	6%	10%
Reputation for using environmentally friendly materials and practices	2%	2%	4%
Contractor was certified by BPI, government, utility, etc.	1%	1%	1%
Referral from utility or government program	2%	2%	1%
Personal relationship or reason for selecting the vendor (family, religion etc.)	10%	8%	4%
Contractor selected through retailer, manufacturer, or insurer	1%	2%	1%
Timing/availability	1%	1%	2%
Warranty provided by contractor (not product)	0%	0%	0%
Trust/honest	0%	0%	0%
No contractor	0%	0%	0%
Local	0%	0%	1%
No contractor- homeowner did the work.	1%	0%	3%
Other	0%	0%	0%
DK	2%	3%	2%
Ref	1%	1%	5%

Issues brought up by the contractor when discussing project plans			
A55 - %Yes	**Full Sample**		
	CA Program Area	**OOS Comparison Area**	**CA Comparison Area**
n=>	**501**	**501**	**200**
Impacts of the project on your energy costs	46%	55%	50%
Energy savings options for equipment or construction practices	33%	36%	35%
Effect of renovations on comfort, such as eliminating drafts and hot or cold spots in the home	30%	32%	25%
Effect of renovations on indoor air quality	24%	26%	21%
Effect of renovations on safety of heating and cooling equipment	25%	24%	20%
Effect of renovations on controlling mold	15%	21%	12%

Installed heating, a/c, and used loan	Full Sample		
	CA Program Area	**OOS Comparison Area**	**CA Comparison Area**
n=>	**501**	**501**	**200**
A21=Yes=Installed space heating such as furnace or boiler as part of the project	28%	22%	21%
A33=Yes=Installed an a/c system as part of this project	31%	53%	33%
A49=Yes=Used loan or other type of financing to pay for this project	19%	23%	25%

WO54 Whole House Retrofit Homeowner Survey

HOMEOWNER QUESTIONNAIRE

1 Introduction

[TARGET: Trying to reach current owner or co-owner of home. If co-owners, respondent should have been involved in renovation decisions].

LEAD-IN: Hello, my name is _____ and I am conducting a study to help state agencies improve their energy efficiency programs for their citizens.
[IF REQUESTED]: This study is sponsored by the California Public Utilities Commission. *(for calls to #s within CA)*
[IF REQUESTED: We are calling on behalf of organizations that oversee energy and environmental programs in California *(for calls to #s outside CA)*
May I speak with the owner of your home?

- If owner is not home: record best time to call back.
  CALL BACK DATE/TIME: _____
- If owner lives elsewhere and/or has diff. phone #: record name, phone#, best time to call.

[REPEAT LEAD-IN FOR RESPONDENT IF NEEDED]

***WITHIN CALIFORNIA, READ*:** We are conducting a study of households who **have recently completed renovations** to their homes. The California Public Utilities Commission will use this information to help plan programs to benefit the homeowners.

OUTSIDE OF CALIFORNIA, READ: We are conducting a study of households who **have recently completed renovations** to their homes. We are calling on behalf of organizations that oversee energy and environment programs in California.

I want to assure you that this is not a sales call and your answers will be strictly confidential.
[CONTINUE ON TO SCREENER]

2 Screener

S0_CELL1. . Before we begin, have you received this call on a cellphone or on a landline?
01 [WIRELESS] [GOTO S0_CELL2]

02 [LANDLINE] [GOTO S1]
96 [Refused] [**Thank and Terminate**]
97 [Don't know] [**Thank and Terminate**]

S0_CELL2. Are you driving a vehicle or doing something that requires your attention? [INTERVIEWER: IF RESPONDENT SAYS YES, READ] Due to safety reasons we will need to call you back at a more convenient time. Thank you very much.
01 [YES] [SET AS SOFT CALLBACK]
02 [NO] [GOTO S1]
96 [Refused] [**Thank and Terminate**]
97 [Don't know] [**Thank and Terminate**]

/*
Instructions to CATI programing: Use <AREA>=CITY=Group 2=Non Program Areas and <AREA>=COUNTY-Groups 1 and 3=Program and Non Program Areas within CA.
*/

S0_CELL3 Which <AREA> is your home located in? [DO NOT READ]
1. [SPECIFY]
IF REFUSED ➔ Thank and Terminate

S1. I'd like to first confirm, are you the owner or co-owner of [ADDRESS]?

1. Yes
2. No
98. DK
99. REF

IF YES ➔ GO TO S2
IF NO➔ - Ask for Owner's name and phone # and best time to call.
- If Contact has no connection to Address, record disposition, thank & terminate.
IF REFUSED ➔ Thank and Terminate

S2. Is your house a … **[READ LIST]**

1. Single-family home, detached from other homes
2. A two-family house
3. A townhouse or row house attached to other units ➔ **Thank and Terminate**
4. Or a multi-family building ➔ **Thank and Terminate**
97. (Other_____[SPECIFY]) ➔ **Thank and Terminate**
98. (Don't know) ➔ **Thank and Terminate**

99. (Refused) ➔ **Thank and Terminate**

S3. Within the past three years, have you completed renovations to your home that involved any of the following? **[READ LIST, RANDOMIZE, ACCEPT MULTIPLES]**

1. Breaking through an outside wall (to add rooms, or extend a room, or raise part of the roof)?
2. Replacing windows?
3. Installing a new furnace or boiler?
4. Adding insulation to the home?
5. Adding a new Central Air Conditioning unit?
6. Add/Replace water heating equipment?
7. Finishing a basement?
8. Remodeling or upgrading the kitchen?
9. Finishing a room above the garage?
10. Added a pool or spa?
11. None of those ➔ **Thank and Terminate**

98. (Don't know) ➔ **Thank and Terminate**
99. (Refused) ➔ **Thank and Terminate**

S4. Did this project cost more than $3,000 to complete?

1. Yes
2. No ➔ **Thank and Terminate**

98. (Don't know) ➔ **Thank and Terminate**
99. (Refused) ➔ **Thank and Terminate**

S5. What was the **main** purpose for this project [**CODE RESPONSE INTO PRECODES BELOW, ACCEPT ONE ONLY, PROBE FURTHER FOR MAIN PURPOSE IF RESPONDENT MENTIONS > 1**].

S6. What were some of the other purposes of the project? **[READ LIST EXCLUDING S5 RESPONSE FOR S6, ACCEPT MULTIPLES FOR S6]**

Reason (Randomize, Other is always last)	**S5**	**S6**
Replace old or failing equipment	1	1
Modernize kitchen and/or bath	2	2
Add or reconfigure living space	3	3
Reduce energy use or costs	4	4
Repair or replace exterior of the house	5	5
Repair or replace interior elements of the house	6	6

Improve comfort [e.g. stop drafts; keep cooler in summer or warmer in winter]	7	7
Qualify for program rebates	8	8
Improve indoor air quality	9	9
Increase the value of the home	10	10
Other (Specify) _____	11	11
Don't know	98	98
Refused	99	99

3 Project Details

Next, I'd like to ask you some questions about the renovation project you completed.

A1. In which year did you complete this project? **[DO NOT READ]**

1. 2013
2. 2012
3. 2011
4. 2010
5. Earlier than 2010 (T&T if A1=5=earlier than 2010=prior to program onset)
6. Ongoing

98. DK

99. REF

A1_1 And which month in <A1> did you complete this project?
Codes 1-12 for Jan – Dec , 98, 99 for DK, Ref respectively.

A1_2 (***Ask if A1_1=98, 99)*** Would you say it was completed in

1 Summer <A1>
2 Fall <A1>
3 Winter <A1>
4 Spring <A1>

98 DK
99 Ref

Program Participation/Energy Audit

A2. Did you receive assistance in carrying out this project from an energy efficiency program sponsored by an electric or gas utility company, a state or local government agency, or a non-profit organization?

1. Yes → **Ask A3**
2. No → **Skip to A15**

98. (Don't know) → **Skip to A15**
99. (Refused) → **Skip to A15**

A3. What kind of organization sponsored the program in which you participated? **[DO NOT READ LIST, ACCEPT MULTIPLE RESPONSES]**

1. Electric and/or gas utility company (includes Energy Upgrade CA)
2. Government agency
3. Non-profit organization
4. Other (Specify)

98. (Don't know)
99. (Refused) → **Skip to A15**

A4. What types of assistance did the program provide to your project? **[READ LIST, RANDOMIZE, ACCEPT MULTIPLE ANSWERS]**

1. Financial incentives or rebates
2. Loans
3. In-home assessment of energy efficiency opportunities, sometimes known as energy audits
4. Other kinds of information and guidance
5. Referrals to contractors
6. Inspections of completed work
7. Other (Specify)

98. (Don't know)
99. (Refused)

IF A4 = 3, SKIP TO A6.

A5. Prior to undertaking this project, did you have an assessment done of your home to identify measures that would reduce energy use and costs? Sometimes these are referred to as "energy audits" or "energy assessments".

1. Yes → **Proceed to A6.**
2. No → **Skip to A15**

98. (Don't know) ➔ **Skip to A15**
99. (Refused) ➔ **Skip to A15**

A6. Did the energy assessment or energy audit you received incorporate the following elements? [**READ LIST. CODE: 1 = YES, 2 = NO, 98 = DON'T KNOW, 99 = REFUSED**.]

1. In-person inspection of your home
2. Blower door test with large fan to measure air leakage
3. Tests to measure leaks in heating and air conditioning ducts, sometimes known as "Duct Blaster"
4. Testing of the combustion efficiency of your furnace or boiler
5. A report of results from the energy auditing
6. In-person discussion of results and energy saving options with contractor
7. A projection of energy savings from possible retrofits
8. Anything else? (SPECIFY)

A7. Did the contractor who performed the Energy Audit also carry out the improvements to your home? **[DO NOT READ LIST]**

1. Yes – all of the improvements
2. Yes – some of the improvements
3. No – none of the improvements

98 Don't know
99 Refused

A8. Was there a fee for the Energy Audit? **[DO NOT READ LIST]**

1. Yes
2. No

98 Don't know
99 Refused

A9. Did the energy audit identify opportunities to save energy in your home that you had not been aware of before the audit?

1. Yes
2. No

98 DK

A10. 99 REF
Did you install all of the energy efficiency measures recommended in the Energy Audit?

1. Yes ➔ **SKIP TO A14**
2. No ➔**PROCEED TO A11**
98 DK ➔ **SKIP TO A15**

99 REF → **SKIP TO A15**

A11. Do you recall which of the recommended energy efficiency measures you did not install? **[DO NOT READ. ACCEPT MULTIPLES.]**

Measure	A11
Attic insulation	1
Wall insulation	2
Floor insulation	3
Air sealing	4
Energy-efficient windows	5
New boiler or furnace	6
New central air conditioner	7
New heat pump	8
Programmable thermostat or other heating/cooling controls	9
Efficient water heater	10
Tankless water heater	11
Duct sealing	12
Hot water pipe insulation	13
Whole house fan	14
Solar Photovoltaic	15
Energy-efficient lighting	16
Lighting controls	17
Other (Specify)	77
DK	98
REF	99

A12. What was the **main** reason you decided not to install those measures? **[DO NOT READ]**

A13. Were there other reasons? **[DO NOT READ, ACCEPT MULTIPLES]**

Reason	A12	A13
Could not afford to do more/ran out of money	1	1
Did not think the savings justified the costs	2	2
Did not fit with other aspects of the overall project	3	3
Was not convenient to do the measure at that time	4	4

No additional reasons	5	5
Other (Specify)	77	77
Don't know	98	98
Refused	99	99

A14. On a scale of 1 to 10 where 1 means "not at all useful" and 10 means "very useful", how useful was the energy audit in helping you to decide which energy efficiency measures you wanted to install?

ENTER SCORE 1 – 10; 98 FOR DK; 99 FOR REF _____

Shell Elements and Related Efficiency Measures

A15. Did the project include building new exterior walls or extending existing ones?

1. Yes
2. No
98. DK
99. REF

A16. Did the project include adding new roof areas or extending existing roofs?

1. Yes
2. No
98. DK
99. REF

A17. Did the project include adding new interior floor area?

1. Yes
2. No
98. DK
99. REF

[READ IF S3 = 4: You indicated earlier that you had purchased a furnace or boiler, just to confirm:]

A18. As part of this project, did you or your contractor add insulation in existing parts of your home in the following areas? **CODE 1 = YES; 2 = NO; 98 = DON'T KNOW; 99 = REFUSED**

Areas	Code
Attic or ceilings	
Exterior/Interior walls	
Floors between levels	
Foundation	

A19. As part of this project did your contractor check air leaks to the exterior using a blower door test?

1. Yes
2. No
98. DK
99. REF

A20. DELETED

Space Heating Equipment and Efficiency Measures

[READ IF S3 = 3: You indicated earlier that you had purchased a furnace or boiler, just to confirm:]

A21. Did you install space heating equipment such as a furnace or a boiler as part of the project?

1. Yes **➔ Ask A21_1**
2. No **➔ Skip to A33**
98. DK **➔ Skip to A33**
99. REF **➔ Skip to A33**

A21_1 Was this installation to…

1 **Replace** broken/failed equipment?
2 **Upgrade** working equipment?
98 DK
99 Ref

A22. What type of space heating equipment did you install? **[PROMPT IF NECESSARY.]**

1.	Hot water boiler	➔ **Ask A23**
2.	Hot water furnace	➔ **Ask A24**
3.	Air source heat pump	➔ **Ask A25**
4.	Ground source heat pump	➔ **Skip to A26**
5.	Electric resistance baseboard heating	➔ **Skip to A26**
97.	(Other_____[SPECIFY])	➔ **Skip to A26**
98.	DK	➔ **Skip to A26**
99.	REF	➔ **Skip to A26**

A23. Did the boiler have an Energy Star Label? **[**READ IF NECESSARY: The energy star label shows the word energy, written in script, with a star symbol at the end of the word.]?

1. Yes
2. No
98. DK
99. REF

A23a Can you recall the energy efficiency rating of the boiler, given as an Annual Fuel Use Efficiency or AFUE percent?

1. Yes → What was the AFUE? _____
2. No → SKIP TO A26
98. DK → SKIP TO A26
99. REF → SKIP TO A26

A24. Did the furnace have an Energy Star Label? **[**READ IF NECESSARY: The energy star label shows the word energy, written in script, with a star symbol at the end of the word.]?

1. Yes
2. No
98. DK
99. REF

A24a Can you recall if the new furnace exhausts through a white plastic pipe or through a conventional metal flue pipe?

1. White plastic → SKIP TO A26
2. Metal pipe → SKIP TO A26
98. DK → SKIP TO A26
99. REF → SKIP TO A26

A25. Did the air source heat pump have an Energy Star Label, meaning that its efficiency rating was SEER 14.5 or higher? [READ IF NECESSARY: The energy star label shows the word energy, written in script, with a star symbol at the end of the word.]?

1. Yes
2. No
98. DK
99. REF

A26. Prior to installing the heating system, did your contractor discuss with you the costs and energy savings associated with equipment of varying efficiency levels?

1. Yes
2. No
98. DK
99. REF

A27. Did your contractor recommend or specify Energy Star labeled equipment? [READ IF NECESSARY: The energy star label shows the word energy, written in script, with a star symbol at the end of the word.]?

1. Yes
2. No
98. DK
99. REF

A28. Did your contractor discuss with you the methods he used to determine the proper size for your heating equipment?

1. Yes → ASK A28a.
2. No → SKIP TO A29
98. DK → SKIP TO A 29
99. REF → SKIP TO A 29

A28a. Did your contractor mention any of the following methods for sizing your heating equipment?

1. Matched the unit that was replaced
2. Heat load calculations
3. Manufacturer's computer model
98. DK
99. REF

A29. Did you install or replace heating distribution equipment such as hot water radiators or warm air ducts as part of this project?

1. Yes → **ASK A30**
2. No →**SKIP TO A31**
98. DK → **SKIP TO A31**
99. REF → **SKIP TO A31**

A30. Was that… **[READ LIST]**

3. Hot water radiators
4. Warm Air Ducts
5. Other (Specify _____)

A31. Did your contractor insulate the heating hot water lines or ducts as part of this project?

1. Yes
2. No
98. DK
99. REF

[IF A30 = 2 ASK A32; ELSE SKIP TO A33]

A32. Was a test conducted after project completion to ensure that your ducts were properly sealed?

1. Yes
2. No
98. DK
99. REF

A32_1(If A32=Y) Who conducted the tests(READ LIST)?

1. **Contractor**
2. **HERS rater**
3. **Both Contractor and HERS rater**
4. **DK**
5. **REF**

Air Conditioning Equipment and Efficiency Measures

[READ IF S3 = 5: You indicated earlier that you had purchased a central air conditioning system, just to confirm:]

A33. Did you install a central air conditioning system as part of this project?

1. Yes ➔ **Ask A33_1**
2. No ➔ **Skip to A40**
98. DK ➔ **Skip to A40**
99. REF ➔ **Skip to A40**

A33_1 Was this installation to…

1 **Replace** broken/failed equipment?
2 **Upgrade** working equipment?
98 DK
99 Ref

A34. Did the air conditioning system have an Energy Star Label, meaning that its efficiency rating was SEER 14.5 or higher? **[**READ IF NECESSARY: The energy star label shows the word energy, written in script, with a star symbol at the end of the word.]?

1. Yes
2. No
98. DK
99. REF

A35. Prior to installing the air conditioning system, did your contractor discuss with you the costs and energy savings associated with equipment of varying efficiency levels?

1. Yes
2. No
98. DK
99. REF

A36. Did your contractor recommend or specify Energy Star labeled equipment? **[**READ IF NECESSARY: The energy star label shows the word energy, written in script, with a star symbol at the end of the word.]?

1. Yes
2. No
98. DK
99. REF

A37. Did your contractor discuss with you the methods he used to determine the proper size for your cooling equipment?

1. Yes
2. No
98. DK
99. REF

A38. Did you install air conditioning ducts as part of this project?

1. Yes ➔ **Ask A38a**
2. No ➔ **Skip to A40_1**
98. DK ➔ **Skip to A40_1**
99. REF ➔ **Skip to A40_1**

A38a Were tests conducted after project completion to ensure that your ducts were properly sealed?

1. Yes
2. No
98. DK
99. REF

A38a_1 (If A39=1) Who conducted the tests (READ LIST)?

1. Contractor
2. HERS rater
3. Both Contractor and HERS rater
4. DK
5. REF

A39. Did your contractor conduct tests to ensure that your air conditioner was properly charged with refrigerant and operating at the correct air flow rate?

1. Yes
2. No
98. DK
99. REF

Domestic Hot Water

[READ IF S3 = 6: You indicated earlier that you had purchased water heating equipment, just to confirm:]

A40. Did you add or replace water heating equipment as part of the project?

1. Yes **➔Ask A40_1**
2. No **➔ Skip to A43**
98. DK **➔ Skip to A43**
99. REF **➔ Skip to A43**

A40_1 Was this installation to…

1 **Replace** broken/failed equipment?
2 **Upgrade** working equipment?
98 DK
99 Ref

A41. What type of water heating equipment did you install? **[READ, IF NECESSARY.]**

1. Gas-fired tank
2. Electric-fired tank
3. Tankless "on-demand" heater
97. (Other_____[SPECIFY])
98. DK
99. REF

A42. Did your contractor insulate hot water lines and the hot water tank as part of this project?

1. Yes
2. No
98. DK
99. REF

Solar PV

A43. Did your contractor install solar electric panels as part of this project?

1. Yes
2. No
98. DK
99. REF

IF RESPONDENT ANSWERED QUESTIONS A11 – A13 REGARDING IMPLEMENTATION OF AUDIT RECOMMENDATIONS, SKIP TO A48..

A44. Did your contractor suggest any additional measures to reduce energy consumption that you decided not to carry out?

1. Yes
2. No → SKIP to A48

98 DK → SKIP to A48

99 REF → SKIP to A48

A45. Do you recall which of the recommended energy efficiency measures you did not install**?**

[DO NOT READ. ACCEPT MULTIPLES.]

Measure	**B31**
Attic insulation	1
Wall insulation	2
Floor insulation	3
Air sealing	4
Energy-efficient windows	5
New boiler or furnace	6
New central air conditioner	7
New heat pump	8
Programmable thermostat or other heating/cooling controls	9
Efficient water heater	10
Tankless water heater	11
Duct sealing	12
Hot water pipe insulation	13
Whole house fan	14
Solar Photovoltaic	15
Energy-efficient lighting	16
Lighting controls	17
Other (Specify)	77
DK	98
REF	99

A46. What was the main reason you decided not to install those measures? **[DO NOT READ, ACCEPT ONLY ONE RESPONSE]**

A47. Were there other reasons? **[ACCEPT MULTIPLE RESPONSES]**

Reason	A46	A47
Could not afford to do more/ran out of money	1	1
Did not think the savings justified the costs	2	2
Did not fit with other aspects of the overall project	3	3
Was not convenient to do the measure at that time	4	4
No additional reasons	5	5
Other (Specify)	77	77
DK	98	98
REF	99	99

Project Finances

A48. Which of the following ranges contains the total cost of your project? **[READ LIST. ACCEPT ONE ONLY.]**

1. Less than $5,000
2. Between $5,000 and $10,000
3. Between $10,000 and $25,000
4. Between $25,000 and $50,000
5. Between $50,000 and $75,000
6. Between $75,000 and $100,000
7. $100,000 or more
8. Don't know
9. Refused

1.

A49. Did you use a loan or other type of financing to help pay for this project?

1. Yes ➔ **Ask A50**
2. No ➔ **Skip to A51**

98. DK ➔ **Skip to A51**

99. REF ➔ **Skip to A51**

A50. Which of the following financing methods did you use? **[READ LIST. RANDOMIZE. OTHER IS ALWAYS LAST. ACCEPT MULTIPLES.] CODE 1 = YES; 2 = NO; 98 = DON'T KNOW; 99 = REFUSED.**

#	Appliance Type	Code
A	Refinancing of home mortgage	
B	Second mortgage or home equity line of credit	
C	Consumer loan from bank or finance company	
D	Credit card	
E	Installment loan from contractor or equipment vendor	
F	Loan from a utility or government program	
G	Rebate or discount from a utility sponsored program (Specify)	
H	Other (Specify) _____	

Contractor Information

I'd like to ask you a few questions about the contractor who completed your project.

A51. How would you characterize the firm or individual who had the primary responsibility for your project? Which specialties apply … **[READ LIST. RANDOMIZE. OTHER IS ALWAYS LAST. SELECT "GENERAL HOME CONTRACTOR" IF MULTIPLE DESCRIPTORS APPLY]**

1. a general home contractor
2. a kitchen or bath remodeling specialist
3. a heating and cooling contractor
4. a homebuilder
5. an insulation contractor
6. a contractor specializing in energy efficiency

97. Some other type of contractor (specify) _____
98. DK
99. REF

A52. How did you find out about this contractor? **[DO NOT READ. ACCEPT MULTIPLE RESPONSES.]**

1. Used this contractor for previous work
2. Word of mouth from family/friends
3. Yellow pages
4. Advertising in newspapers or other general media
5. Referral from other tradesmen or vendors
6. Referral from a utility or government program

7. Internet or websites
97. (Other_____[SPECIFY])
98. DK
99. REF

A53. Did you contact more than one contractor about doing this project?

1. Yes
2. No
98. DK
99. REF

A54. Why did you decide to use this contractor? **[DO NOT READ. ACCEPT MULTIPLES]**

a. Satisfied with previous work
b. Good recommendations from others
c. Best price
d. Best approach to meeting my needs
e. Reputation for using energy efficient equipment and practices
f. Reputation for using environmentally friendly materials and practices
g. Contractor was certified by BPI, government, utility, etc.
h. Referral from utility or government program

97. (Other_____[SPECIFY])
98. (Don't know)
99. (Refused)

A55. In discussing plans for your project, did your contractor bring up any of the following issues?
[READ LIST. RANDOMIZE. ACCEPT MULTIPLES.] CODE 1 = YES; 2 = NO; 98 = DON'T KNOW; 99 = REFUSED.

#	Issue	Code
A	Impacts of the project on your energy costs	
B	Energy savings options for equipment or construction practices	
C	Effect of renovations on comfort, such as eliminating drafts and hot or cold spots in the home	
D	Effect of renovations on indoor air quality	
E	Effect of renovations on safety of heating and cooling equipment	
F	Effect of renovations on controlling mold	

A56. Did the contractor mention that he or his company had received special training or certification in energy-saving renovation techniques?

1. Yes
2. No
   98 DK
   99 REF

A57. Using a scale of 1 to 10 where 1 means "strongly *dis*agree" and 10 means "strongly *agree*". How much do you disagree or agree with the following statements? **[READ LIST. RANDOMIZE. FOR EACH STATEMENT CODE 1 – 10, 98 FOR DK. 99 FOR REF.]**

a. I felt confident that the contractor was capable of doing a good job on all components of the project.

b. The project was worth the money it cost.

c. The project used the highest quality materials and installation techniques.

d. The project resulted in reduced energy costs for my household.

e. The project increased the comfort of my home.

f. I achieved more energy savings by installing a number of measures at once than I would have by installing them individually.

Program Recognition and Participation

IF A2 = 1 (RESPONDENT RECEIVED ASSISTANCE IN CARRYING OUT THE PROJECT FROM A PROGRAM) ASK A58, ELSE SKIP TO A63.

A58. Do you recall the name of the program from which you received assistance in carrying out the project?

1. Yes
2. No
98 DK
99 REF

IF A58 = 1, ASK A59. ELSE SKIP TO A60.

A59. What was the name of the program? **(ENTER VERBATIM)**.

A60. On a scale of 1 to 10, where 1 means "very *un*likely" and 10 means "very likely", what is the likelihood that you would have carried out the project *at the time* you did if program assistance had not been available?

CODE 1 – 10, 98 for DK; 99 for REF.

A61. On a scale of 1 to 10, where 1 means "very *un*likely" and 10 means "very likely", what is the likelihood that you would have installed all of the energy efficiency measures you did if program had not been available?

CODE 1 – 10, 98 for DK; 99 for REF.

A62. And, on a scale of 1 to 10, where 1 means "not at all important" and 10 means "very important", how important were each of the following program services in encouraging you to plan and complete the project? If you did not use the service or if it was not offered, just say "Does not apply". (**REPEAT AS NECESSARY for Q62b-Q62f.**

READ LIST. RANDOMIZE. CODE 1 – 10, 22 for "Does not Apply", 98 for DK; 99 for REF.

a. Energy assessment or energy audit
b. Customer education materials provided by the program
c. Referrals to certified contractors
d. Rebates or other financial incentives
e. Loan offers
f. Inspection of completed work by a third party

QUESTIONS A63-A68 FOR CUSTOMERS WHO <u>DID NOT RECEIVE</u> ASSISTANCE IN COMPLETING THE PROJECT, THAT IS A2 DOES NOT EQUAL 1.

ALL OTHERS SKIP TO C1

A63. Have you heard of [FOR CALIFORNIA –"ENERGY UPDATE CALIFORNIA"; FOR OTHER STATES USE NAME OF ANY LOCAL GOVERNMENT PROGRAMS OR THE GENERIC TERM "HOME PERFORMANCE" PROGRAMS?

: This program provides training and certification to general remodeling and specialty contractors on opportunities to save energy and to improve comfort, safety, and indoor air quality in existing homes. The contractors assess energy savings for various improvements to the home's exterior,

heating, and cooling systems. Projects ensure that the whole house system works together more efficiently.

1. Yes
2. No
98. (Don't know)
99. (Refused)

A64. Were you aware of the [PROGRAM] prior to undertaking the project we have just discussed?

1. Yes ---SKIP TO A66
2. No GO TO A65
98. (Don't know) **SKIP TO A66**
99. (Refused) **SKIP TO A66**

A65. [ASK IF A64=2=NO, NOT AWARE OF PROGRAM] If you had been aware of the [PROGRAM] program prior to undertaking your remodeling project, would you have sought the assessment of energy savings opportunities?

1. Yes → **SKIP TO A68**
2. No => **GO TO A66**
98. (Don't know**)** =>**GO TO A66**
99. (Refused) =>**GO TO A66**

A66. What is the main reason why you would **not** have sought the assessment of energy savings opportunities? **[DO NOT READ. ACCEPT ONE ONLY.]**

1. Not enough time to get involved with that kind of service
2. Not enough money to implement recommended measures
3. Trusted that the contractor would use energy-efficient methods
4. Energy savings would not be large enough to justify getting involved
5. Lack of confidence in special energy efficient measures
6. Lack of confidence in objectivity of contractors offering those kinds of service
97. (Other_____[SPECIFY])
98. (Don't know)
99. (Refused)

A67. Are there other reasons why you would not have sought the assessment service? **[DO NOT READ. ACCEPT MULTIPLES. THEN SKIP TO CHARACTERISTICS C1]**

1. Not enough time to get involved with that kind of service
2. Not enough money to implement recommended measures
3. Trusted that the contractor would use energy-efficient methods

4. Energy savings would not be large enough to justify getting involved
5. Lack of confidence in special energy efficient measures
6. Lack of confidence in objectivity of contractors offering those kinds of service
97. (Other_____[SPECIFY])
98. (Don't know)
99. (Refused)

A68. If at the beginning of your remodeling project you had received a home assessment from an accredited contractor that identified energy saving measures that cost an additional $5,000 but would pay for themselves within five years, would you have incorporated them into your project?

1. Yes
2. No
98. (Don't know)
99. (Refused)

4 Respondent and Household Characteristics

My last questions are used for statistical purposes only. All information is kept completely confidential.

C1. How many bedrooms does your home have?

Number of bedrooms: _____ **[1 through 25, DK = 98, REF=99]**

C2. How many bathrooms does it have?

Number of bathrooms: _____ **[DK = 98, REF=99]**

[If half baths, enter decimal, e.g., 1 and ½ bath = 1.5]

C3. Roughly how large is the living area of your home in terms of square feet?

ENTER NUMBER OF SQUARE FEET, DK = 98, REF=99 _____

C4. What is the main fuel used to heat your home?

1. Oil
2. Natural gas
3. Propane
4. Electricity
97. (Other_____[SPECIFY])
98. (Don't know)

99. (Refused)

C5. Does your home have central air-conditioning?

1. Yes
2. No
98. (Don't know)
99. (Refused)

C6. Do you **["also" if C5=1]** have any window air-conditioning units?

1. Yes
2. No
98. (Don't know)
99. (Refused)

C6_1 **(If C6=1=Yes) How many?**

Number of wall units: _____ **[1 through 25, DK = 98, REF=99]**

C7. How many people, including yourself, lived in this home **before** the retrofit?_____ [DK=98, REF=99]

C8. How many people, including yourself, lived in this home **after** the retrofit? _____ [DK=98, REF=99]

C9. Which of the following categories includes your age? **[READ LIST]**

1. Under 25
2. 25 to 34
3. 35 to 44
4. 45 to 54
5. 55 to 64
6. 65 or over
99. (Refused)

C10. I'm going to read several education categories. Please stop me when I come to the highest level of schooling you've completed. **[READ LIST]**

1. Less than high school
2. High school graduate
3. **Some college, trade or technical school**
4. **Completed business or technical school (2 year)**
5. **College graduate (4 year)**

6. **Post graduate work or advanced degree**

99. (Refused)

C11. Which of the following ranges includes the current assessed value of your home? Please stop me when I come to the appropriate value range. **[READ LIST]**

1. Less than $300,000
2. Between $300,000 and $400,000
3. Between $400,000 and $500,000
4. Between $500,000 and $600,000
5. Between $600,000 and $700,000
6. More than $700,000

98. (DK)
99. (REF)

C12. Which of the following ranges includes your total household income in 2012? Please stop me when I come to the appropriate range. **[READ LIST]**

1. Less than $50,000
2. between $50,000 and $75,000
3. between $75,000 and $100,000
4. between $100,000 and $150,000
5. $150,000 or more

98. (DK)
99. (REF)

C13. [INTERVIEWER: RECORD GENDER]

5 Wrap-up

Those are all the questions I have for you today. Thank you for your time and cooperation.

WO54 Whole House Retrofit Contractor Survey

Introduction

LEAD-IN: Hello, this is [interviewer name] from Discovery Research Group, and I'm helping evaluate state energy efficiency programs. This is not a service or a sales call. We're offering a $50 Visa gift card to residential remodeling or equipment installation contractors who complete our 15-minute phone survey on energy efficiency and construction.
May I speak with the person who is most involved in business decisions for your residential remodeling or equipment installation business
NAME OF CONTACT: _____
IF CONTACT IS NOT AVAILABLE, ASK FOR BEST TIME TO CALL BACK.
CALL BACK DATE/TIME: _____

[REPEAT LEAD-IN FOR RESPONDENT, IF NEEDED]

READ: We would like to interview you about your recent experience in residential construction and remodeling. This is not a sales call and your answers will be strictly confidential and reported only in the aggregate. State agencies and electric utilities in California will use this information to help plan programs that benefit homeowners. We are offering a $50 Visa gift card to contractors who qualify and complete this survey. Also, please be aware that upon receipt of the gift card, you will be asked to sign and return a verification form to acknowledge that you have received the item. Once that verification form is received, your card will be activated. This usually occurs about three business days after you mail the form.

[IF REQUIRED]
To confirm the legitimacy of this study, you may contact Cathy Fogel at the California Public Utilities Commission at Cathleen.fogel@cpuc.ca.gov

[CONTINUE ON TO SCREENER]

Screener
S0_CELL1. Before we begin, have you received this call on a cellphone or on a landline?
1. CELL PHONE [GOTO S0_CELL2]
2. LANDLINE [GOTO S1]
9998 DK [T&T General]
9999 REF [T&T General]

S0_CELL2. Are you driving a vehicle or doing something that requires your attention?

[INTERVIEWER: IF RESPONDENT SAYS YES, READ] Due to safety reasons we will need to call you back at a more convenient time. Thank you very much.

1. Yes [SET AS SOFT CALLBACK]
2. No [GO TO S1]
9998 DK [T&T]
9999 REF [T&T]

S1. First, I would like to confirm that <ADDRESS> is your company's address?

S2. For our records, what is your job title? [OPEN END, RECORD RESPONSE]

S3. Thank you, and how many full-time employees do you have in your location/in all your locations in California? [RECORD RESPONSE.][If required, your best guess is fine,]

1. # EMPLOYEES: ¬¬¬¬¬¬¬¬¬¬_____
2. 9998 DK [T&T General]
3. 9999 REF [T&T General]

S4. In what geographical area do you deliver your services? [OPEN END, RECORD RESPONSE]

S4_1. (For CA contractors only): Are you listed/registered as a participating contractor with Energy Upgrade California? [IF THEY ASK WHAT THAT IS: A list that displays local contractors. It is not necessary to be on the list to take this survey]

01 Yes
02 No
9998 DK
9999 Ref

S5. Please indicate which ONE of the following best describes the core/primary services your firm provides? [RANDOMIZE a-d, e is always asked last. READ LIST, ACCEPT ONE RESPONSE]

a) Heating/Air Conditioning for homes [SKIP TO H1]
b) Insulation for homes [SKIP TO I1]
c) Renovation/General contractor for home improvements [SKIP TO G1]
d) Energy efficiency services, such as energy audits, air sealing, duct sealing, insulation, and heating or cooling system improvements for homes [SKIP TO E1a]
e) None of these [T&T (Not Specialty)]

[SKIP TO SECTION WHERE RESPONSE = YES FOR A-D.]

E1a. How many residential energy efficiency projects did your company complete in 2012? (if required: Your best guess is fine)

ENTER NUMBER: _____ [IF E1a < 10 PROJECTS, T&T , else GO TO E1B]
9998 DK
9999 REF

H1. What year did your company begin installing home heating or cooling systems?
ENTER YEAR:_____
9998 DK
9999 REF

H2. How many residential HVAC systems did your company install in 2012? [READ OPTIONS, RECORD RESPONSE] [If required, your best guess is fine]
1. 0-9 [T&T]
2. 10-24
3. 25-49
4. 50-100
5. More than 100 [ENTER NUMBER]
4. 98. DK
5. 99. REF
6.

H3. What percent of your residential HVAC projects in 2012 were…[READ LIST, RECORD PERCENTAGE, H3a+H3b need to be =100] [If required, your best guess is fine]
a) In new construction
b) In existing homes [if H3B < 10%, T&T, else GO TO H4]
I1. How many residential insulation projects did your firm complete in 2012?
1. 0-9 [If I1 =1 < 10 projects, T&T]
2. 10-24
3. 25-49
4. 50-100
5. More than 100 [ENTER NUMBER]
9998. DK
9999. REF

I2. What percentage of the <I1> residential insulation projects in 2012 were installed in …[RECORD PERCENTAGE, I2a+I2b needs to = 100]
a) New construction
b) Existing homes [if I2b < 10% or DK/REF, T&T, Else Go To I3]

G1. Roughly how many residential remodeling projects did your firm complete in 2012?
ENTER NUMBER: _____ [IF G1 < 10 PROJECTS, T&T , else GO TO G1A]

9998 DK
9999 REF

G1a . What percentage of the <G1> residential remodeling projects in 2012 were installed in …[RECORD PERCENTAGE, G1aa+G1ab needs to = 100]
a) New construction
b) Existing homes [if G1ab < 10% or DK/REF, T&T, Else Go To G1b]

T&T
Those are all the questions I have for you today. Thank you for your time☐ THANK AND TERMINATE]
T&T (Not specialty)

IF S5=e=NONE, READ T&T script below
For this survey, we are interested in speaking with contractors who are primarily involved with those services." ☐ THANK AND TERMINATE]

Energy Efficiency Service Providers

E1b. What percent of those <E1a> projects was in single-family homes? (if required: Your best guess is fine)
ENTER PERCENT: _____
9998 DK
9999 REF
If E1b=0, then T&T.

E2. Which of the following pre-installation services do you offer?
[RANDOMIZE a-f, g always asked last, READ LIST, MULTIPLE RESPONSES ALLOWED]
1. Yes
2. No
9998 DK
9999 REF

E3. [FOR ALL E2_*=1, ASK]: On what percentage of projects do you provide <E2_*>?
E2 (Yes/No/DK/Ref) E3
(%, if E2_*=1=Yes)
a Energy audits
b Blower door test for infiltration
c Duct leakage testing
d Combustion efficiency for heating equipment
e Refrigeration diagnostics for air conditioning equipment

f Radon test
g Other diagnostic test (Specify)

ENTER PERCENT: _____
9998 DK
9999 REF

[If E2_*=No/DK/Ref for ALL E2_*, T&T]

E4. [ASK IF E2a = 1=YES, ELSE SKIP TO E6] Do you use a standard computerized package to conduct your energy audits?
1. Yes
2. No
9998 DK
9999 REF

E5. What company or organization publishes the energy audit package you use [OPEN END, ACCEPT MULTIPLES]?
ENTER VERBATIM
RESPONSE:¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬¬_____

E6. Which of the following energy efficiency improvements do you install? [RANDOMIZE a-n, o always asked last, READ LIST, MULTIPLE RESPONSES ALLOWED]
1. Yes
2. No
9998 DK
9999 REF

[If E6_*=No/DK/Ref for ALL E6_*, go to WH1]

E7. [FOR ALL E6_*=1, ASK]: On what percentage of projects do you provide <E6_*>?

	E6 (Yes/No/DK/Ref)	E7 (%, if E6_*=1=Yes)
a	Attic insulation	
b	Wall insulation	
c	Floor or sill insulation	
d	Air sealing	
e	Duct sealing	
f	Energy efficient windows	

g ENERGY STAR furnace or boiler
h ENERGY STAR central air conditioner or heat pump
i Programmable thermostat or learning thermostat such as the NEST
j Energy efficient water heater
k Hot water pipe insulation
l Whole House Fan
m Photovoltaic panels
n Lighting controls
o Other (Specify)

ENTER PERCENT: _____
9998 DK
9999 REF

E8a. [ASK IF E6g = 1= YES, ELSE SKIP TO E8b]What methods do you typically use to size heating equipment installed in your projects? [DO NOT READ. CHECK ALL THAT APPLY]
1. Match the size of the unit that was replaced
2. Heat load calculations based on home measurements
3. Manufacturer's computer model
4. Other(Specify)
9998 DK
9999 REF

E8b [ASK IF E6h = 1= YES, ELSE SKIP TO E9]What methods do you typically use to size cooling equipment installed in your projects [DO NOT READ. CHECK ALL THAT APPLY]
1. Matched the unit that was replaced
2. Manual J calculations
3. Heat load calculations
4. Manufacturer's computer model
5. Other (Specify)
9998. DK
9999. REF

E9. Which of the following post-installation services do you offer?
[RANDOMIZE a-f, g always asked last, READ LIST, MULTIPLE RESPONSES ALLOWED]
1. Yes
2. No
9998. DK
9999. REF

E10. [FOR ALL E9_*=1, ASK]: On what percentage of projects do you provide <E9_*>?

E9
Yes/No/DK/Ref E10
%, where E9_*=1=Yes

a Infrared inspection of insulation
b Blower door test for infiltration
c Duct leakage testing
d Combustion efficiency for heating equipment
e Refrigeration diagnostics for air conditioning equipment
f Radon test
g Other diagnostic test (Specify)

ENTER PERCENT: _____
9998 DK
9999 REF

E11a Do you subcontract any of the services or installation work you mentioned?
1. Yes [GO TO E11b]
2. No [SKIP TO E11c]
9998. DK [SKIP TO E11c]
9999. REF [SKIP TO E11c]

E11b. Which services did you typically subcontract? [DO NOT READ.]
1. Insulation and air sealing
2. Controls
3. Electrical
4. Plumbing
5. HVAC installation
6. Duct and sheet metal work
7. Carpentry
8. Other (Specify) _____
9998. DK
9999. REF

E11c. What was the cost of the typical energy efficiency project that you completed in single family homes in 2012? Your best estimate is fine.
ENTER $ AMOUNT: _____ [SKIP TO E12]
99998 DK [GO TO E11D]
99999 REF [GO TO E11D]

E11d. Which of the following ranges includes the cost of your typical energy efficiency project in 2012 [READ LIST]?
1. less than $2,500

2. $2,500 - $5,000
3. $5,000 - $7,500
4. $7,500 - $10,000
5. $10,000 - $12,500
6. $12,500 - $15,000
7. more than $15,000
9998. DK
9999. REF

E12. Does your firm help customers obtain financing for the energy efficiency projects you install?
1. Yes [GO TO E13]
2. No [SKIP TO E14]
9998. DK [SKIP TO E14]
9999. REF [SKIP TO E14]

E13. What kind of organization provides the financing? [DO NOT READ. ACCEPT MULTIPLES. PROMPT, IF NECESSARY.]
1. Contractor finances the installation itself
2. Bank
3. Other type of commercial lender, such as Household Finance
4. Utility program
5. State or local government agency
6. Manufacturer of materials or equipment installed
9998. DK
9999. REF

E14. Have you or employees of your firm received training in energy efficiency improvement for existing homes?
1. Yes [GO TO E15]
2. No [SKIP TO E17]
9998. DK [SKIP TO E17]
9999. REF [SKIP TO E17]

E15. What organizations provided the training? [DO NOT READ. ACCEPT MULTIPLES. PROMPT IF NECESSARY]
1. Building Performance Institute (BPI)
2. Local college or junior college
3. Utility program
4. State of local government agency
5. Equipment or materials manufacturer

6. Internal Training Program
7. Other, Specify _____
9998. DK
9999. REF

E16. How many of your <S3> employees have received training in energy efficiency?
ENTER RESPONSE:
9998. DK
9999. REF

E17. What year did your firm first begin providing energy efficiency services to homeowners?
ENTER RESPONSE:
9998. DK
9999. REF

E18. What was your firm's principal line of business prior to that? [DO NOT READ LIST, ACCEPT SINGLE RESPONSE. USE FOLLOWING PRECODES]
1. General contracting
2. Kitchen and/or bath remodeling
3. Insulation
4. Heating and Cooling
5. Plumbing
6. Electrical
7. No other business (prior to entering the energy efficiency business)
8. Other (Specify) _____
9998. DK
9999. REF

E19 What was the main reason your firm decided to enter the energy efficiency business? [DO NOT READ. SELECT ONE ONLY]

E20 What are some of the other important reasons you decided to enter the energy efficiency business? [DO NOT READ. ACCEPT MULTIPLES]

Reason	E19	E20
Personal interest of the proprietor	1	1
Customers asking for energy efficiency services	2	2
Save the environment, "Right thing to do"	3	3
Promotion by local utility	4	4
Promotion by state or local government	5	5
Saw big local market	6	6
Add revenue stream for an established business	7	7

Increase revenue per project	8	8
Other (Specify)	9	9
None/No other reasons	10	10
DON'T KNOW	9998	9998
REFUSED	9999	9999

[GO TO WH1 – Questions for all respondents]

HVAC Contractors
I'd like to ask you a few questions about your HVAC projects.

H4. What percent of your projects in existing homes in 2012 were… [READ LIST, RECORD PERCENTAGE, H4a+H4b+H4c need to be = 100] [If required, your best guess is fine]
a) Heating only
b) Cooling only
c) Both

H5. In what percent of residential HVAC installation projects in existing homes do you typically: [RANDOMIZE, READ LIST, RECORD PERCENT 0-100] [If required, your best guess is fine]
a) Install ENERGY STAR-labeled heating or cooling units
b) Install programmable thermostats
c) Install advanced heating or cooling controls such as: zone controls, NEST or similar "smart" thermostats, thermostats that can be controlled remotely through cell phones or computers
d) Install or rework distribution systems such as ducts or heat pipes
e) Seal ducts
f) Insulate circulation ducts or pipes
g) Test ducts for leakage
h) Check charge levels and air flow over condenser coils
RECORD %:_____ [0-100%]
9998 DK
9999 REF

H6. What methods do you typically use to size heating equipment installed in your projects? [DO NOT READ. CHECK ALL THAT APPLY]
1. Match the size of the unit that was replaced
2. Heat load calculations based on home measurements
3. Manufacturer's computer model
4. Other (Specify)
9998. DK

9999. REF

H7. What methods do you typically use to size cooling equipment installed in your projects? [DO NOT READ. CHECK ALL THAT APPLY]
1. Matched the unit that was replaced
2. Heat load calculations
3. Manufacturer's computer model
4. Other (Specify)
9998. DK
9999. REF

H8. What was the typical cost of HVAC installation projects you completed in existing homes in 2012?
[RECORD RESPONSE] $_____ [SKIP TO H10]
9998. DK [GO TO H9]
9999. REF [GO TO H9]

H9. Which of the following ranges would you say includes the cost of your typical HVAC project in 2012? [READ LIST]
1. less than $2,500
2. $2,500 - $5,000
3. $5,000 - $7,500
4. $7,500 - $10,000
5. $10,000 - $12,500
6. $12,500 - $15,000
7. more than $15,000
9998. DK
9999. REF

H10. Do you market any other energy-related home improvement services other than HVAC?
1. Yes
2. No

H11. Why not? [OPEN ENDED, RECORD RESPONSE] ==> SKIP TO WH1 – Questions on Whole House for all respondents.

H12. Which of the following services do you offer? [READ LIST, RANDOMIZE a-f, g is always last]

1. Yes

2. No
11. 9998 DK
12. 9999 REF

H13. [FOR ALL H12_*=1, ASK]:On what percent of projects do you provide <H12_*>? [READ LIST, RANDOMIZE a-f, g is always last]

H13 – Capture % for all H12_*=1

A Energy audits
B Blower door test for infiltration
c Duct leakage testing
D Combustion efficiency for heating equipment
E Refrigeration diagnostics for air conditioning equipment
F Radon test
G Other diagnostic test (Specify)

ENTER PERCENT: _____
9998 DK
9999 REF

H14. Which of the following energy efficiency improvements do you install? [READ LIST for all except shaded items e, g, h, i. RANDOMIZE a-n, o is always last.]
1. Yes
2. No
9998 DK
9999 REF

[If H14_*=No/Dk/Ref for ALL, then skip to WH1 – Whole House questions for ALL respondents]

H15. [FOR ALL H14_*=1, Ask]: On what percentage of projects do you provide <H14_*>? [READ LIST for all except shaded items e, g, h, i. RANDOMIZE a-n, o is always last.]
Capture H15 for % for all H14_*=1

a Attic insulation
b Wall insulation
c Floor or sill insulation
d Air sealing
e Duct sealing
f Energy efficient windows

g ENERGY STAR furnace or boiler

h ENERGY STAR central air conditioner or heat pump
i Programmable thermostat or learning thermostat such as the NEST
j Energy efficient water heater
k Hot water pipe insulation
l Whole House Fan

m Photovoltaic panels

n Lighting controls
o Other (Specify)

ENTER PERCENT: _____
9998 DK
9999 REF
[If H15_*= some combination of 0/DK/Ref for all then GO TO WH1 – Whole House questions for ALL respondents]

H16. Do you subcontract any of the services or installation work you mentioned?
1. Yes [GO TO H17]
2. No [SKIP TO H18]
98. DK [SKIP TO H18]
99. REF [SKIP TO H18]

H17. Which services did you typically subcontract? [DO NOT READ, ACCEPT MULTIPLE.]
1. Insulation and air sealing
2. Controls
3. Electrical
4. Plumbing
5. HVAC installation
6. Duct and sheet metal work
7. Carpentry
8. Other (Specify) _____
9998. DK
9999. REF

H18. You mentioned earlier that the cost of a typical HVAC ONLY installation project you completed in 2012 was <H8> or <H9>. What was the cost of a typical project that included services in addition to HVAC installation in existing homes in 2012? [RECORD RESPONSE]

[RECORD RESPONSE] $_____ [SKIP TO H20]
9998. DK [GO TO H19]
9999. REF [GO TO H19]

H19. Which of the following ranges would you say includes the cost of a typical project that included services in addition to HVAC installation in 2012? [READ LIST]
1. less than $2,500
2. $2,500 - $5,000
3. $5,000 - $7,500
4. $7,500 - $10,000
5. $10,000 - $12,500
6. $12,500 - $15,000
7. more than $15,000
9998. DK
9999. REF

H20. What year did your firm first begin providing energy efficiency services in addition to those related to heating and cooling equipment?
ENTER YEAR:_____
9998 DK
9999 REF

H21. What was the main reason your firm decided to offer energy efficiency services other than those related to HVAC? [DO NOT READ. SELECT ONE ONLY]

H22. What are some of the other important reasons you decided to offer these services? [DO NOT READ. ACCEPT MULTIPLES]

Reason	H21	H22
Personal interest of the proprietor	1	1
Customers asking for energy efficiency services	2	2
Save the environment, “Right thing to do”	3	3
Promotion by local utility	4	4
Promotion by state or local government	5	5
Saw big local market	6	6
Add revenue stream for an established business	7	7
Increase revenue per project	8	8
Other (Specify)	9	9
None/No other reasons	10	10
DON’T KNOW	9998	9998
REFUSED	9999	9999

[GO TO WH1 – Questions for all respondents]

Insulation Contractors

I'd like to ask you a few questions about your insulation projects.

I3. What percent of your 2012 insulation projects in existing homes was your company…[RECORD PERCENTAGE, I3a + I3b needs to =100]

a) The prime contractor
b) The subcontractor

I4. What percent of jobs included the following services? [READ LIST. RECORD PERCENTAGE FOR EACH]

a) Ceiling insulation
b) Wall insulation
c) Floor insulation
d) Sill insulation
e) Air sealing
f) Duct sealing

I5. What was the typical cost of insulation projects you completed in existing homes in 2012?

[RECORD RESPONSE] $_____ [SKIP TO I7]
9998. DK [GO TO I6]
9999. REF [GO TO I6]

I6. Which of the following ranges would you say includes the cost of your typical insulation project in 2012? [READ LIST]

1. less than $2,500
2. $2,500 - $5,000
3. $5,000 - $7,500
4. $7,500 - $10,000
5. $10,000 - $12,500
6. $12,500 - $15,000
7. more than $15,000
9998. DK
9999. REF

I7. Does your firm offer any of the following pre-installation services? [RANDOMIZE a-f, g always asked last, READ LIST, MULTIPLE RESPONSES ALLOWED]

1. Yes

2. No
9998. DK
9999. REF

I8. [FOR ALL I7_*=1, ASK]: On what percentage of projects do you provide <I7_*>? [READ LIST. RANDOMIZE a-f, g is always last.]

Capture I8 % for I7_*=1

a Energy audits
b Blower door test for infiltration
c Duct leakage testing
d Combustion efficiency for heating equipment
e Refrigeration diagnostics for air conditioning equipment
f Radon test
g Other diagnostic test (Specify)

RECORD PERCENT: _____
9998. DK
9999. REF
If I7_*=2=No for all, then skip to I10

I9. Do you typically charge a fee for these services in addition to the cost of the insulation installation?
1. Yes
2. No
9998. DK
9999. REF

I10. Do you market energy-related home improvement services other than insulation and air sealing?
1. Yes [SKIP TO I12]
2. No [GO TO I11]
9998. DK [GO TO I11?]
9999. REF [GO TO I11?]

I11. [IF I10=2=NO] Why not? [OPEN ENDED, RECORD RESPONSE]

SKIP TO WH1, Whole House questions for ALL RESPONDENTS.

RECORD RESPONSE:_____

I12. Which of the following energy efficiency improvements, if any, do you install? [RANDOMIZE a-n, o always asked last, READ LIST except shaded items a-e, MULTIPLE RESPONSES ALLOWED]

1. Yes
2. No
9998. DK
9999. REF

I13. [Ask for all I12_*=1]: On what percentage of projects do you provide <I12_*>?

	I12 Yes/No/DK/Ref	I13 % for I12_*=1
a	Attic insulation	
b	Wall insulation	
c	Floor or sill insulation	
d	Air sealing	
e	Duct sealing	
f	Energy efficient windows	
g	ENERGY STAR furnace or boiler	
h	ENERGY STAR central air conditioner or heat pump	
i	Programmable thermostat or learning thermostat such as the NEST	
j	Energy efficient water heater	
k	Hot water pipe insulation	
l	Whole House Fan	
m	Photovoltaic panels	
n	Lighting controls	
o	Other (Specify)	

RECORD PERCENT: _____
9998. DK
9999. REF
If I12_*=2=No for all, then skip to I16

I14. Do you subcontract any of the services or installation work you mentioned?
1. Yes [GO TO I15]
2. No [SKIP TO I16]
9998. DK
9999. REF

I15. [If I14=Yes, Ask:]Which services did you typically subcontract? [DO NOT READ, ACCEPT MULTIPLE.]
1. Insulation and air sealing
2. Controls
3. Electrical
4. Plumbing
5. HVAC installation
6. Duct and sheet metal work
7. Carpentry
8. Other (Specify) _____
9998. DK
9999. REF

I16. You mentioned earlier that the cost of a typical Insulation ONLY project you completed in 2012 was <I5>/<I6>. What was the cost of a typical project that included products and services in addition to insulation?
[ENTER THE PRICE] $_____ [SKIP TO I18]
9998 DK [GO TO I17]
9999 REF [GO TO I17]

I17. Which of the following ranges would you say includes the cost of your typical project in 2012 that included products and services in addition to insulation? [ENTER THE PRICE OR RANGE] $_____
1. less than $2,500
2. $2,500 - $5,000
3. $5,000 - $7,500
4. $7,500 - $10,000
5. $10,000 - $12,500
6. $12,500 - $15,000
7. more than $15,000
98. DK
99. REF

I18. What year did your firm first begin providing energy efficiency services in addition to those related to insulation and air sealing?
ENTER YEAR:_____
9998 DK
9999 REF _____

I19. What was the main reason your firm decided to offer energy efficiency services in addition to those related to insulation and air sealing? [DO NOT READ. SELECT ONE ONLY]

I20. What are some of the other important reasons you decided to offer these services? [DO NOT READ. ACCEPT MULTIPLES]

Reason	I19	I20
Personal interest of the proprietor	1	1
Customers asking for energy efficiency services	2	2
Save the environment, "Right thing to do"	3	3
Promotion by local utility	4	4
Promotion by state or local government	5	5
Saw big local market	6	6
Add revenue stream for an established business	7	7
Increase revenue per project	8	8
Other (Specify)	9	9
None/No other reasons	10	10
DON'T KNOW	98	98
REFUSED	99	99

SKIP TO WH1, Whole House questions for ALL RESPONDENTS.

Renovation/Remodeling/General Contractor

Now I'd like to ask you a few questions about your remodeling projects.

G1b What percentage of your remodeling projects in 2012 involved breaching the envelope of the home to add new space or rooms?
RECORD PERCENT: _____
9998 DK
9999 REF

G2a. What was the typical cost of the remodeling projects you completed in 2012?
[RECORD RESPONSE] $_____ [SKIP TO G3]
999998. DK [GO TO G2b]
999999. REF [GO TO G2b]

G2b. Which of the following ranges would you say includes the cost of your typical remodeling project in 2012? [READ LIST]

1. less than $5,000
2. $5,000 - $10,000
3. $6,000 - $20,000
4. $20,500 - $40,000
5. $40,000 - $70,000
6. $70,000 - $100,000
7. more than $100,000

999998. DK
999999. REF

G3 What percentage of your 2012 remodeling projects involved… [READ EACH. RECORD PERCENTAGE]

a) Installation of new heating or cooling equipment
b) Installation or replacement of windows
c) Installation of new hard-wired lighting fixtures
d) Installation or addition of insulation

G4 Now, I am going to read a list of features for remodeling projects involving changes to exterior walls. Please tell me whether they were included in all, most, some, or none such remodeling projects you completed in 2012. If any of these features are not applicable to your projects, just say "does not apply". [RANDOMIZE. READ LIST]

	Measure	All	Most	Some	None	N/A
a	Attic insulation above R – 30	1	2	3	4	5
b	Wall insulation above R-13	1	2	3	4	5
c	Basement insulation above R-10	1	2	3	4	5
d	Floor (basement ceiling) insulation greater than R-19	1	2	3	4	5
e	Ceiling insulation over unheated garage above R-19	1	2	3	4	5
f	Insulation over exposed outdoor floors or overhangs, above R-19	1	2	3	4	5
g	Install new or replacement Low-e or ENERGY STAR windows	1	2	3	4	5
h	Blower door testing to detect and reduce air leakage.	1	2	3	4	5
i	ENERGY STAR high-efficiency heating and cooling equipment	1	2	3	4	5

G5 Now, I am going to read a list of features for remodeling projects involving changes to heating and cooling systems. Please tell me whether they were included in all, most, some, or none of such remodeling projects you completed in 2012. If any of these features are not applicable to your projects, just say "does not apply". [RANDOMIZE. READ LIST]

	Measure	All	Most	Some	None	N/A
a	ENERGY STAR high-efficiency heating and cooling equipment	1	2	3	4	5
b	Duct sealing	1	2	3	4	5

c	Automatically-controlled mechanical ventilation systems	1	2	3	4	5
d	Advanced controls such as fan timers, occupancy sensors, programmable thermostats	1	2	3	4	5
e	Tankless instantaneous water heaters	1	2	3	4	5

G6 Please tell me whether the following measures were included in all, most, some, or none of such remodeling projects you completed in 2012. If any of these features are not applicable to your projects, just day "does not apply"

	Measure	All	Most	Some	None	N/A
a	Solar photovoltaic systems	1	2	3	4	5
b	Hard-wired compact fluorescent or LED lighting fixtures	1	2	3	4	5

G7 Do you provide any of the following energy efficiency analysis services for your remodeling customers?

1. Yes
2. No 9998. DK
9999. REF

G8 [Ask for all G7_*=1]: What percent of projects do you provide <G7_*> ?[READ LIST, RANDOMIZE A-F, G is always last]

RECORD PERCENT: _____
9998 DK
9999 REF

	Capture G8 % if G7_*=1
A	Energy audits
B	Blower door test for infiltration
C	Duct leakage testing
D	Combustion efficiency for heating equipment
E	Refrigeration diagnostics for air conditioning equipment
F	Radon test
G	Other diagnostic test (Specify)

G9 When you develop plans for a major renovation or room addition, would you say you develop estimates of its impact on the home's energy use and energy costs……[READ LIST, SINGLE RESPONSE]

1. For all or most projects

2. For some projects
3. For relatively few projects
4. Never
9998 DK
9999 REF

G10 In your opinion, what are some benefits to homeowners of including energy-efficient features?
[DO NOT READ. ACCEPT MULTIPLE RESPONSES. PROBE FOR OTHERS IF ONLY COST SAVINGS ARE MENTIONED.]
1. Reduce energy costs, costs of ownership
2. Greater comfort
3. Feel good about making the right environmental choice
4. Higher resale value for the house
5. Lower long-term maintenance costs
6. Longer useful life for components
7. Other (Specify) _____
8. No benefits mentioned

9998 DK
9999 REF

[IF G10 = 1 – 7, ASK G11. ELSE SKIP TO WH1.]

G11 Do you discuss these benefits with the homeowner…
1. For all or most projects
2. For some projects
3. For relatively few projects
4. Never
9998 DK
9999 REF

For All Respondents: Understanding of Whole House Retrofit

WH1. We may have already discussed this, but just to confirm, are you aware of whole house retrofit concepts for energy efficiency?
1. Yes [GO TO WH2]
2. No [SKIP TO WH4]
9998 DK [SKIP TO WH4]
9999 REF [SKIP TO WH4]

WH2. How would you describe those concepts?
RECORD VERBATIM: _____

WH3. How did you hear about whole house retrofit concepts? [DO NOT READ. ACCEPT MULTIPLES.]

1. From other contractors, competitors
2. From customers
3. From trade organizations
4. From trade publications
5. From local utility or utility program
6. From state or local government agencies
7. From vocational school or junior college
8. From general press
9. Word of mouth
10. Other (Specify) _____
11. DK
12. REF

WH4. For purposes of this interview we define "Whole House Retrofit" as a holistic approach to making homes healthier, safer, more affordable, durable, comfortable, and energy efficient through application of building science and best practices in construction.

Do you think it would be worthwhile for your firm to invest in developing the capability to deliver whole house retrofit services?

1. Yes ☐ [GO TO WH5]
2. No ☐ [GO TO WH5]
3. Maybe/Undecided ☐ [GO TO WH5]
4. Already provide ☐ [GO TO WH9]

9998 DK
9999 REF

WH5. [IF WH4 = 1, 2, 3 ASK:] Why do you say that? [OPEN ENDED. RECORD RESPONSE]

WH6. DELETED

WH7. [IF WH4=3 or DK ASK] What additional information would you need to assess such an investment? [OPEN ENDED. RECORD RESPONSE]

WH8. IF WH4=1 or 3 or DK] Do you think you could market and deliver this kind of service with current employees?

1. Yes
2. No
3.
4. Maybe
9998 DK
9999 REF

WH9. Many organizations around the country offer programs that provide financial incentives to homeowners for whole house retrofits and related services such as energy audits, as well as technical and marketing support for contractors who offer those services. Are you aware of any such programs that operate in your market area?

1. Yes ☐ GO TO WH10
2. No ☐ T&T
3. DK ☐ T&T
4. REF ☐ T&T

WH10. What type of organization or organizations offer such programs?[READ LIST, ACCEPT MULTIPLE]

a. Utility
b. State or local government agency
c. Non-profit organization
d. Community college or vocational school
e. Banks/Financial Institutions
f. Other (Specify) _____

1. Yes
2. No
9998 DK
9999 REF

WH11. Has your firm completed any projects with the assistance of any such programs?
1. Yes ☐ GO TO P1
2. No ☐ T&T
3. DK ☐ T&T
4. REF ☐ T&T

[IF WH11=1=Yes=PARTICIPATE, ASK P* series. IF NOT, T&T]

Program Participation

P1. How long has your organization participated in programs that provide assistance for whole house retrofits? [OPEN END. RECORD RESPONSE IN YEARS]

RECORD # of YEARS: _____
9998. DK
9999. REF

P2. [IF P1 GREATER THAN 0]How many energy audits did you complete through the program in 2012?[OPEN END, RECORD NUMBER] [If required: Your best guess is fine]

RECORD # of energy audits: _____
9998. DK
9999. REF

P3. [IF P1 GREATER THAN 0]How many Whole House retrofit projects did you complete through the program in 2012? ?[OPEN END, RECORD NUMBER] [If required: Your best guess is fine]

RECORD # of retrofit projects: _____
9998. DK
9999. REF

P4. [IF P3=DK/Ref, Ask:] Is the number of whole house projects your firm completed in the following ranges?
1. 0-5
2. 6-10
3. 11-25
4. 25-50
5. More than 50[ENTER NUMBER]
9998. DK
9999. REF

P5. On a scale of 1 to 5, where 1 is “not at all important” and 5 is “very important”, how important is the information provided in the audits in convincing customers to install qualifying measures?
ENTER SCORE 1 – 5: _____
98 DK
99 REF

P6. Did the program offer financial incentives to customers?
1. Yes ☐ ASK P7
2. No ☐ SKIP TO P10
98. DK ☐ SKIP TO P10
99. REF ☐ SKIP TO P10

P7. Which of the following kinds of financial incentives did the program offer? [READ RESPONSES. ACCEPT MULTIPLES]
a. Cash rebate for completed installations
b. Loans directly from the program sponsor
c. Loans from banks
d. Guarantees for loans from banks
e. Other: Specify _____

1. Yes
2. No
9998. DK
9999. REF

P8. [IF P7b or P7c= 1, ASK:] Do those loans receive an interest subsidy?

1 Yes
2 No
9998 DK
9999 REF

P9. On a scale of 1 to 5, where 1 is “not at all important” and 5 is “very important” how important was the availability of financing in convincing customers to install qualifying measures?

ENTER SCORE 1 – 5
9998 DK
9999 REF

P10. What was the main reason you decided to participate in the program? [DO NOT READ. ACCEPT ONE ONLY.]

P11. Were there other important reasons? [DO NOT READ. ACCEPT MULTIPLES.]

a) Customers were requesting the services 1 1

b)		Use program incentives to support investment in a new business line	2	2
c)		Use program incentives to support investment in expanding an existing business line	3	3
d)		Energy efficiency is closely related to my existing business	4	4
e)		Profitability of initial business was declining	5	5
f)		Increase the average size of projects	6	6
g)		Help the environment/right thing to do, etc.	7	7
h)		Other: Specify	97	97
i)		DK	9998	9998
j)		REF	9999	9999

P12. On a scale of 1 to 5 where 1 means "not at all likely" and 5 means "very likely", How likely would you be to continue to offer whole house retrofit and related home performance services if this program were to end?

ENTER SCORE 1 – 5
9998 DK
9999 REF

T&T

That's all the questions that I have for you. Thank you so much for your time and information.

Questions to be inserted when interviewer completes interview with eligible respondents and in the spot where they ask for respondents' first name.

Remove respname
Add question

VERIF: To ensure we have the correct name and address in our records so that we can send you the $50 gift card as a thank you for participating in the study can you confirm the information I have listed

INTERVIEWER READ EACH CATEGORY AND SPELL OUT THE NAME AND ADDRESS TO CONFIRM INFORMATION

Name: [pull from sample]
Address: [pull from sample]

1 – Name Incorrect

2 - Address Incorrect

If punch 1 selected in VERIF ask VERIF1

VERIF1 May I please have your first and last name?

VERIF1a – First name _____
VERF1b – Last Name _____

If punch 2 selected in VERIF ask VERIF2a-VERIF2

VERIF2a What is your street address? _____
VERIF2b City? _____
VERIF2c State?

T&T

That's all the questions that I have for you. Thank you so much for your time and information.