California Retrofit Home Performance Program, Phase 2 – 2004-2005, Final Evaluation Report

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Main Report and Appendices

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1 Evaluation Design, Goals and Methods

This evaluation report considers program implementation and program effects of the 2004-2005 California Retrofit Home Performance (HP) Program, conducted by the California Building Performance Contractors Association (CBPCA). It is almost entirely a *process evaluation*. As an "information only" program, the HP program did not have any explicit resource acquisition goals. It was however, an innovative effort that went beyond merely "informing" its clientele. The program was an attempt to build new capacities into market systems that would *transform* residential retrofit markets in Northern California in significant ways—creating home performance contracting choices for consumers by training and mentoring a corps of contractors who approach retrofits with a building science orientation and set of skills and tools. While we do analyze some of the program's likely energy savings impacts to date and in the future, as a *process evaluation* report, this document is primarily intended to provide a detailed assessment of the program's aims and assumptions, activities, and effects within its target market segments (i.e., Northern California contractors and homeowners).

1.1 Program Background

The CBPCA Home Performance Program was first funded by the California Public Utilities Commission (CPUC) as an innovative "third-party" "information only" program for the 2002-2003 funding cycle. However, funding and approval delays meant that the initial program start-up did not begin until late 2002 and early 2003, with most of the program activity (and nearly all of the evaluation work) compressed into the latter part of 2003. By the time the final evaluation report was being drafted in 2004, the CBPCA and the evaluators were informed that the CPUC had agreed to fund a somewhat expanded second phase of the program for 2004-2005. So rather than documenting the rapid rise and demise of a very short program in the Phase 1 report, we took this opportunity to evaluate a work in progress and provide a number of recommendations to the CBPCA and the CPUC for program changes and improvements in Phase 2.

Because this was Phase 2 of the earlier program, it is impossible to understand the most recent evaluation results in isolation from an understanding of the program's start-up phase. So at several points in this report we provide background information from the Phase 1 evaluation, so that readers can understand the experience and evolution of the program from its inception, without a having to consult a separate document. We believe that this is important because of a growing interest in home performance programs, both by policy makers and businesses.

Because the HP Program has strong market connections and significant market transformation goals, we also include a fair amount of information about baseline markets for residential real estate retrofit services in the CBPCA program's California target geographies. And because it is necessary to evaluate the strengths and weakness of this *California approach* to home performance contracting in a larger context, we also

include information in the concluding chapter about emerging home performance programs in other states.

This report first provides information on our data collection and analysis methods. We then discuss baseline conditions in target markets and market actor segments. We discuss present information from several salient literatures and discuss the CBPCA's HP program theory and program design. We assess program implementation in five areas: market development, training and mentoring, information and reporting, coordination, and changes made in program implementation over the course of the program. We assess program effects in five areas: retrofit jobs completed, contractor knowledge and practice, homeowner benefits, market effects, and energy savings impacts. In the final chapter, we present our conclusions and offer a series of recommendations for the CBPCA and CPUC (and program planners elsewhere in the U.S.) to take into account when implementing similar programs in the future.[1]

1.2 Evaluation Plan, Data Collection & Analysis

In this section we discuss data sources for the evaluation, details of sampling, surveying and interviewing for primary data collection, and subsequent analytic strategies and feedback from evaluation results in-progress to program implementers.

The Phase 2 Evaluation Plan (CBPCA 2003) identified a number of key questions related to training, contracting, marketing, consumer response, baseline market conditions, and program impacts (included as Appendix A). These questions informed our data collection efforts and provided guidance for our subsequent analysis. In Phase 1, detailed interviews were conducted with small samples of contractors and customers. The Phase 2 Evaluation Plan anticipated continued data collection from both of these groups, as well as collecting program records/contractor reports, and interviewing program staff/subcontractors throughout the period of implementation, from April 2004 through December 2005.

1.2.1 Methodology and Data Sources

A variety of qualitative and quantitative social science and evaluation research methods were used, as appropriate, to support as thorough a process evaluation as possible. Data sources included documents, public and private databases, in-depth interviews (with program participants, implementers and market actors), and surveys of homeowners who had been customers of home performance services and allied products.

[1] A Consortium for Energy Efficiency (CEE) report on home performance contracting programs in the U.S. concludes that would-be sponsors and implementers are faced with several "significant challenges," that include: (1) lack of training and service delivery infrastructure, (2) lack of industry/government consensus on performance testing protocols, (3) not cost-effective in start-up years, and (4) lack of detailed evaluation. In terms of the latter, CEE concludes: "Useful multiyear evaluations of early programs using the ENERGY STAR model are only just coming out, and only a few of these currently exist. … the general lack of evaluation makes it difficult to learn from past programs experience and to understand how managers overcame the challenges discussed above." (CEE 2005)

For the baseline analyses (chapter 2), market information was gathered from a number of sources. These included the Qwest business directory listings for Northern California cities, the U.S. Census of Population, and the California Residential Appliance Saturation Survey (RASS), industry publications and websites, and academic library databases (e.g., ProQuest and LexisNexis™ used for searches of the trade press and popular periodicals). All are discussed in greater detail in the following chapter.

To understand the program design, program theory, and implementation (and changes in these over time), we collected and reviewed all available program-related data. Official program documents were also an important source of information. These included: the original HP Program proposal to the CPUC, the Program Implementation Plan (and revisions), quarterly program reports, website information, recruitment and training materials, etc. Products developed for marketing were also collected, including flyers, advertisements, and newspaper articles. We obtained the most complete information available from the program's Management Information System (MIS) on participating contractors and homeowners (including names/locations, dwelling size, retrofits completed, cost, and estimated energy savings).

As anticipated in the Evaluation Plan, it was also necessary to collect a significant amount of primary data from program participants. This was accomplished through a combination of in-depth interviews with contractors, as well as several waves of detailed surveys completed by homeowners. We contacted and interviewed nearly all of the contractors who were reported as actively pursuing home performance goals in their businesses in 2005. We completed a detailed mail survey of a reasonably large sample (for a small program) of home performance customers. We have interviewed the CBPCA implementers on several occasions and maintained continuous communication with them throughout the course of the program. In addition, we have drawn on government, academic and industry sources of information in order to assess the CBPCA program performance from a comparative perspective—i.e., in the light of market conditions and trends in California and elsewhere in the U.S.

Throughout this report the evaluators use the term "active contractor" in slightly different senses as we focus on the different programmatic stages that contractors are expected to move through.

- Training: contractors participating in training at that time are considered "active" as trainees.
- Mentoring: post-training contractors who are soliciting and receiving field support are "active" in their pursuit of home performance practices.
- Applying training to business: contractors that reported to the CBPCA (or to evaluators) that they were applying building science techniques post-training and mentoring in their business practices are considered "active" at this stage.
- Reporting jobs: contractors that reported home performance jobs to the CBPCA are considered "active" in terms of reporting.

Since the evaluators examined training records, mentoring records, and reporting records at different points in time, and interviewed contractors in several waves throughout the Phase 2 implementation, different numbers (or sets) of contractors are considered "active" in our records at different points in time. Because of this complexity, the count of "active" contractors varies somewhat in different sections in the evaluation report—depending on the process or stage being discussed. The most salient count of "active" contractors is the one reported for the end of the Phase 2 program period, in December 2005. At that time, thirty-two contractors were considered "active" by the CBPCA according to the criteria noted above.

1.2.2 Contractor Interviews

Over the course 2004-2005, the CBPCA supplied the evaluators with information about 65 contractors[2] who had participated in home performance training and with whom the Association had maintained subsequent contact. This included both contractors who were actively utilizing home performance contracting methods or are planning to do so in the near future, as well as contractors who were not active and had no plans to pursue HP contracting. It included a mix of contractor types (e.g., HVAC contractors, remodelers/builders, installers of insulation, windows, etc.) and of contractor firm sizes (e.g., from sole proprietors to companies with 50+ employees).

A series of detailed contractor telephone interviews were conducted. These built upon a comprehensive interview protocol developed in Phase 1 and covered a wide range of topics, from the characteristics of the contractor firm, training and mentoring, business practices, and interactions with customers, to challenges in implementing HP contracting, their views of marketing materials, strategies and messages, suggestions for how the CBPCA program could be improved, and perceptions of market conditions. The contractor interview guide was thoroughly reviewed by CBPCA and modified as a result of that review. It is included as Appendix B. The modified interview guides were then tested and appropriate wording and question placement adjustments made. Modest refinements were also introduced during the data collection process to improve the quality of information being obtained.

Telephone contact was made with prospective interviewees and appointments for phone interviews were arranged. As noted, the interview guides were extensive and allowed for semi-structured interviews—in which both interviewer and interviewee were able to stray from the script as needed to tell a complete story. On average, the interviews took 20-25 minutes (longer for some). Where it was agreeable to the interviewees, tape recordings of the interviews were made to capture answers precisely in their own words. If taping was not agreed to, the interviewer took detailed notes.

Interviewing took place throughout the program cycle in an effort to capture information about contractor attitudes and behavior (1) within different subgroups, (2) at different

[2] For the purposes of this evaluation the term "contractor" refers to a unique count of the businesses, sole-proprietors, or individuals that attended training (either or both types of training offered). Based on lists provided by the CBPCA, 65 unique contractors were identified – 57 from Phase 2, and 8 continuing from Phase 1.

points in their maturation in the business, and (3) at different points in the program's evolution (as refinements were made in contractor recruitment, training and support activities). Twenty-two interviews with active contractors were conducted—eighteen were interviewed between April 2004 and August 2005 and four (who had completed training very late in the program cycle) were interviewed in June 2006. [3] These contractors were all full participants in the program, having completed at least six days of training (and some had actually taken the sequence of courses twice).

We attempted to interview an additional five active and ten partially active or inactive contractors. Because contractors are usually very busy and are often extremely difficult to contact, considerable time and effort was devoted to securing either an interview or a refusal in each case. Some required a number of contact attempts to resolve. We learned that two trainees were no longer with their firms and the balance was non-responsive. Among active contractors, we achieved an 81% cooperation rate.

Interviews were conducted across a range of industry sub-sectors. As shown in Table 1 below, roughly half of the firms that we interviewed were HVAC contractors. In Phase 1 the HVAC/mechanical/electrical contractors were clearly the most active. However, in Phase 2, the addition of a number of active remodeler/builder contractors (with two of these being larger firms that sent several employees to training sessions) provided a wider range of contractor experiences and perspectives.

Table 1. Contractor Interviews by Firm Type

Firm Type	Interviewed	Attempted to Interview
Consultant		1
HVAC	13	5
Mold remediation / HP	1	
Rater	2	2
Remodeler / Builder	6	6
Weatherization / HP		1
Total	22	15

All interviews were tape recorded and transcribed. To facilitate analyses, questions and responses were entered into a database. In the analysis process, contractor responses and response patterns were examined and categorized. Typical of qualitative approaches—the most appropriate for this sort of evaluation, given both the lack of knowledge of the phenomena/processes of interest and the small sample of responses—an analytic process was used that focused on *variations* across cases and *similarities* in sets of accounts. Significant themes were identified, different levels of participation were considered, interviewees' experiences and explanations were compared, barriers were noted, and firm characteristics were considered. As reported in the following sections, we were able to

[3] The active status was defined by the CBPCA from routine contact with their trainees.

identify different firm types, motivations, and outcomes in this analysis. Excerpts from interviews are provided throughout when they are particularly insightful or illustrative.

1.2.3 Consumer Survey

To support primary data collection, samples of customers were drawn from CBPCA's MIS records. Sampling took place at several points in time as new customer information became available to us.

In total, the evaluators received 291 customer names with and addresses.[4] Because four HVAC customers were being reported for every one remodeler/builder customer, 106 HVAC customers (36% of our customer base) were randomly excluded from sampling.[5] However, an effort was made to contact *all* of the remodeler/builder customers (53, or 18 % of our customer base). Since the remodeler/builder customers responded at a somewhat higher rate than the HVAC customers (43% vs. 39%) the final set of respondents (74) included 31% remodeler/builder and 69% HVAC customers.

According to customer reports, some of the HVAC contractors also installed additional HP measures such as air sealing or replacement windows. As a result, the evaluators were able to survey a large proportion (46% of those who purchased retrofits) of customers who received fairly extensive home performance services.

The customer surveys built upon interview guides developed in Phase 1. Those interview protocols were quite comprehensive and allowed respondents to report a wide range of HP diagnosis and retrofit experiences and decisions—many in their own words. The evaluators began to develop a Phase 2 mail survey instrument by first reviewing both our own Phase 1 open-ended interview results and a survey designed for use by the Wisconsin Home Performance Program evaluation team. We included a number of new items in order to more carefully measure variables related to program performance and consumer decision-making (e.g., regarding levels of retrofit selected and motivations for purchasing home performance services and products). The resulting draft survey instrument was reviewed by CBPCA and the results of that review and a thorough pre-test were used to refine the final instrument (included as Appendix C).

The final instrument contained 27 questions and was divided into three main parts. The first section of the survey concentrated on the home inspection process, the second focused on the home improvements completed, and the third collected information on household demographics.

Four rounds of surveys were conducted. The first three were mail surveys while the fourth was conducted over the phone (using the same instrument). The first survey took place in November and December 2004, the second in May and June 2005, the third in December 2005 and January 2006, and the fourth was completed in January 2006. A total of 74 surveys were completed over all four waves, the

[4] The total MIS database contained 299 customers, however not all had complete address information.
[5] The excluded customers were reported by one contractor primarily reporting HVAC change-outs and duct sealing–jobs that were already well represented in our sample.

total response rate of 41% was quite good for a fairly long and involved survey instrument. A profile of the consumer sample is described in Chapter 5.

1.2.4 Feedback to Implementers from Evaluation Work in Progress

Mid-cycle feedback was provided to the CBPCA in order to allow the association to better plan and manage program activities. Because contractors, consumers and others are often very forthcoming in their communications with third party evaluators, interim feedback can provide important (albeit preliminary) information that might not otherwise be available to program operators, allowing mid-course program adjustments.

Informal/Verbal Feedback The evaluators maintained a consistent, arm's length, relationship with the program administration and staff. Program staff supplied MIS data on a monthly basis, and email exchanges and telephone conferences were conducted regularly. The advantage of informal feedback is that it can be immediate and honest. These exchanges are valuable for both evaluators and implementers. But they represent a snapshot of concerns or observations at a specific point in time within a program cycle. Therefore, provision for more formal, written feedback was included in the Evaluation Plan to ensure that developments and trends beyond snapshot observations were more thoroughly examined.

Formal Feedback The evaluators supplied the CBPCA with two "formal" written feedback reports—one in May 2005 and the other in Aug 2005. Both were based on preliminary customer and contractor survey results (e.g., April 2004 through August 2005 interviews). These reports were responsive to the implementer's interest in particular topics but they also reported observations and questions that the evaluators saw as particularly important. The reports were discussed with the CBPCA and their feedback to the evaluators also helped considerably to improve our understanding of program dynamics and our subsequent evaluation work. Throughout, it was important to maintain appropriate protections of customer and contractor confidentiality. For example, in cases where customers asked (checked a box on their questionnaire) for additional program information, the evaluation team did supply the CBPCA with customer contact information. However in the one case of a customer complaint, the evaluators notified the CBPCA of the nature of the complaint, while maintaining the customer's confidentiality at their request.

2 Baseline Conditions

Given the HP Program aims of initiating a transformation of the residential retrofit market, the baseline conditions of interest include: (1) current market characteristics, (2) residential energy efficiency retrofit potentials, and (3) consumer and contractor awareness of home performance problems, solutions, benefits, and business opportunities. In this chapter, we provide baseline information in these topic areas.

2.1 Demographic and Environmental Characteristics

According to the Phase 2 CBPCA proposal:

> "The principal geographic area targeted by the proposed CBPCA program is the PG&E portion of the greater Central Valley, an underserved high-cooling climate area. The valley area is to be extended both south and north of the current program's Fresno area territory. Major targets of this valley expansion are Stockton-Lodi, Merced, Davis-Willows and Redding urban areas. … A secondary geographic area to be served is the present program's greater San Jose-Peninsula area." (CBPCA 2003)

In addition to the Fresno and San Jose areas (targeted in Phase 1), the CBPCA proposed to add 4 new areas in Phase 2: Stockton, Merced, Davis, and Redding. Table 2 shows some of the most relevant population and housing statistics for Fresno (Fresno County), San Jose (Santa Clara County), Stockton (San Joaquin County), and Merced (Merced County), Davis (Yolo County), and Redding (Shasta County). While the population of San Jose is by far the largest, its growth rate is much lower than other target areas. Also its income and education levels are much higher. The differences in average housing values between the six locales are striking. We might assume that San Jose residents would have greater resources to spend on housing retrofits. However, energy costs might also be expected to represent a higher percentage of incomes in all areas relative to San Jose (see income and weather data below).

Although income, educational levels and the value of owner-occupied homes are significantly higher in Yolo County (and much higher in the city of Davis) than in the Stockton, Merced and Redding areas, the number of rental or multi-unit dwellings is also higher in Davis. The transient nature of the population in Davis, a university town, is reflected in the relatively low percentage of owner-occupied units and those continuously occupied from the period 1995-2000. Connected to this is the high number of rentals (multi-unit dwellings) for the area.

Table 2. Social and Demographic Characteristics of Target Areas[6]

	Fresno (Fresno County)	San Jose (Santa Clara County)	Stockton (San Joaquin County)	Merced (Merced County)	Davis (Yolo County)	Redding (Shasta County)
Population est. 2003-2005	877,584	1,699,052	271,466 (2003)	241,706 (2005)	184,932 (2005)	179,904 (2005)
Pop. growth 2000-2005	9.8%	1.0%	11.4% (2000-03)	14.8%	9.6%	10.2%
Caucasian (White)	81.4%	64.0%	43.3% (2000)	85.3% (2004)	81.5% (2004)	90.9% (2004)
Living in same house 1995 & 2000	51.0%	51.2%	48.5%	50.5%	41.8%	50.0%
Have BA/BS degree, 2000	17.5%	40.5%	15.4%	11.0%	34.1%	16.6%
Number of housing units	286,072	600,685	82,042	75,110	67,039	73,250
Units in multi-unit structures	26.6%	31.6%	NA	18.4% (2000)	31.0% (2000)	15.4% (2000)
Ownership Rate	56.5%	59.8%	51.6%	58.7%	53.1%	66.1%
Median value of owner-occupied units, 1999	$104,900	$446,400	$119,500	$111,100	$169,800 (2000)	$120,800 (2000)
Median household income, 2003	$35,952	$68,167	$35,453 (1999)	$36,709	$43,491	$36,418

Table 3 shows the differences in environmental conditions faced in the six locales (using city-level data, which are the most commonly reported). Average annual temperatures are quite similar, although heating degree-days are highest in Davis, followed by Stockton. On the other hand, cooling degree-days are considerably higher in Fresno and Redding than in San Jose. We might expect that the combination of greater heating and cooling, as seen in Fresno, Redding, and Merced, would mean that these areas would benefit more from (and perhaps be more receptive to) energy efficiency retrofits than areas with more temperate weather conditions. In addition, the higher population growth rates for Merced, Stockton and Redding suggest that there are opportunities for new Energy Star homes, which might raise the visibility of energy efficiency potentials for owners of existing homes.

[6] Source: U.S. Bureau of the Census (2006).

Table 3. Environmental Conditions[7]

Normal Climate Conditions	Fresno	San Jose	Stockton	Merced	Davis	Redding
Mean temperature	63.3	61.3	61.5	62.0	60.2	62.0
Heating Degree Days	2492	2171	2634	2583	2814	2855
Cooling Degree Days	1967	587	1381	1515	1090	1797
Precipitation	10.90	14.66	14.00	12.44	17.40	33.3

2.2 Residential Retrofit Infrastructures

Table 4 reports information on the home retrofit infrastructures in the target locales. These data were acquired from commercial directories of businesses that offer consumers various home improvement and housing-related services. Since the searches that located these contractors took in large market areas, it is difficult to know exactly what geographies are involved when comparisons are made. For example, Davis is a relatively small city that could not physically accommodate 900+ general contracting firms. However, the market area from which business directories, such as the Davis yellow pages, draw is much larger—encompassing all of Yolo County and much of Sacramento.

The key finding is that there is a significant amount of residence-focused business activity that involves contractors and ancillary services in all of the target locales. When they are all considered together, the volume of work taking place must be considerable. Also there is a substantial contractor pool from which to draw for home performance training and support. In addition, there seems to be a large volume of "do-it-yourself" renovation, repair and remodeling activity routinely taking place in these markets, as evidenced by the large numbers of building materials and home appliances retailers. Therefore, we should expect that there is also a fairly large pool of consumers who are involved in repair, remodeling, equipment replacement, and retrofits that could benefit from home performance services.

[7] Source: Western Regional Climate Center (2006).

Table 4. Numbers of Residential Market Actors in Target Locales (Cities + Surrounding Areas)[8]

Contractor/Services Types	Fresno area	San Jose area	Stockton area	Merced area	Davis area	Redding area
Contractors general "building contractors"	649	575	953	1020	950	635
Contractors remodel & repair: "remodeling contractors" + "remodeling and repairing"	89	173	303	234	326	155
Air conditioning contractors & systems	149	220	117	65	60	116
Air conditioning equipment & systems – repairing	48	106	75	64	79	25
Air conditioning equipment - servicing	5	20	17	21	23	39
Heating contractors & specialties	15	29	26	25	32	33
Insulation contractors	43	64	43	41	45	27
Electrical contractors	281	909	464	490	451	350
Windows (excl hardware & manufacturing	252	505	220	195	293	143
Ducts "ventilating contractors" + "ventilating equipment"	17	122	66	69	75	52
Building materials & hardware: "building materials/hardware;" "hardware: retail, wholesale or manufacture"	198	149	309	354	117	380
Appliances	143	315	177	163	176	149
Solar products & services-retail	28	192	180	166	157	144
Energy conservation products & services	11	20	5	NA	16	13
Home inspection	62	47	125	100	83	93
Realtors	250	530	491	518	266	209
Real estate appraisers	132	379	227	228	204	193

[8] Source: Qwest Business Directory (2006) – City plus expanded search area.

2.3 Residential Energy Efficiency Retrofit Potentials

It would be useful to estimate the size of the potential market for energy efficiency retrofits in the target markets, taking into account factors such as housing condition, HVAC equipment age/condition, financial means of homeowners, etc.

Baseline data on appliance and HVAC equipment sales (one indicator of market size, and we would assume correlated with numbers of contractors and vendors identified above) are, for the most part, proprietary and closely held by manufacturers, distributors and retailers for competitive business purposes. However, we can find data on equipment and appliance markets in survey results from the California Energy Commission's *Consortium Residential Appliance Saturation And Unit Energy Consumption Study* (RASS). These data are from a 2003 study conducted in the areas covered by the investor-owned utilities in California.[9] They provide good indications of the size of selected appliance markets.

We should first note that there are five CEC energy demand-forecasting zones in the PG&E territory, with a total customer base of over 4.25 million households (estimated number of accounts in 2003).[10] Since the CBPCA's target markets in Phase 2 are located in zones 2, 3 and 4 (Yolo county in Zone 2, Shasta, San Joaquin, Merced, and Fresno counties in Zone 3, and Santa Clara county in Zone 4), it was convenient to produce the following tables for the entire PG&E territory. As seen in Table 5, Zone 1 is quite small relative to the others, so no special effort was made to exclude it from the analysis.

Table 5. Numbers of Selected Customer Accounts by CEC Forecast Climate Zone in PG&E Territory, 2003
(Owners, Individually Metered, Detached/Duplex/Row Houses)

Zone	Electric + Gas Customers	%	Electricity Customers	%
1	43,602	2%	205,952	8%
2	168,584	8%	202,566	8%
3	319,693	16%	486,183	19%
4	905,117	44%	1,061,389	41%
5	623,883	30%	664,566	25%
	2,060,879		2,620,656	

Source: RASS 2004.

The population of California households is made up of a wide variety of types that can analytically be combined or segmented in various ways. For example there are homes

[9] Pacific Gas and Electric (PG&E), San Diego Gas and Electric (SDG&E), Southern California Edison (SCE), Southern California Gas Company (SoCalGas), and Los Angeles Department of Water and Power (LADWP). The study results can be found at CEC (2004).
[10] The forecasting zones are defined on the basis of weather conditions, for example, heating and cooling degree-day differences across the state.

with owner and renter occupants, individually and master metered buildings, attached and detached units, and so on. Also, each type tends to have somewhat different arrays of major and minor appliances, as well as different sorts of occupants (in socio-demographic terms).

As a result, we know that not all households have the same probability of undertaking a remodeling or retrofit job, or of replacing a major appliance, at any given time. In any given year, only a small minority will, and, in fact, some households are quite unlikely to do so under any circumstances. So by limiting the discussion to selected housing and population segments, we hope to present a realistic picture of the market potential for various retrofits and housing upgrades in the PG&E territory.

Using RASS definitions, we start with a subset of households most likely to be interested in home performance. Very simply, they are households who are:

- Owner-occupied (responsible for house)
- Individually metered (the household pays for its own energy use)
- Single-family detached, town/row houses, or duplexes (excluding apartments and condos and mobile homes)

In the PG&E territory, 62% of all housing units (2,620,656) were owner-occupied and individually metered at the time of the RASS study. By further excluding from our study group units that are difficult to retrofit (condos, apartments, mobile homes), the remaining target households represent just over 48% of all PG&E residential customers).[11]

Table 6. Existing HVAC Equipment - PG&E
(Owner-occupied households)

Major Appliance	Households	%
Central AC	831,031	40%
Central Evaporative Cooler	31,114	2%
Room AC only	158,941	8%
Multiple AC systems	149,413	7%
No AC	901,648	44%
Natural Gas (Primary Heat)	1,700,414	82%
Electricity or Propane (Primary heat)	282,114	14%
Other (wood, solar, etc.)	97,582	5%

[11] In the following section, it should be noted that when cross-tabulations are presented, the base numbers change somewhat depending on the response rate and the applicability of the questions (e.g., not everyone has an air conditioner, etc.)

As seen in Table 6 above, 44% of our target subgroup does *not* have air conditioning. Those who do typically have a central air conditioner, while almost none own a central evaporative cooler. Almost all households heat their homes with natural gas.

To better define the potential market for home performance contracting related to HVAC, information regarding the age of the major appliance stocks is essential—older equipment is more likely to be replaced than newer equipment. The average life span of household major appliances ranges from 11 to 20 years according to a recent PG&E consumer information appliance fact sheet (PG&E 2006). For example, the average expected life of an air conditioner is 15 years, while a heat pump has a somewhat shorter expected life span (approximately 10 to 12 years), since they tend to be operated year round (Trane 2006). These estimates are shown in Table 7.

Table 7. Appliance Average Life Expectancy

	Years
Refrigerator	20
Dishwasher	11
Dryer, electric	18
Dryer, gas	18
Freezer	16
Microwave	10
Range, gas or electric	20
Washer, automatic	20
Water Heater, electric or gas	15
Central Air Conditioner	15
Heat Pump	12

In terms of the age of HVAC systems in our target market segment, the RASS data suggest that about 50% of the main central air conditioners (and a similar percentage of the first room air conditioners reported) are 9 years and older (449K and 117K respectively), in that group, while 43% of main heaters are 14 years and older (838K)—see Table 8.

The major appliances in the 14+ years category are clearly the most likely targets for replacement. Do these households with older equipment represent our best estimate of a realistic HP target market? Perhaps not. Other factors such as household income (which limits the capacity of the household to undertake retrofit or remodeling projects) and the year the house was built should also be considered. The age of the house is not an important factor when estimating the target market for HVAC retrofits, but it is a major factor for estimating the potential market for shell upgrades (wall and ceiling insulation in particular).

Table 8. Existing HVAC Equipment by Age of Unit [12]
(Owner-occupied households)

	Main Central AC	%	Room AC (#1)	%	Main heater (gas)	%
LT 1 Yr	43,902	5%	20,961	8%	68,244	3%
1-3 Yrs	203,934	21%	54,311	22%	293,615	15%
4-8 Yrs	235,047	25%	56,071	23%	380,598	19%
9-13 Yrs	218,768	23%	40,564	16%	380,749	19%
14 + Yrs	252,689	26%	76,931	31%	838,613	43%
Totals	954,340	100%	248,838	100%	1,961,819	100%

Three examples of the value of additional segmentation are displayed in Tables 9-11 below. They reveal the potential impact of household income on our estimates of the size of HVAC retrofit target market in the PG&E territory. In all three tables, the most likely target groups are highlighted. These are identified on the basis of income and age of unit or level of insulation.[13]

Table 9. Age of Main Heating System by Income

	< $35K	Col %	$35-75K	Col %	$75K+	Col %	Total	
LT 1-3 Yrs	37,848	11%	121,584	23%	136,557	18%	295,989	18%
4-8 Yrs	66,963	19%	86,283	16%	168,589	22%	321,835	20%
9-13 Yrs	61,803	17%	78,010	15%	182,518	24%	322,331	20%
14+ Yrs	191,111	53%	246,467	46%	271,584	36%	709,162	43%
	357,725	100%	532,344	100%	759,248	100%	1,649,317	100%

Table 10. Age of Main Air Conditioner by Income

	< $35K	Col %	$35-75K	Col %	$75K+	Col %	Total	
LT 1-3 Yrs	29,369	21%	73,899	27%	99,357	26%	202,625	26%
4-8 Yrs	38,263	28%	59,327	22%	99,238	26%	196,828	25%
9-13 Yrs	26,723	19%	53,783	20%	96,814	25%	177,320	23%
14+ Yrs	42,836	31%	83,731	31%	84,691	22%	211,258	27%
	137,191	100%	270,740	100%	380,100	100%	788,031	100%

The last table in this section displays "inches of insulation" cross-sectioned by income groups. For some types of retrofits, knowing the age of the home may provide a useful layer of detail for market estimations. For example, we split insulation levels by general age of the home—"Pre-1997" and "1997-2003," categories pre-defined by the RASS developers. The results reveal that for our study group of single-family and town homes (including row houses and duplexes), virtually none of the newer homes were reported to

[12] Source: RASS.

[13] Appliance rebates and financing may have an impact on the motivations of some lower income groups that are not highlighted. However, at the time of this report, there were no air conditioner or furnace rebates offered by PG&E.

have only 0-3 inches of insulation. At the same time, 344,495 homes in the older group (almost 19%) have 0-3 inches of attic insulation.

Table 11. Inches of Attic Insulation by Income

	< $35K	Col %	$35-75K	Col %	$75K+	Col %	Total	
0-3 Inches	93,346	37%	91,849	22%	117,431	20%	302,626	24%
4-6 Inches	117,322	46%	238,711	58%	314,058	53%	670,091	53%
7-10 Inches	34,164	13%	60,896	15%	128,162	22%	223,222	18%
10 + Inches	8,802	3%	23,295	6%	32,763	6%	64,860	5%
	253,634	100%	414,751	100%	592,414	100%	1,260,799	100%

What can we conclude from our analysis of RASS data? Simply that the potential target market, while quite large in absolute terms (i.e., many tens and hundreds of thousands of households), is a minority of all households. Depending on the retrofits under consideration, it may be as little as 10-20% of the total customer population at any give time. Of course, as time passes, persons move into and out of that target segment. So on CEC/CPUC 20 year planning horizons, the group is actually somewhat larger.

2.4 Home Performance in the Popular Press

Do these present and future homeowners who are the potential market segment for home performance services know anything about home performance diagnosis, testing and retrofits? Do they know or care about energy efficiency? What about the non-energy benefits (e.g., health, comfort, property values) of home performance services?

The evaluators gave a significant amount of attention to these questions, searching on-line databases of magazines and newspapers for evidence of awareness among the general public (or at least in the mass media that speak to/for the general public). We were interested in the treatment of topics related to energy in general, energy efficiency in particular, and to special building practices—certainly home performance, but also related areas of innovation such as green building, healthy home environments, and so on. The results were somewhat surprising. There are niche markets and magazines in several areas that might be called "natural" and "environmental" areas such as *Natural Home* and *Real Simple*. But we wanted to get a sense of the treatment of home performance-related topics in more mass-market publications. We used three different strategies to do this.

First, we examined back issues of one of the oldest magazines focused on household matters with a fair amount of coverage of the house and its surroundings—*Better Homes and Gardens*. The publishers also maintain an elaborate website devoted to home decorating and remodeling. For the 10-year period between 1992 and 2001 we were able to search BH&G using a commercial library database. For articles after 2002, we could search the web site. We found virtually no mention of home performance topics in either source. Even the very generic search term "energy efficiency" only turned up 12 potential articles. Eleven were 1-page articles (or side bars). Only one was a full-length feature article on the subject of a "healthy home" that appeared in 2001.

Second, we examined a somewhat more specialized, but still mass market source. This is *Sunset* magazine, which is targeted at residents of the western states and focuses on aspects of "western living." The magazine devotes considerable coverage to home remodeling and building materials.[14] We were able to search the annual indexes of the magazine using a variety of search terms for the period 1996-2005. Table 12 reports the results in numbers of articles found for specific search terms.

Table 12. Occurrence of HP-Related Terms in *Sunset Magazine* Subject Indexes, 1996-2005

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
energy	1	-	-	-	-	-	-	1	-	-
energy - save	-	1	-	-	1	2	2	-	-	-
Energy Star	-	1	-	-	-	-	-	-	-	-
energy efficiency	-	1	2	-	-	5	1	-	-	1
green building	-	1	-	-	-	-	-	-	-	1
home performance	-	-	-	-	-	-	-	-	-	-
healthy home	-	1	-	-	-	-	-	-	-	-
air quality	-	-	-	-	-	-	-	-	-	-
mold	-	-	-	-	-	-	-	-	-	-
paint (general reference to issues)	-	-	-	-	1	-	-	1	-	1
VOC	-	-	-	-	-	-	-	-	-	1
environmentally friendly	-	1	1	1	-	-	1	3	-	-
recycle or salvage	2	1	2	2	3	3	4	2	3	5
non-toxic	-	-	1	-	-	-	-	-	-	-
CFL	-	-	-	-	-	-	-	-	-	-
sensor (e.g., switching off)	-	1	-	-	-	-	-	-	-	1
solar	-	-	1	1	1	1	1	1	2	-
resource efficient	-	-	1	-	-	-	-	1	-	-
water saving	-	-	-	-	-	-	-	-	-	-

Locating and scanning the actual articles allowed us to get a better sense of how these topics were being treated. For example, straw bale homes have had a notable presence in *Sunset*, with feature articles in 5 of the 10 years indexed. These articles typically report on the energy saving of this type of construction, as well as the frequent use of environmentally friendly products. However, except for some references to a green building resource guide, the Energy Star new homes program, a healthy home handbook, and a guide to home energy (all in 1997), this popular magazine (with approximately 1.5 million subscribers) has not focused explicitly on energy or health and safety issues during this 10 year period.

Our third strategy involved looking at newspaper articles, in this case across the U.S. for

[14] *Sunset* annual index on line at http://www.sunset.com/sunset/general/article/0,20633,845011,00.html.

evidence of home performance coverage. We conducted this search using LexisNexis™ a well-known database of worldwide news sources. The key search terms combined "home performance" and "energy." We were surprised to find so few references in the general press. The results are shown in Table 13. There have been few of these articles, but they are increasing in frequency. The concentration in New York State (mostly upstate newspapers) is not surprising, given the significant expenditures for home performance programs in that region by the State of New York.

Table 13. General News Articles Related to Home Performance

	California	New York	Oregon	Missouri	Minnesota	Others*	Totals
2006		3	4				7
2005	1	3		4	2		10
2004		2			1	1	4
2003		1			1	2	4
2002						3	3
2001	1	1					2
2000					1	1	2
1999							0
1998						1	1
1997							0
1996							0

* Georgia, Massachusetts, Ohio, and Canada.

Because this narrower subject search on "home performance" produced so few matches, we specified a broader LexisNexis™ search for "energy audit" plus "home." Between 1995 and 2005, an average of just over 50 "hits" were found. On close inspection, however, very few were associated with media outlets in California.

In an effort to make a California-specific newspaper search, we turned to the *San Francisco Chronicle's website*.[15] Here a search for items referring to "home performance" published in the last year "hit" on hundreds of articles. However, a close search among the first 60 returned, revealed only one (published in June 2006) that was related to energy (and this article was about solar energy systems). This isn't surprising since the last article in the *San Francisco Chronicle* about whole house or home performance contracting was published on March 2005. The subject matter of the articles returned by the search ranged from trees, to fine arts performances, real estate values, and obituaries. A search for "whole house" turned up one article about the Pacific Coast Builders' trade show in June of this year.

In addition to searching *Chronicle* archives, we looked for evidence of news related to "home performance," "whole house," and "healthy house" on line in the *Sacramento Bee* newspaper. Unfortunately, we could only search the previous year's worth of articles, and there were no hits for "home performance" or "healthy house" among articles published in 2006. While one article about cooling was referenced, the subject was about

[15] *San Francisco Chronicle* at http://www.sfgate.com/

whole-house fans, not whole house contracting. A similar search of the *Fresno Bee* turned up one article focused on energy use in buildings and regional air quality. The results were similar for the *Oakland Tribune* and the *San Jose Mercury News*, although the latter allowed archive searches that turned up some relevant articles on energy audits and housing-related environmental problems in past years.

These sources certainly do not represent a full-scale search for trends in public awareness of concepts related to those advertised by the CBPCA program (e.g., home performance, whole house contracting, and healthy home). However they are useful indicators that suggest that both state and national media outlets (and their readers) do not readily identify these concepts with "home contracting." Since these terms are specifically used by the "Home Performance with Energy Star" programs to describe their program goals and services, there seems to be a disconnect between those concepts and the public awareness of their meanings, and likely their value.

2.5 Home Performance in the Trade Press

In an effort to investigate the level of exposure to home performance contracting, building science and related concepts among the trades, we conducted another series of database and website searches. To provide broad exposure to the businesses involved in home retrofits, we first selected two prominent trade associations of HVAC contractors: the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) and the Air Conditioning Contractors Association (ACCA). Both are information and lobbying groups with a number of trade publications (magazines, newsletters, technical reports, issue alerts, etc.) that are indexed on their websites. We then selected the two leading trade magazines focused on the residential remodeling business (*Professional Remodeler* and *Qualified Remodeler*), the leading monthly magazine targeted to residential new construction (*Builder*) and closely allied with the National Association of Home Builders, but also widely read across the housing industry. Finally, we selected *Fine Homebuilding*, a high-quality monthly magazine directed to customer builders, high-end remodelers, craftsmen, and homeowners with interests in building and remodeling.

Searching these sources, we investigated the levels of attention to key topics indexed by the following search terms: "energy efficiency," "Energy Star," "home performance," "building science," "energy audit," "retrofit," "IAQ" and "VOC" (industry shorthand for "indoor air quality" and "volatile organic compounds"), and "mold." The time period searched varied somewhat, but mostly focused on the past 5-7 years. While some of the articles first appeared in the late 1990s, they are still available on the web (and, in some cases, have not been improved upon by later work).

The results of the searches are reported on Table 14. It shows fairly widespread awareness and coverage of energy efficiency topics. We note that the concept is also widely approved, as is the Energy Star program and brand. Many articles chronicle successful businesses that have allied themselves with Energy Star and encourage others to follow suit. The concept of "home performance" (at least by that name) is not widely

recognized. The exception is one of the remodeling magazines that has published a series of recent articles with titles such as: "Actions for Optimizing Home Performance on (Almost) Any Job," "Holistic Medicine for Existing Homes," "Contractors' Wake-Up Calls" (regarding "mold, mildew, faulty building performance, sick building syndrome"), "A Taste of Energy Efficiency," and "Growing Up Green." Unlike home performance, building science is more of a known quantity across the gamut of trade sources (sometimes discussed in detail, sometimes simply mentioned).

Table 14. Frequency of Selected Topics in Trade Publications and on Industry Web Sites (numbers of articles)

Search Terms	SMACNA	ACCA	*BUILDER*	*PROF. REMOD.*	*QUAL. REMOD.*	*FINE HOMEBLDG*
energy efficiency	82	40	97	60	34	37
Energy Star	13	37	49	34	14	9
home performance	0	0	1	9	0	1
building science	7	6	15	14	1	16
energy audit	4	1	2	1	0	0
retrofit	132	7	14	43	8	58
IAQ	61	25	3	1	1	1
VOC	3	1	14	11	4	13
mold	48	39	117	70	36	7

In an effort to see if the older term "energy audit" was more familiar, we found that it really does seem to be dated and rarely appeared in these sources. We wondered if "retrofit" was also a "retro" term, and found that it was not. It has solid technical meaning in SMACNA, which focuses on many commercial HVAC issues, where remodeling of commercial space often involves equipment/system retrofits. It also seems to have a strong basis in remodeling and even home building.

When we considered indoor air quality issues (the professional/technical side of consumers' interests in the "healthy house"), we found significant salience of the term "IAQ" among the HVAC trade. This is not surprising, since the "V" in HVAC points to a core concern with air quality and proper ventilation. Interestingly, the term "VOC" is most salient to remodelers, where issues related to off-gassing of laminates, paints, carpet, furniture, etc. may concern customers as well as workers and business owners who have daily exposures. Finally, we found that mold is a widely recognized problem and a hot-button issue, particularly for builders (who have been exposed to well-publicized lawsuits related to moldy houses), but also for remodelers and the HVAC trades.

We conclude that baseline awareness, knowledge, and information resources related to home performance contracting are fairly good across industries. There is an ongoing discussion, at a modest level at least, of the problems that home performance approaches can address and how they fit into the business context—i.e., how they can be profitable,

and how ignoring home performance issues can be unwise and costly. We found no evidence in this search of opposition to the principles of taking a building science approach or of a home performance contracting model. We found no controversies. We did find encouragement for contractors, along with written technical assistance, links to industry/government resources, and positive stories with "boosters," "champions," and "role models."

3 Program Theory and Program Design

Design of a new program in a new area of intervention is challenging. In many ways, the CBPCA Home Performance (HP) Program involves significant innovation in uncharted territory. In these sorts of cases, best practice would require that program design be guided by a combination of past experience, accepted practice, and careful consideration of how to approach novel circumstances.

In the case of the HP Program, there is relatively little past experience available with whole-house diagnostics, particularly when applied on a large scale to residential markets. The HP Program staff did have past training and program operation experience, and this clearly benefited the program design. Since the CBPCA program was launched in 2002, a number of other home performance programs have sprung up around the U.S. over the past few years and have been branded "Home Performance with ENERGY STAR" by U.S. EPA/DOE. The CBPCA investigated these developments during program start-up, but none were mature enough to serve as a useful model.

Accepted practice was also not particularly helpful. Business-as-usual in the home improvement market pays little attention to energy efficiency, and virtually none to the house as a system of interacting components. Accepted practice in residential sector energy efficiency programs and policy has generally involved promotion and/or subsidy of single measures (e.g., compact fluorescent bulbs, more efficient appliances, high SEER air conditioners). With the exception of one large-scale program launched recently by the New York State Energy Research and Development Authority (NYSERDA),[16] there has been little serious energy efficiency policy attention given to whole-house retrofits and how these might be realized in market contexts.

Under these circumstances, an evaluation of the program theory and program design can refer to insights from residential sector (EM&V and policy) studies, as well as social science energy research (e.g., concerned with consumers and organizations).[17] In general, these literatures report considerable variability and uncertainty surrounding consumer energy efficiency choices. Lack of knowledge, weak incentives, competing priorities, constraints, and weak connections to energy efficiency providers are routinely reported. There is less known about retrofit contractors' motivations, practices, organization, and decision-making, and still less know about their behavior in market

[16] The NYSERDA Energy Smart Home Performance Program (see getenergysmart.org)
[17] For reviews of the latter, see Lutzenhiser (1993, 2002a, 2002b), Lutzenhiser et al. (2001).

systems such as local home improvement/repair markets. It is useful to look more closely at these literatures, however, before discussing CBPCA's program theory.

3.1 Relevant Literature

The evaluation looked for accepted knowledge about residential energy efficiency program design at the time of the CBPCA's initial planning efforts. An important source was the California Measurement Advisory Council (CALMAC) database (CALMAC, 2006).[18] We also examined a meta-analysis of residential sector efficiency policy options that was conducted in 2004-2005 by the California Energy Commission (CEC). This study, which was mandated by California Assembly Bill 549, considered home performance contracting along with a number of other energy efficiency interventions that might address the legislature's interest in reducing the waste of energy in existing buildings. This study was obviously not available to the CBPCA program designers in 2003, but it provides some useful information in hindsight (and it, in fact, drew upon the CBPCA's program experience in including home performance contracting in its list of possible residential interventions. Also, the CBPCA program designers could not be expected to draw very much upon the social science literature in their program theory development and planning efforts. But there are some complementary insights in that literature that we introduce for the benefit of readers who might be planning similar programs in the future.

3.1.1 Prior California Energy Efficiency Studies

In accessing the CALMAC archive, we focused on analyses related to attempts to transform the California residential housing market. Although these findings are instructive, their coverage is relatively thin.[19] None of the studies related directly to home diagnostics and retrofits. They did consider previous residential sector programs, market actors' practices and perceptions, and related market dynamics.

For example, in an analysis of PG&E's Comfort Home program, Hagler, Bailly, Inc. (1998: ES-8), found that market barriers such as asymmetric information, performance uncertainties, organizational practices, access to financing, product unavailability, information search costs, hassle costs, and split incentives have stymied efforts to increase energy efficiency in homes. These are, to a significant degree, problems located in *supply chain dynamics/organization*, rather than in the consumer context.

In a later study, Hagler, Bailly, Inc. also found that consumer awareness of specific actions that can be taken to save energy at home was low.[20] But they also found that consumer attitudes toward energy efficiency were favorable and that consumers look to a diverse range of information sources when making energy efficiency product decisions (Hagler, Bailly 1999, p. ix).

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[18] Suggested by the *CPUC Energy Efficiency Manual* (CPUC 2001).

[19] We particularly identified relevant studies by Hagler, Bailly, Inc. (1998, 1999), Opinion Dynamics Corp. (1999), Pacific Consulting Services (1998), Wirtshafter Associates, Inc. (2000), and Xenergy Inc. (2000).

[20] These findings were based on data collected prior to California's 2001 energy crisis. During and after that crisis, awareness, concern and action levels have been higher (Lutzenhiser et al. 2004).

In the case of energy efficiency mortgages, Xenergy Inc. found that the lack of "champions" impeded lenders and real estate agents from embracing them. The study also concluded that more education was necessary to inform buyers about energy efficient mortgages and their benefits (Xenergy 2000, p. E-8).

Other research has considered consumer response to particular residential technologies. For example, acceptance of evaporative cooling technology is influenced both by market actors' perceptions and performance problems (Pacific Consulting Services, 1998, p. ix). Opinion Dynamics (1999) found a number of significant barriers to energy efficient HVAC equipment purchases and installations. These include financial barriers, low consumer awareness, short home tenure (between 5 and 8 years), lack of an appropriate sales approach, and piecemeal program implementation. Finally, Wirtshafter Associates found that:

> *Residential contractors from all trades feel that the 'lack of consumer demand' and 'the higher cost or unfavorable economics' of the high efficiency options are the most important factors preventing contractors from providing more energy efficient equipment and services. The contractors generally feel that the high cost to purchase and install the equipment is the most important factor preventing consumers from installing the equipment…Most contractors either do not know the paybacks for major items, or see the paybacks as being greater than 5 years for major energy efficiency measures* (Wirtshafter 2000: E1).

Many of these findings (e.g., struggles with technologies, lack of sales approach, search for "champions," etc.) were echoed in our interviews and surveys (reported below). The residential energy efficiency EM&V literature would predict low levels of knowledge and awareness, communications difficulties, uncertainties about technologies, risk avoidance by both consumers and supply chain actors, and a lack of visible, persuasive sponsors of energy efficiency change.

Recommendations from these evaluations for program design include:

- Efforts should be made to keep the flow of information between program managers, clients, and customers open and symmetrical.
- Document and broadcast how well a retrofitted home performs versus a home that has not had any work done.
- Document and broadcast how traditional organizational practices and inertia can limit a firm's potential, and provide new models of innovative and effective organizations.
- Work with the State and financing institutions to determine the opportunities for helping households afford diagnostics and retrofits.

- Eliminate hassle costs and product unavailability by working with supply chains and stores to ensure that the necessary products to perform quality retrofits are always available.
- Make sure that all technology used by clients is user friendly (the number one complaint from active contractors was invariably about the TREAT software).
- Augment the skills of contractors and other efficiency advocates in the market (e.g., with a sales or advertising approach).
- Enthusiastically "champion" residential efficiency—and in as many venues and media as possible—to convince the building industry and customers of the multiple benefits of a better performing home.

To some degree, these lessons seem intuitive. However, the apparent widespread persistence of barriers to energy efficiency innovation in the residential sector indicates that past lessons have either not been learned or effective strategies for overcoming them have yet to be developed.

3.1.2 The AB549 Study

The AB549 process was initiated by the California Assembly in 2001 when the CEC was directed to "…investigate options and develop a plan to decrease wasteful peak load energy consumption in existing residential and nonresidential buildings…" (CEC 2005). The result was a staff and consultant study process and report to the Legislature. During that process, a wide range of efficiency problems, potentials, barriers, and program options were considered. Among these was a "whole building diagnosis" approach. Following their own literature review, the AB549 team also conducted a series of expert interviews and topic panels, during which program approaches such as that adopted by the CBPCA program were considered.[21] The final AB549 report includes discussion of the program approach, along with a listing of barriers that is salient to an evaluation of the CBPCA's program theory and program design.

The AB549 study identified "several barriers that could reduce the effectiveness of a whole building diagnostic testing intervention strategy." These include:

- *Lack of expert advice and information*. Without better education of the residential customer as to how energy is consumed in the home, this initiative will likely flounder. This initiative is closely tied to the "Information Gateway" intervention since only an educated homeowner can make an informed decision on the potential benefits of the whole building diagnostic testing strategy.
- *Lack of trained and certified contractors*. Although there is a mechanism in place to train contractors, significant statewide demand for services does not currently exist. Without the demand from the marketplace, it is difficult for a contractor to justify the expense of having their employees go through the training and purchasing the diagnostic equipment. This barrier is closely linked to the barrier above.

[21] CBPCA staff and contractors were asked to provide input to the study process, and they participated on expert panels and reviewed the final report.

- *Segmented nature of state contractor licensing*. Contractors holding a C-20 license may not be able to do all work covered under a whole building approach.
- *Inertia*. In boom cycles, contractors have little motivation to differentiate themselves from their competitors since work is abundant. Changing a contractor's business model from the status quo to a performance-based approach has an element of risk. Each contractor needs to determine the costs and benefits of undergoing this transformation.
- *Lack of valuing non-energy benefits*. Much of the benefit of whole house diagnostic services is an improvement in indoor comfort, indoor air quality, health and safety, and overall aesthetic improvements to the structure. These benefits are very real to the homeowner and typically of more significance than the potential energy savings. Unfortunately, CPUC Total Resource Cost (TRC) test methodologies do not value the non-energy benefits.
- *Lack of valuing performance verification*. Utility programs offering incentives to homeowners for installation of energy efficiency measures do not regularly verify that the installed measure performance is consistent with the design intent. The whole building approach involves performance verification resulting in documented value to both the homeowner and the utility.
- *First cost*. Cost is certainly a barrier to this approach. With the comprehensive nature of this approach and the expense associated with the diagnostic testing. (CEC 2005, pp. 55-56)

3.1.3 Energy Social Science Studies

Both the CALMAC studies and the AB549 study paint a picture of a complex (and confusing) market in which there are many barriers to efficiency improvement and relatively mild suggestions for intervention are offered. Much seems to rely upon consumer choice, and this is not an area that is well understood in energy policy circles.

Social scientists who have studied energy conservation decisions and actions can offer more insight. For example, they point out that a good deal of the early program development, evaluation, and policy analysis in the energy efficiency field was dominated by "rational actor" models (of the sort originally favored in neo-classical economics and later exported to the energy arena). Those models failed to predict or account for conservation behavior and energy efficiency choice (Stern 1992, Lutzenhiser 1993). Psychological models focused on "attitudes" and "intentions" have not fared much better. However, alternative models that focus the social shaping of choice seem more promising, and they have become more and more common over the past decade in anthropology, sociology, psychology, and most recently economics.[22] But despite this progress, the problem of social behavior and consumer choice related to buildings, technologies and the complex systems within which these are all embedded remains a frontier area of social science research.

[22] For example, in anthropology see Wilk (1996), sociology see Biggart (2002), psychology see Gardner and Stern (1996), and economics see Camerer et al (2003).

One promising approach involves "diffusion of innovation" theory (Rogers 2003). In this literature, the uptake of new technologies and practices is seen as a social process in which different sorts of consumers with different sorts of motivations weigh in with their purchase decisions at different points in an adoption process (and along an "adoption curve"). This model is best applied to choices involving particular devices and discrete decisions (e.g., purchase of a VCR or DVD), and it "works" best (i.e., most satisfactorily accounts for observed change) after the adoption process is well along. Early in the process, it does tell us to be attentive to the special characteristics of "early adopters," and as the process unfolds it suggests that the nature of the choice (and the chooser) will change. However, its fit to an innovation as potentially complex as residential sector retrofit market transformation (which is actually a bundle of innovations)—particularly very early in a diffusion process—is problematic.

Another promising approach can be found in "actor network" theory, which comes primarily from studies of the evolution of technologies.[23] The strength of this approach is that it views innovation, adoption and diffusion (1) as taking place within a complex social and technical systems, (2) as an uncertain process in which outcomes are incompletely controlled by actors and are rarely fully understood in advance, (3) as a multi-causal process in which human actors, organizations, codes/rules/laws/norms, markets, technologies, buildings, and nature all play parts in shaping and constraining outcomes. Its weakness is that it literally requires that we look in many places for influences, and that we do not prejudge processes about which we have little knowledge—e.g., not imposing rational expectations or linear diffusion paths on change processes where these are not warranted by prior knowledge or past experience.

The AB549 process used insights from actor network theory, but in a very tentative way (e.g., developing actor-network maps or diagrams for each target intervention). We take an actor network view of the HP program intervention being evaluated here *as a general perspective*. This is simply to say that, absent much guidance from existing literatures, we recognize that the CBPCA has been attempting to intervene in a new (from a policy point of view) and complexly-configured market. The test of program design will be how well the program theory on which it is based reflects the real-world complexity and dynamics of that market.

3.2 Program Theory

It is important to be explicit about the program theories used by efficiency program designers. There are several reasons for this. We want to: (1) clearly identify the systems and problems that are being targeted, (2) be clear about the assumptions being

[23] These studies range from close examinations of the innovation process in the case of lighting (Bijker 1998), to the building of large-scale electricity grids (Hughes 1989), and the interaction of social, market and regulatory factors in the evolution of home heating systems (Cowan 1989) and water heating (Banks 2000). An actor network approach to energy efficiency innovation is advocated by Shove et al. (1998) and Wilhite et al. (2001).

made about system dynamics and the motivations and behaviors of market actors, (3) provide grounding for program design that will allow (4) comparisons of expectations with outcomes. Making program theory clear also offers obvious benefits for EM&V work, since it provides a fair basis for evaluation that is grounded in program designers' own understandings and intentions—i.e., programs are not being evaluated on the basis of unknown or arbitrary criteria.[24]

3.2.1 CBPCA Program Theory

In order to characterize the CBPCA program theory, we drew upon program documents (e.g., the original HP Program proposal, the CPUC's required Program Implementation Plans, quarterly and monthly reports, the CBPCA website, and related sources), along with interviews with staff and subcontractors.

We summarize the CBPCA program theory under which the intervention was funded and launched as follows.[25]

There is significant waste and a lack of energy efficiency improvement in the existing housing stock. Where retrofits occur, often single-items and/or a haphazard selection of efficiency measures take place. Conventional approaches do not maximize energy and non-energy benefits for the homeowner, and may, in fact, prescribe solutions that endanger the integrity of the home and the health and safety of its occupants.

The division of labor among the trades, the relatively low level of importance given to energy efficiency in the market place, and the lack of both conceptual and technical tools for understanding building performance in the residential sector, result in low levels of contractor capacity to provide state-of-the-art retrofits.

The lack of effective retrofits can be traced, at least in part, to:

(1) a lack of consumer awareness of common energy, comfort, health and safety problems in homes,

(2) a lack of a supply of contractors with the technical expertise necessary to diagnose and remedy building problems, and

(3) a lack of experience, even among skilled contractors, in marketing and delivering sophisticated testing and remediation services.

A promising solution to this set of problems can be found in the adoption by consumers and contractors of a "whole house" understanding of building performance. The whole house approach maximizes energy and non-energy benefits through testing and retrofits of homes based upon building science principles (i.e., understanding the performance and interactions of the envelope, systems and environment).

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[24] For a discussion of the role of program in theory in evaluation in general, see Weiss (1997), and in the context of energy efficiency market transformation, Blumstein et al. (1998).

[25] Changes in program theory have also taken place over the course of the program in response to feedback from participants, program experiences, and EM&V findings in progress. However, these changes have been more refinements than significant modifications of the program's basic assumptions.

Improved consumer understandings would lead to an appreciation of the energy, health, comfort, and safety benefits of better-performing houses. Improved contractor technical knowledge would apply building science concepts and practices through advanced testing, diagnosis, reporting, and remediation of building problems. Improved contractor marketing skills would support effective communications with customers and increased sales of sometimes costly needed retrofit packages.

Consumers will be attracted to a service that offers energy and non-energy benefits and guarantees quality retrofits on the basis of those factors alone. They can be reached through media coverage, news articles, endorsements by public figures, and conventional industry means (home show booths, direct mail, telephone solicitation, etc.). Those who are interested will follow up by calling a CBPCA toll-free number and/or by visiting the HP Program website.

Contractors will be attracted to the program if consumer demand can be demonstrated. They can be recruited through mass and targeted mailings, phone calls, faxes and e-mails. Industry associations may also be helpful in contractor recruitment through endorsements and the use of their membership lists.

Subsidies for either the consumer or the contractor are not needed, and would have negative effects on contractors and the functioning of the market when they are (inevitably) withdrawn. However, initially some referrals from CBPCA are necessary to link contractors with prospective customers.

Extended courses of study for contractors are not required to master necessary building science techniques. Contractor capabilities in testing and analysis can be developed through intensive training sessions, if supported by a reasonable amount of mentoring and technical assistance from CBPCA.

Testing and diagnosis of building problems will allow contractors to provide compelling reports and bids to consumers that will lead to sales of needed retrofit packages. They will be able to effectively market this new service (and generate their own business) after a short period of in-field training and a reasonable amount of experience with the techniques and their real-world benefits.

Contractors will be willing and able to use building simulation software to estimate energy saving and compare alternative retrofit packages. They will report these results to the CBPCA.

Contractors will re-test each retrofit house after work is completed to assure customers of the quality of retrofits by offering measures of actual performance improvement (which will also provide estimates of likely energy savings to CBPCA). The quality of contractor work can be assured by the mentoring process, contractor reporting on jobs performed, and random re-testing of building performance and review of contractors' simulation runs by CBPCA staff.

Transformation of this market is possible. Beginning in Fresno and San Jose, the HP approach and business model can gradually be expanded statewide by the CBPCA with the aid of other energy efficiency programs, its contractor members, public agencies, private foundations, and suppliers of premium equipment and materials.

3.2.2 Program Objectives

The HP Program's fundamental aim is to "…create both public demand for true test-based optimized whole-house retrofits and effective supply of the required expertise." (CBPCA 2002)

This is further specified by four key objectives:

(1) *Build Contractor Commitments and Capabilities*

This objective creates the supply of service providers, and requires contractor outreach, "sale" of the concept, training, and follow-up services such as quality control, remedial assistance, and technical best-practices updates.

(2) *Create Consumer Awareness, Interest, and Demand*

This demand-building objective requires a variety of tactics, including public education, connections to suppliers, confidence-building certification and endorsements, quality control, and effective sales capabilities.

(3) *Facilitate Successful Contractor Sales Efforts*

Here specialized sales training will be required, including strengthening the contractor's understanding of the retrofit value proposition, the use of options to meet budget needs, and assistance in the use of the best available financing mechanisms.

(4) *Develop Market Momentum and Self-Financing*

This longer-term objective seeks to accelerate the spread of the concept and to generate financial support both internally (contractors and suppliers) and externally (foundations and local governments) as a means of systematically moving away from CPUC funding. (CPBCA 2002, p. 11).

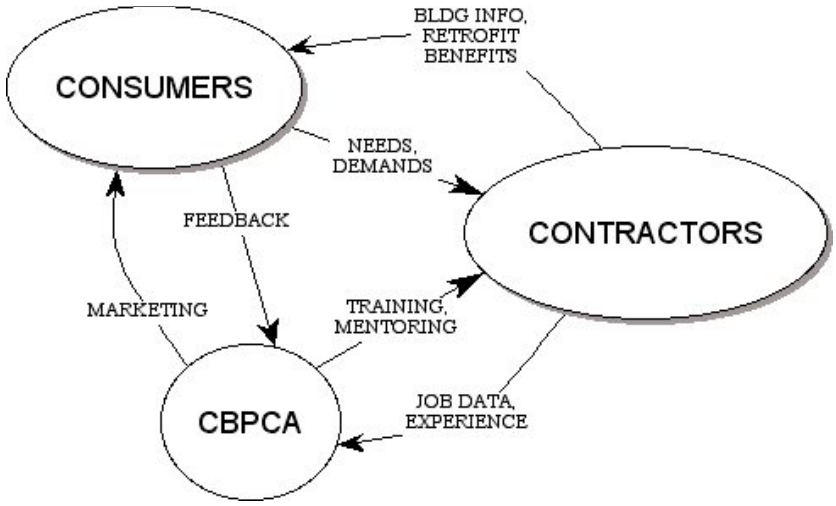
3.3 Program Design

In order to construct a program on the basis of this theory, a relative complex program design was proposed by the CBPCA to the CPUC and approved for implementation in 2002, with a timeframe extension and geographic broadening of the program in 2004. Over the course of the 2002-2005 period, the design has undergone modification as a result of field experience, feedback from participants, and findings from work-in-process by the evaluators. These modifications are discussed in the Program Implementation chapter that follows.

Despite the complexity of the market, and the complexity of the original CBPCA intervention design, the program was designated as a third-party (non-utility)

information-only program for a good reason. At bottom, the program objectives would be met through a number of *information flows*. In other words, the program theory makes a fundamental assumption that *information dissemination* can significantly alter the system. And the CBPCA program design is essentially a *information-delivery* approach that supplies different kinds of information to different market actors at different points in time in efforts to increase their competence, reduce their uncertainty, and improve the effectiveness of their actions. This includes flows of information from CBPCA, contractors and consumers (see Figure 1).

Figure 1. Information Contents and Flows



These information flows are to be accomplished through a set of activities that grow out of the program theory and operationalize the program objectives. They fall in six program areas that include: (1) administration and coordination, (2) marketing/public information, (3) solicitation of contractor participants, (4) contractor training, (5) information and referral for customers, (6) monitoring/quality control and evaluation (see CBPCA 2002).[26]

Administration and Coordination These activities involve program management, fiscal responsibility, and reporting to sponsors (via Bevilacqua-Knight, Inc. (BKi) staff as contract managers). Assure appropriate coordination and information sharing with complementary public and private efforts.

Marketing/Public Information Use a combination of marketing strategies, with continuous review and refinement during the course of the program. Low-cost face-to-face methods of contact are emphasized, including public service announcements, targeted neighborhood campaigns with local community service organization support,

[26] Material in this section is excerpted and condensed from the original program proposal (CBPCA 2002).

media interviews, and the use of local intermediaries, public appearances, and limited local radio. Media approaches have included news releases, a dedicated website, briefing papers, doorstep flyers, a video (for use on public-service TV as well as handouts), and neighborhood-targeted direct mailing. Testimonials by prominent civic and business leaders are solicited. News articles about the program will appear in major newspapers in target areas, as well as in neighborhood newspapers.

Contractor Outreach These activities are designed to attract trainees and to keep them as members of the CBPCA in order to help advance their success and support the Association's continuing development of the profession. Outreach methods have included direct mailing, telephone calls, broadcast faxes, e-mails, and CBPCA-sponsored industry meetings. Trade associations and major equipment suppliers will provide mailing lists for outreach efforts. Follow-up contacts with potential trainees will be made, and referrals taken from former trainees. The HP Program and CBPCA websites solicit contact from interested contractors. Also, BKi staff and subcontractors present information about the program at public meetings, professional conferences, and similar settings. CBPCA board members also provide outreach to various organizations with which they are familiar.

Professional Training These activities are intended to provide "…the rapid and accelerating rollout of enough well-trained technicians to meet certification standards and consumer demand, both in the target cities and beyond for the future. They begin with enrollment of the contractor candidates into a training sequence. Following formal training, field assistance and mentoring is provided to contractors who have successfully completed the training.

Information and Referral for Consumers Activities in this area are intended to help provide a steady and equitable flow of interested clients to member contractors. After stimulating interest with market development activities, consumers who visit the website or call the HP Program toll-free number are given whatever information they need to better understand building performance issues and possible resources. They are also asked if they wish to have a qualified contractor get in touch with them. CBPCA staff then provide the customer contact information to a contractor in their locale, taking into account proximity, performance, and equity in share of referrals already received.

Monitoring/Quality Control and Evaluation Activities in this area include: management information, quality assurance, and program evaluation.

Management information involves the collection and organization of adequate data for operations, adjustments and periodic assessment of program performance. A variety of data on program activities, outcomes, and costs are routinely collected. Particularly important are contractor-supplied data on pre-retrofit testing and "test-outs," and feedback from consumers (via complaints and contractor-distributed satisfaction surveys).

Quality assurance data take a variety of forms. In addition to the contractor and customer-supplied data mentioned above, random spot-checks of contractor work and re-testing of customer dwellings are conducted by program subcontractors. If/when problems are identified, they are corrected in those cases, and appropriate amendments are made to training and/or mentoring practices.

Program evaluation provides both a formal assessment of the program, as well as in-process feedback to program staff and subcontractors from the results of evaluation interviews (e.g., with contractors, customers, program staff and others), surveys and preliminary analysis. The evaluation contractor is able to draw upon the program's management information and quality assurance data sources, as well as primary data collected as part of the evaluation, to inform both the formal evaluation and in-process feedback and recommendations to program operators.

All of these program elements were monitored over the course of the 2002-2005 period. A number of adjustments to program activities, goals and strategies were made as a result of a combination of management information, quality assurance and program evaluation findings. Particular program changes are described in various sections below.

4 Program Implementation

The CBPCA program was implemented with numbers of activities and events specified as *performance goals* (CBPCA 2006). These included conducting 10 training cycles, recruiting 40 contractor firms and 50 contractor employees to the training, expanding program coverage to 3 new market areas, participating in 8 marketing events, producing and distributing 20,000 marketing brochures and 5,000 marketing CDs, and generating 300 contractor leads. Non-numerical performance goals included establishing the CBPCA as a dues-based home performance contractors professional group, and working collaboratively to develop a statewide expansion strategy for home performance contracting in California. The training goals and most of the marketing goals were met. Progress was also made on the organizational and industry development fronts. However, the planned expansion was limited to 1new market.

In this chapter, we discuss implementation activities in the following program areas: market development, training and mentoring, information and reporting, and coordination. We conclude with a summary of adaptive changes made during implementation.

4.1 Market Development

The CBPCA program design included marketing and market development activities in support of contractor training and technical assistance. It was clearly understood by program designers that the lack of interested and qualified clients (or customers

"leads"),[27] would mean that contractors would have no business. "Building demand" was from the beginning considered an important part of the program. On the other hand, interested customers had to be linked to trained and qualified contractors in order to convert interest into action. This would require a means of contact and flow of information from the demand side to the supply side. The original CBPCA proposal stated the problem this way:

> "What's First—the Chicken or the Egg? A key element of our strategy involves the timing of contractor training versus public education. What must come first—supplier capability or consumer demand? This issue has been debated endlessly for introducing new programs, and most planners have taken the conventional view that the capability to serve must be created before encouraging the public to understand, appreciate, and seek those services. But this means a slow start and increased investment risks for the contractors. We take a different view. … our approach is to begin public education at the same time we are preparing the training infrastructure and contractor outreach—similar to advertising a new car model to generate interest at the same time it is being made available. There are some already-capable contractors and diagnosticians within the State, and we propose to enlist those as initial suppliers as well as success models for other contractors. Then our training and certification process would steadily enlarge this pool of suppliers in our target communities and beyond." (CBPCA 2002:12)

In the first phase of the program, CBPCA implemented a range of market development activities. In the second phase, these were significantly scaled back as the question of cost effectiveness was considered and newly trained contractors began to generate their own leads.

4.1.1 Phase 1 Marketing Strategy

In the CBPCA's proposal to the CPUC, the Association's stated goal for market development was the successful implementation of an *educational campaign* that would introduce the California Home Performance Program, and educate the public in the two original target markets (Fresno and San Jose). The campaign would focus on whole-house diagnosis benefits and advertise the availability of this new service in the locales. The projected outcome was to be the acceleration of demand sufficient to facilitate the completion of at least 1000 retrofits within the program's 21-month term.

Planned multi-path public awareness efforts were to function by working with and through:

- local public officials and government agencies,
- community opinion leaders,
- visible organizations such as homeowner associations, and
- media relations and appearances at home shows and other public events.

[27] Client contacts are often referred to as "leads" (for selling purposes) in the industry.

A process of continuous review and refinement of these public information efforts was expected (particularly since this was originally thought to be the project's most costly task). Methods and channels were to be diverse, but in all cases low-cost—e.g., public service announcements, targeted neighborhood campaigns with local community service organization support, alliances with real estate agents, local intermediaries, public appearances, media interviews, limited local radio advertising, and a video produced by the California Energy Commission. The CBPCA also proposed to coordinate with utilities to use their outreach mechanisms. Mass media contact would be through news releases, supported by a dedicated website, briefing papers, and the CEC video (for use on public-service TV). These sources of information would be complemented by neighborhood targeted direct mailing and doorstep flyers (see CBPCA 2002).

To evaluate these activities, we conducted in-person and telephone interviews with CBPCA staff, the primary marketing-subcontractors (Solem Associates), and their sub-contractors who directed specific marketing activities in Fresno (KPT Communications) and San Jose (Catapult Strategies). An additional marketing consultant (Advertising Rising) brought onto the project at mid-course was interviewed as well.

These marketing experts agreed that the CBPCA funding did not include the level of support necessary for a "new-product-roll-out" advertising campaign, which would be extensive, protracted, and grounded in traditional market research (e.g., conducting surveys to better understand consumer perceptions of the product, testing of optional messages, development of an understanding of consumer "triggers" related to the product, collection of data to support the price point set, tailored advertising through segment-relevant channels, and the like).

In an effort to shorten the message-testing requirements of a traditional media campaign, the CBPCA and their marketing contractors jointly developed media materials to be tested in focus group settings. These materials were based primarily on the following initial program assumptions:

- that "home performance" and "energy efficiency" would be the right consumer "triggers" (naming the program "Home Performance with Energy Star" was considered)
- that customers would be attracted to a service provided by a trained, WH contractor that included both the diagnostic service and remediation services (installing the retrofits recommended by the tests)
- that "stayers"—homeowners (of some wealth) who live in older homes and are not contemplating a new home purchase—would be the appropriate market in the initial roll-out phase
- that larger homes have the most potential for waste (and therefore for savings)
- that California Public Utility Commission sponsorship would add credibility to the new program
- that an incentive based (subsidy) program would not be sustainable in the long run

The primary marketing contractor developed test materials designed to promote Home Performance and Energy Efficiency as the objective *and* to promote the advantages of "One-stop-shopping" for a contractor business that was also trained to perform Home Performance diagnosis (and deliver all needed retrofitting and follow-up testing). These materials were tested on a focus group in Fresno in February 2003 (Solem Associates 2003).

Based on several consumer reactions identified during the focus group session, media materials were then re-developed—concerns for "a comfortable home" and "a healthy home" took precedence over "home performance" and "energy efficiency". Advertisements (radio, TV, newspaper) were released in first quarter of 2003 using a medical metaphor. Advertisements included the phrases "Call today for a checkup", "A cure for the ailing house…" and "How healthy is your home?"—with the words "mold," "asthma," "drafts," "allergies," and "dust" predominating over "high energy bills."

As a radio and TV advertising blitz was not economically feasible for disseminating the new program message (under the new name of "California Home Performance Program"), CBPCA program administrators and their marketing consultants devised two main strategies to increase program visibility—"targeted" and "shotgun" approaches.

Several strategies to get the messages to *targeted* consumers were employed in the summer of 2003. One targeted approach worked to create consumer awareness in San Jose through networks of local intermediaries (e.g., neighborhood associations and their newsletters, political leaders, council members, etc.). Another used direct mailing to the types of homes deemed appropriate in program. The *shotgun* approach, devised to simply get program information in the hands of potential do-it-yourselfers, made brochures available for random pickup in local hardware stores.

The primary goal of the marketing program was to *introduce* the concept of Home Performance (HP) testing combined with Whole House (WH) retrofitting. In the view of the primary marketing contractor, the *role* of the marketing effort was to generate "consumer awareness" (interest in the HP/WH approach) "that delivers calls to a CBPCA toll-free number."

In essence, the marketing activities were intended to accomplish two things: (1) to distribute CBPCA program information to potential customers (and the general public) in the two pilot cities, and (2) to secure a sufficient number of interested customer leads to supply newly trained HP/WH contractors with an initial customer base. Based on program theory, this initial customer base would assure early business/financial success, while giving contractors (alone or with the CBPCA) time to develop their own marketing strategies.

Interviews revealed that a very large majority of the earliest Phase 1 consumers (86%) contacted the CBPCA toll-free number to find out more about testing and contractors. Only a very few (8%) contacted a CBPCA contractor directly. It is not surprising that the toll-free number was clearly the primary point of initial contact, since the marketing,

mass media, and website information referred those interested in more information to the CBPCA toll-free number.[28] It is also clear that newspapers were a primary source of initial exposure. Interested consumers reported newspaper articles as the most frequent initial source of information about home performance testing and retrofits (62%), followed by contractor advertising (10%), the internet (6%), a home and garden show (6%), radio coverage (2%), and contractor recruitment (2%).[29]

4.1.2 Phase 2 Shift in Marketing Approach

It was decided by the CBPCA that early public information efforts, while innovative, did not generate a level of interest commensurate with their cost. Therefore, the CBPCA initiated a mid-course correction; soliciting and adopting a new multi-faceted marketing plan in the latter half of 2003. This plan included the following types of approaches to generate consumer interest: telemarketing, home and garden show marketing, contractor marketing (e.g., materials created for use by contractors), media advertising, public relations, collateral materials, guerrilla marketing (e.g., handing out leaflets in public places), a new emphasis on contractor recruitment, and website redevelopment.

Due to consumer response primarily from newspaper articles, the CBPCA had, in their estimation, an adequate number of potential customers (leads) for referral to contractors by fall 2003. Subsequently, public marketing efforts (that generated *demand*) were slowed to keep pace with contractor training (the *supply* of trained contractors being generated), and marketing emphases shifted from a CBPCA-centered effort to one in which contractors were expected to conduct their own marketing activities. Table 15 summarizes some of the significant points in the market development process.

From CBPCA reports and customer accounts, in-depth newspaper articles can be credited with generating the most customer interest and subsequent contact with the Program for referral to a HP contractor. However, the marketing experts we interviewed pointed out that while the success of the newspaper and radio coverage was strengthened by the fact that *local* and *credible* persons who were featured, regardless of the initial success of these media events in generating consumer interest, a long-term marketing campaign cannot rely on one-time media events.[30] So as the "bounce" in public awareness from the news articles printed in the third quarter of 2003 continued to fade from public view, it was hoped that leads generated from home shows, and other personal outreach events, would increase accordingly.

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[28] For example, while an influential *Fresno Bee* article mentions two CBPCA contractors by name, the only contact number printed was the CBPCA toll-free number.

[29] The remaining 13% didn't recall the source of information.

[30] One of the marketing consultants said that that sort of free coverage only happens about once a year, unless something really big occurs.

Table 15. 2004-05 Market Development Activities

Activity	Planned	Actual
Public event marketing events (e.g., booth at home show)	8	12
Verified-quality customer leads generated for new contractors	300	131
Printed marketing materials developed and published	20,000	5,450
Updated display materials for exhibition booth	1	1
Reprints of program's CD-ROM on "Healthy House Inspection"	5,000	3,500
Marketing guidelines for contractors	1	1
Co-funded marketing program with on-call advice to contractors	–	28

After struggles to recruit interested contractors who would actually undertake a change in business approach to embrace home performance contracting throughout 2003 and 2004, a surprising turn-around took place in January 2005. The CBPCA, PG&E and the EPA Energy Star program co-sponsored with Affordable Comfort a two-day industry meeting devoted exclusively to home performance contracting. Topics covered ranged from technical issues in testing and remediation, to creating and managing a home performance contracting business. The event was attended by a large number of contractors from across California who were exposed to home performance principles and to the CBPCA program. This was a supply-side marketing coup (see Affordable Comfort 2005). After that session, the CBPCA had no difficulties in recruiting interested and serious students for their training sessions conducted in 2005.

By mid to late 2005, the shift in marketing strategy seemed to have been paying off. Many contractors seem to be acquiring customers from usual industry sources such as responses to ads, yellow page listings, prior customers, and home show and big box retailer leads. Earlier complaints by some trained contractors who expected/wanted CBPCA to "deliver the leads" were not repeated with this group of new and continuing contractors (although future interviews with non-active trained contractors may turn up similar marketing issues for them).

In our interviews with contractors early in the program, we found that their opinions of marketing materials, strategies and messages were focused primarily on whether or not they saw the market development activities producing leads. There seemed to be a bit of a tension between the CBPCA and the trained contractors regarding the delivery of leads. Contractors hoped that the CBPCA would give them solid leads from additional direct advertising to "soften up the market." However, the CBPCA had been clear in outlining the limits of their role regarding lead-delivery, and the expectation that contractors would work with existing customers to market home performance testing and retrofit services. To this end, some contractors reported changing their Yellow Pages ads to include home performance testing.

In fact, a number of customers that we interviewed in Phase 2 of the program reported contacting a CBPCA-trained contractor for a single retrofit service (e.g., a replacement AC unit) and subsequently became interested in home performance testing when they were offered information about it. Also, the CBPCA continued to supply potential customers and contractors with marketing materials, including program brochures and fliers, EPA Home Performance and Energy Star brochures, program CDs, and copies of newspaper articles. To gauge the effectiveness of these marketing materials, we asked participating homeowners what they had received. We hoped to follow up with questions about their perceptions of those messages and delivery/dissemination routes (e.g., in terms of resonance, vividness, actionability, trustworthiness, etc.). We were not able to do so. It turns out that very few diagnosis customers reported receiving educational materials from contractors. Our data are somewhat spotty on this, since we stopped asking this question mid-way through data collection because of early low response rates. However, among the 25 who were asked, only 6 reported receiving educational materials during the testing phase, 17 reported not receiving materials, and 2 could not recall.

Some homeowner concerns about the *trustworthiness* of contractors' recommendations (for needed retrofits) were also revealed in some customer interviews. This suggests uncertainty that might have been addressed by informative and effective marketing materials and presentations. However, several messages that *did* resonate with customers about the HP diagnosis (and helped to resolve concerns for those customers) included: the fact that the CBPCA was playing an active role in setting standards, the fact that the program had specially-trained local contractors, the appeal of building science and modern measurement technologies, and the relatively low cost of the test. Some customers clearly understood that they were purchasing a higher quality solution to their specific house-related problems by hiring a contractor that applied the home performance perspective.

Finally, the value of target marketing to consumers who are already on a home improvement trajectory—and/or the seeking out of the program by such persons after they read about it in the newspaper—seems to have been at least modestly supported by program experience. Our consumer interviews showed that about 60% of diagnosis customers already had pre-existing ideas about specific home improvements. About 3/4 of those cases either did or planned retrofits after testing, while a smaller proportion (about 1/2) of those who were not already on a home improvement trajectory did or planned retrofits after testing.

4.2 Training and Mentoring

By training and supporting residential contractors in state-of-the art testing and building science-based services, the CBPCA is attempting to transform a residential retrofit market in which "business as usual" overlooks considerable opportunity for energy savings and non-energy benefits.

The primary strategies for accomplishing these goals involved the training of HVAC, insulation, weatherization, and general remodeling contractors. Contractors interested in conducting whole-house diagnoses were provided both classroom training and field experience that covered:

- Home performance contracting business and marketing practices
- In-depth technical training in building science, testing, diagnosis, and retrofit selection and installation
- Assistance in purchasing diagnostic tools
- Actual field applications and problem-solving

In the field, the trained home performance contractor first identifies, through sophisticated testing procedures (e.g., carbon monoxide tests, combustion efficiency tests, duct air flow estimates), what the home needs for better energy efficiency, economy, air quality, structural soundness, long-term value, and the health, safety, and comfort of its occupants. Then the contractor presents a package of remediation services—building science-based retrofits and remodeling work—based on the diagnosis. In this model, the needs of the whole house can be addressed in a single transaction. The training needed involves a combination of technical analysis, implementation, communications, and business skills.

4.2.1 Training Design and Implementation

The CBPCA drew upon existing curricular materials and trainers who had considerable experience in building science and contractor training to construct a six-day course of study. Individual contractor-managers and technicians from a number of firms of different sizes and types were enrolled in each of 10 training sessions conducted in the target locales in 2004 and 2005.

The curriculum covered the following general topic areas:

- Building performance contracting business and marketing practices; ethics and communications; WH Program requirements and goals;
- In-depth technical training in building science principles, diagnostic testing (including the use of duct blasters, blower doors, smoke stick, infrared imagining, manometer, etc.), analysis and simulation, retrofit package selection, and installation issues;
- Locating equipment and materials; assessing and purchasing diagnostic tools;
- In-field applications; available financial assistance;
- Hands-on use of TREAT and OTTER software (building simulation and data upload).

Table 16 presents a detailed outline of the training content (CBPCA 2006). The training was intended to be broad, thorough and rigorous. CBPCA trainers were intended to set "high standards" for the quality of the content, the modes of presentation, and the improvement in trainee knowledge and skills..

Table 16. CBPCA Diagnosis and Remediation Training Curriculum

Fundamentals of Building Performance

- What is Building Performance?
- Practical Applications
- Diagnostic Tools
- The Building Performance Market

Performing the Occupant Interview

Occupant Concerns

- How the interview is important to the sales process
- Building Science concepts to explain to the customer
- Typical questions to ask
- The Workscope / Remediation process

Site Design Inspection

Site Inspection Characteristics

- Dependencies and Characteristics of Good Site Design
- Solar Strategies
- Foliage Strategies
- Environmental and Regional Strategies

Moisture Control and Site Design

- Sources of Bulk Moisture
- Strategies for Dealing with Bulk Moisture
- Seasonal Issues around Bulk Moisture

Combustion Safety Testing

Carbon Monoxide

- Ovens and Ranges
- Vented Combustion Appliances
- Carbon Monoxide Monitoring

Targeting Health and Safety

- Your Role in Occupant Health and Safety
- Indoor Air Quality Issues
- Fire Safety Issues
- Jobsite Safety Issues

Combustion Safety

- Combustion Safety Problems and Issues
- Inspection Techniques
- Standards
- Complicating Factors
- Fire Safety

Infiltration

Building Air Flow

- The Difference Between Air Leakage and Ventilation
- The Effects of Physics on Air Flow
- Measuring Air Flow
- Calculating Air Flow
- Testing for Air Flow

Interpreting the Blower Door

- What can the Blower Door Tell us?
- How Does the Blower Door Work?
- Using the Blower Door

Identify and Control Air Leakage

- Looking for Air Leakage
- Testing for Leaks
- Correcting Air Leakage
- Checking for Results
- Calculating Return on Investment

Air-Balancing Building Zones

- Identifying Zonal Pressures
- Pressure Balancing
- Series Leakage

Ventilation

Controlled Airflow for the Home

- Ventilation Standards
- Proper Ventilation Design
- Remediation Options
- Minimizing Ventilation Requirements

Moisture Control and Ventilation

- The Impacts of Moisture
- Controlling Moisture Levels
- Common Problem Areas

Insulation Performance

Framing Inspection

- The Significance of the Building Frame
- Framing Techniques that Matter
- Common Problems & Issues to Look for

Thermal boundary

- Defining the Thermal Boundary
- Performance Issues
- Calculations
- Sealing Strategies
- Venting Strategies

Infrared Imaging

- The Power of Infrared Imaging

• How to use Infrared Imagers

Windows and doors
• The Benefits of Window Replacement
• The Drawbacks of Window Replacement
• Window Replacement Options
• Window Repair Options

Pressure and Thermal Boundary
• Key Terminology
• Alignment of Pressure and thermal boundaries
• How to Evaluate
• Common Breaches
• Common Problems caused by misalignment
• Remediation

Heating

Combustion Appliances
• Characteristics of Combustion Appliances
• Efficiencies of Design
• Inspecting Combustion Appliance Zones
• Evaluating Efficiency
• NFPA Combustion Air Requirements

Air Conditioning

Cooling Systems
• SEER In The Real World
• Fundamentals of Refrigeration Diagnostics
• Charge & Airflow Verification Services

Ducts

Distribution Systems
• Characteristics of Distribution Systems
• Problem Areas and Issues
• Remediation Strategies

Air Leakage Testing
• How and Why to Test for Air Leaks
• Duct Blaster Testing
• Pressure Pan Testing
• Sealing Air Leakage

To fit with the demands of contractor schedules, and to provide prospective trainees with "samples" of the training in shorter sessions, the course work was originally divided into an introductory one-day business and marketing session, followed by a six-day series of technical sessions for those who were interested in investing their time in the whole course. During Phase 2, this model was changed, dropping the stand-alone introductory session, integrating marketing and business information into the technical curriculum, and reinforcing these topics in the field mentoring work.

Several different qualified trainers covered different topics during the diagnosis and remediation training sessions. Preliminary testing of student knowledge was conducted at each session. A more comprehensive test was administered at the end of the multi-day session. Some contractors trained in Phase 1 returned to take the entire course over as a refresher during Phase 2. The schedule of training sessions is shown in Table 17.

Table 17. Program Training Sessions, 2004-2005

Training Type	Location	Dates	Attendees
Ph 1 – Diagnosis & Remediation	San Jose, Fresno, Stockton	various dates 2002-2003	37
Phase 1 – Business & Marketing	San Jose, Fresno	various dates 2002-2003	49
Diagnosis & Remediation	Clovis	May 2004	7
Diagnosis & Remediation	San Ramon	June 2004	5
Diagnosis & Remediation	Stockton	September 2004	6
Diagnosis & Remediation	San Ramon	October 2004	7
Business & Marketing Seminar	Clovis	October 2004	4
Business & Marketing Seminar	San Ramon	October 2004	14
Diagnosis & Remediation	Fresno	November 2004	
Diagnosis & Remediation	Emeryville	February 2005	12
Diagnosis & Remediation Sem.,	Emeryville	March 2005	7
Diagnosis & Remediation	ETC[31] -Stockton	April 2005	13
Field Training - Remediation	Customer home	May 2005	12
Diagnosis & Remediation	CART - Clovis	June 2005	12
Business & Marketing Seminar	Fresno	June 2005	6
Diagnosis & Remediation	Emeryville	September 2005	13
Business & Marketing Seminar	Emeryville	October 2005	5
Contractor Estimating Session	Vacaville	October 2005	9
Diagnostic & Remediation	Vallejo	November 2005	14

In addition to training sessions, field assistance by trainers and experienced diagnosticians was provided to contractors who had successfully completed the training. Assistance and support takes the forms of on-site help with use of test equipment, consulting on diagnosis, assistance with simulation and data upload software, and general mentoring. Quality control assessment (discussed below) was also conducted by trainers in the field, usually in the process of mentoring contractors.

As one contractor told us:

> *"… it's only when you see it out in the field and you recall something one of the instructors has said, that an understanding comes to mind. And so if, in that situation, if there is something fuzzy I'll call [CBPCA trainer] and say 'This is the situation I have, what do you think?' You know, what's interesting is that he*

[31] ETC – PG&E's Energy Training Center. CART - Center for Advanced Research and Technology

[CBPCA trainer] will ask me some questions that will lead me to come to the right answer myself. Without him having to say it. So it's a wonderful source."

A contractor certification process was included in the original program plan. Component activities in that area were proposed to include development of certification tests, establishment of a certifying agency, testing, award, and periodic review and recertification to assure currency of skills. Small numbers of contractors and lack of current demand for certification resulted in the CBPCA postponing consideration of certification during the 2004-2005 phase of the program.

4.2.2 Contractor and Consumer Assessments

The contractors we interviewed saw the training as well organized and of high quality. The training was uniformly highly valued by those contractors. The contractors also view the mentoring support provided as appropriate, needed and valuable. Their only concern in this area has to do with questions about the ability of the CBPCA's limited number of training/mentoring subcontractors to handle the volume of requests from HP contractors for technical assistance, advice, and hands-on field training.

Most of the contractors were comfortable with their ability to conduct diagnoses and perform HP retrofits as a result of the training—with mentoring backup, which has often been used to check back with the trainers to make sure that they were doing the right things. At least one, however, felt that the HP process—while important and worthwhile in business terms—is complicated enough that close support is necessary to "hand-hold" through enough jobs so that experience and confidence are gained.

From the customers' point of view (see Table 18), the trained contractors were seen as highly capable and professional in their approach. The surveys revealed that the majority of customers said that they received timely service performed by energy-efficiency professionals who provided services that were resource conserving, reduced their energy bills, and made their homes more comfortable. Fewer customers reported that the services they received made their homes healthier to live in, or that they understood the cost of each retrofit option offered, even though the contractors did explain the options in understandable terms

Table 18. Perceptions of Contractor Capacities and Professionalism

The contractor I hired …	Disagree	No Opinion	Agree
responded to me in a timely manner.	2%	9%	89%
seemed like an expert in energy efficiency.	6%	17%	77%
made my home more efficient (resource-wise).	4%	11%	84%
made improvements that reduced my utility bills.	11%	13%	76%
made my home noticeably more comfortable.	4%	13%	82%
made my home more healthy to live in.	4%	40%	56%
explained the cost of each retrofit option.	12%	23%	65%
explained the options in terms I understood.	2%	19%	79%
seemed biased toward certain retrofit options.	28%	53%	19%

4.3 information and Reporting

Of the various information flows depicted in Figure 1, the most important for evaluating program implementation involve the flows of information from contractors and consumers to the program operators. Some of this is direct, for example via contractor reports and consumer inquiries, complaints and complements. Some is indirect, such as periodic feedback from the evaluators who are independently in contact with consumers and contractors. The CBPCA program has benefited from both types of information. However, limited reporting by contractors has been a problem since early in the first phase of the program. The CBPCA's final 2004-2005 report puts it this way: "Monthly reports have detailed reporting efforts and results and this problem was never satisfactorily solved." By this, the implementers mean that repeated efforts have been made to secure reports from contractors on the home performance work that they have been doing—both in terms of individual jobs and test results, as well as overall numbers of diagnosis and/or retrofit cases. The evaluators have discussed the problem with CBPCA on a number of occasions and it is clear to us that the implementers have made continuous efforts to improve the quality and quantity of contractor reporting, even developing new reporting forms, taking information verbally over the telephone, and visiting contractor's places of business.

4.3.1 Contractor Reports

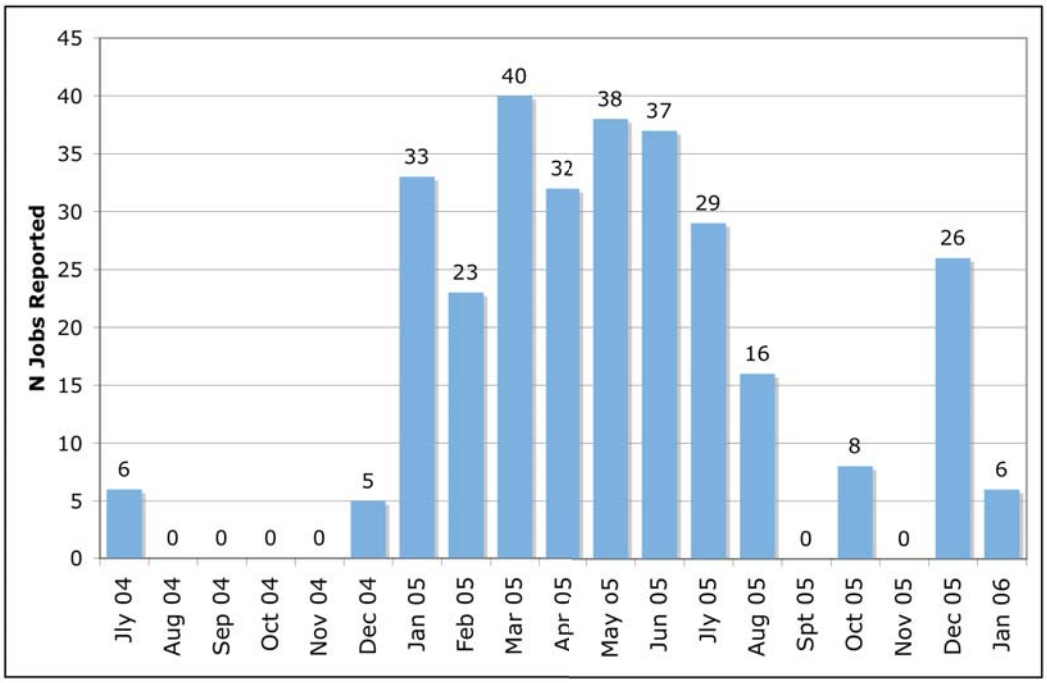
The CBPCA has been able to secure information on 299 cases[32] and they believe, based on a May 2005 contractor poll and ongoing informal conversations with contractors, that

[32] While the CBPCA referred to these cases in their reports to PG&E as "homes diagnosed," it was clear from their database that contractors were actually reporting "jobs completed" or "installed measures" in

there are many more diagnoses and retrofits (in different combinations) that have actually been conducted by CBPCA-trained contractors. There is no way to verify this, however, and the CBPCA has not had the resources to acquire information directly from contractors' records that might support a more accurate estimate. As a result, the implementers have only reported work for the cases actually reported to them by the contractors. They have used this information internally to consider the nature of diagnosis and retrofit work being performed across the population of trained contractors, and they have derived monthly energy savings estimates for these cases, which have been reported to PG&E throughout the program.

The rates of reporting and numbers of cases reported in each time period are shown in Figure 2. Early low levels of reporting are to be expected, since new contractors were just entering the field following training (although some reporting from contractors trained in the first phase of the program might be expected in 2004). The fall-off late in the program (August-November 2005) is more difficult to understand. The lack of reporting in that period by several HVAC contractors who reported earlier on (explored in greater detail in the next chapter) may be part of the story.

Figure 2. Contractor Reporting Rates



Source: CBPCA MIS data provided to evaluators throughout the program cycle.

In the end, it is simply difficult for some busy contractors to find the time to report. In other cases, this also likely reflects the fact that they have little to report—both in terms of home performance jobs and documentation of the results of testing and diagnosis. The

CPUC parlence (versus "recommended measures" from diagnoses alone). Customer interviews confirmed this (see discussion later in this report).

CBPCA contractor census showed high levels of diagnosis and retrofit for some contractors, but very low levels or none for about half of the contractors surveyed. Low reporting levels may also reflect contractors' unwillingness to report ordinary jobs (which may, nonetheless, benefit from CBPCA training and partial testing/diagnosis) as full-blown home performance work. This is a good thing, although it also results in under-reporting of jobs that might legitimately be counted toward the implementer's performance goals.

The failure to report work and testing results may not hamper the work of the contractors, their ability to use knowledge gained from CBPCA training in that work, the quality of the product delivered, or the satisfaction of consumers. However, it does limit the ability of the program implementers to assess their own performance and to manage the program. It also seriously hampers the efforts of evaluators to assess program effects in terms of actual work performed, as well as benefits to consumers and funders (e.g., energy savings estimates).

4.3.2 Information and Quality Assurance

Because we do not have a complete view of the work being done, the question of how well it is being done remains somewhat open. From the CBPCA field mentors, we have a sense that the use of duct testing while sealing is delivering high quality installations. From our interviews with the contractors themselves, we have a sense that most active contractors take their work very seriously and attend carefully to issues such as "right sizing" of equipment, including duct evaluation and sealing with all routine jobs, performing air sealing and insulating that would not otherwise have been considered, and so on. From consumers (reported in the following chapter), we find high rates of satisfaction with the work being done.

But during Phase 1 of the project, the evaluators noted short-cuts in the testing, diagnosis, consumer reporting, and test-out processes. Interviews with contractors during Phase 2 confirmed that many short-cuts were still being taken. Some are legitimate experience-based use of rules of thumb and lessons learned from past practice. Others may not be. However, it is the judgment of the evaluators, based on our interviews and analysis of the reports that the CBPCA does have from the contractors, that those who choose not to pursue home performance work seriously, don't stay in touch with CBPCA, don't bother to report to CBPCA, and are not likely to be representing themselves as offering home performance services. And those who are seriously pursuing home performance work stay in touch with the CBPCA and make use of mentoring services and the contractor chat room, where common problems can be reported and solutions shared.

In the Consortium for Energy Efficiency's survey of U.S. home performance programs, the quality assurance issue is discussed and the role of testing is stressed. The report puts it this way:

> "On one end of the quality assurance spectrum are programs that use third party inspections of the home to verify the improvements. These contractors will have received building science training and generally use a "test-in/test-out"

> approach. The "test-in" allows a contractor to identify a baseline level of performance of the home, as well as the cause of any problems. This is often part of the initial home energy audit. The "test-out" allows him or her to verify and measure any change in home performance. This verification is generally executed on a random sampling of at least 15% of completed homes, though some programs inspect up to 100% of completed homes. On the other end of the quality assurance spectrum are partners that train and certify technicians, or even accredit contractors, in order to ensure that they deliver quality work." (CEE 2005).

The CBPCA program is clearly on the latter end of the spectrum. However, routine discussion of test results between contractors and mentors provide evidence that testing is common and the results are used in retrofit choices and installations. Also, the CBPCA inspected and retested a sample of contractor jobs and were satisfied with the quality of the work performed. As another independent check on testing, consumers were asked: "Did your contractor [named] conduct a house inspection to measure your home's performance and energy efficiency?" While 44 (60%) of the respondents reported receiving a house inspection, 24 reported that they did not (32%), and 6 were unsure (8%). When disaggregated by contractor type, we find the majority of "no" responses (24) were reported by customers working with HVAC contractor referred by a big box retailer. We explored this with the contractor.

> *Q. "What percentage of your residential calls is for a Home Performance diagnosis and what percentage are calls for direct service (without a HP diagnosis first)"*
>
> *A. "30-40% HP customers; 60-70% Direct-service calls."*
>
> *Q. "Do you give direct service call customers any different service now because of the CBPCA training (than prior to training)?"*
>
> *A. "It depends on where the lead comes from. We're at-home service contractors for [big box retailer]. If it's [the retailer's] lead we only talk about air conditioning. But if they're leads from the Yellow Pages or from radio ads or from any other source . . . we bring in all kinds of different measures and talk to them about testing and the house as a system. We pretty much consistently do that."*
>
> *Q. " Is it [the retailer's] rule that you only talk about air conditioning?"*
>
> *A. "We're their at-home services contractor for air conditioning, not for windows or anything else. We're competing with their other at-home services contractors. With the [retailer's] leads we're restricted with what we can do."*

However, this is not to say that the CBPCA training has not influenced the practice of major appliance installations (such as air conditioners and furnaces) for this company's direct service customers. In follow-up questions, we asked if the house as a system is important to how they do business.

"… I'd say the main branch, where [the company owner's] heart is, does believe that and is pretty much all on board. We also have a windows showroom and that particular part of the company just sells windows. So the main part of the business does believe in that."

In fact, this firm actually provides careful sizing, duct testing and sealing as a routine part of their service package whenever they are able to do that, choosing not to make installations of what they now consider to be unacceptable or substandard. And we would assume that in their full diagnosis/retrofit cases (i.e., those cases not constrained by arrangements such as a big box retail contract) that work would more closely approximate the full whole house services model. However, our interviews with nearly all of the active contractors suggest that testing (and particularly comprehensive testing) is not performed in all diagnosis cases.

One contractor really "got it" (the importance of the HP process) from the training and put it this way: "Testing in and testing out is probably the biggest thing that they really emphasized. Making sure that you do have the baseline so you can actually, when you test, you have good data to come up with a performance rating."

However, other contractors say that their experience and training allow them to identify most problems without the use of diagnostic testing equipment/procedures. And some don't really pretend to be doing comprehensive HP contracting. For example, one contractor (who was very much "sold" on the importance of the HP approach and, in fact, said that "… when I left this class [I felt that] … everything that I had learned I had to relearn. It was … very depressing because you feel like you haven't been doing the right job"). He also told us that:

"We don't do the whole house diagnostic. We take a portion of it, like duct sealing. All of our systems are duct sealed and that's how we make our presentation. And sizing the equipment properly. These are the issues that they taught at the home performance course. I sell all of the jobs. I have [several] guys that do the tests, but I'm the only one that went through the training."

Even when testing is done, detailed, written diagnostic reports are not always provided. However, written bids or proposals are routinely prepared and presented to customers, along with discussions of home performance issues. Some contractors and many customers perceive these as equivalent to a formal home performance diagnostic report (more about this below).

Simulation modeling also is not routinely used for whole house diagnosis. One contractor does use building simulation, but with software of his own design. More contractors seem to use software and/or tables for equipment sizing calculations.

As noted in Phase 1, many contractors had problems with the TREAT software, although at least one had innovative ideas about using the software to present feedback to customers:

"If I could enter data directly into a Palm Pilot and to do everything on site and have a proposal in their hands printed out at the end of the day, that's my goal. … I'd like to get it down to where I can do it by myself in a day and have a proposal in hand by the end of the day. Even if I didn't come back to close the sale and contract. … I think that right there could be an incredible sales tool."

In the case of one very successful mid-size home performance firm, none of the information gathered during diagnostic testing had been entered into the TREAT program. This firm also confessed to being so busy that they had frequently been late in giving customers written reports. Although all of the active contractors report favorable interactions with customers, the lack of a written report bothered many customers and threatens the credibility of the contractor and the CBPCA as a training organization (as our customer report will indicate). This problem could often be traced to the TREAT software. When asked, "how often do you uploaded results (and are you having any problems with that)?" this contractor replied:

"Actually, I haven't uploaded any. Primarily because I haven't been able to finish any of my TREAT *runs because of one problem or another. I've operated software [without] problems for a long time, I do Manual J with Right Soft almost every day and understand it thoroughly, have absolutely no problems with it, but this TREAT software has just got me."*

In lieu of a TREAT-generated report that organizes a package of needed retrofits with estimated energy saving for each, this contractor devised a customer proposal "based on the information that we got, and what their request was, and the results of what we found." For the most part, he says, "that solved the [reporting] problems…." We would point out, once again, that while this does seems to address the need for customer feedback, it does not satisfy the CBPCA's reporting requirements (especially since the CBPCA was not given a copy of these self-generated reports).

In an effort to simplify simulation and reporting, the CBPCA devised a 14-page form that collected the necessary information on the building and its equipment that could be used to input information into TREAT for management information, quality assurance and evaluation purposes. The data would be entered and the runs completed by CBPCA staff. The form is professional in appearance and benefits from obvious care in its design and production. The evaluators judge it to be very user-friendly. The CBPCA received few submissions of information using the form, and none of the contractors that we interviewed reported using it—although some thought that it was a good thing and did use parts of it, or used it as a check list for inspections.

One very active contractor reported having no trouble with the TREAT software and subsequent uploads of test results to the CBPCA. However, knowing how to report didn't necessarily improve the rate of reporting. In this case, the contractor admitted that even though he doesn't have a problem with the reporting requirements " it's just that I

don't do it often enough—at least not for the guys that are in charge of the program. They'd like to see it more often."

In part because of lack of modeling results, few reports or bids offer energy savings estimates (although energy savings potentials are discussed in general with customers). However, contractor concerns about the realism and reliability of TREAT estimates (as well as those of other simulation programs) are at least partly to blame for this. There are real concerns reported by contractors about over-promising and creating liabilities by predicting savings that, for a variety of reasons (e.g., consumer behavior changes and weather conditions), may not result.

Of course, this also means that, with only a few exceptions, contractors do not ask for past energy bills in order to calibrate simulation results to the specific household.

In sum, the testing and diagnosis process, including modeling and detailed reporting, seems to be rarely followed to the letter. The CBPCA is well aware of this fact and struggles with the limited amount of information available on the quantity and quality of work being performed.

4.4 Coordination

Coordination efforts are required for a program implementation, however they are particularly important for a program such as this. Because the CBPCA was only able to provide modest marketing, training and mentoring support, other resources provided by other market actors are particularly useful. During the period under review, the CBPCA program implementers made a number of efforts to coordinate their program operations and goals with those of other organizations. They seem to have been effective in this in most cases. Coordination efforts were directed at relationships with:

- *The Pacific Gas and Electric Company* PG&E was the CPUC's third-party program administrator. This required continuous reporting and fiscal interactions between CBPCA and PG&E. Also, contractor training included information about rebates available from the utility for customer retrofits. And CBPCA worked closely with the PG&E Stockton Training Center in terms of curriculum coordination, advertising training, and recruiting contractors. In the coming year, CBPCA will conduct training as part of the Stockton Center's ongoing professional instruction program.
- *Other Utilities* CBPCA has been awarded funding by the Southern California Edison Company to undertake a home performance program similar to the Phase 2 PG&E program in the SCE service territory. Also, CBPCA has held discussions with Anaheim Public Utilities, the Redding Municipal Utility, and the Sacramento Municipal Utility District regarding possible home performance pilot programs in those areas.
- *Other Third-Party Programs* Several efforts have been made to coordinate with other third-party programs. While the interactions have been cordial, they have had limited results. For example, a program to train home inspectors to add abbreviated

energy efficiency audits to their home inspection reports solicited its trainees (those who wished to improve their skills and knowledge) for CBPCA home performance training. But none were interested or able to participate.

- *Home Performance with ENERGY STAR (HPwES)* In addition to being designated as one of 20 national HSwES partners, CBPCA also contributes to a national working group. Semi-monthly conference calls are held with program heads in Colorado, Texas, Atlanta, New Jersey, and elsewhere, to discuss common problems. ENERGY STAR initiated this effort because all of the programs share problems with contractor job reporting. But the group now discusses other common problems and solutions as well. In an interview with the evaluators, a Federal EPA/HPwES staff member strongly praised the CBPCA's gratis contributions of insights, advice and time to other home performance program start-ups around the country.
- *Building Performance Institute* CBPCA has conducted discussions with BPI, a national certification body for home performance contractors, on their evolving program and its potential applicability to California contractors. BPI provides certification for a number of the HPwES programs nationally.
- *California Energy Commission* The CBPCA has worked with the CEC to achieve HERS Provider status approval as a means of moving more contractors toward full home performance retrofit capability and interest. They also worked with the CEC Public Interest Energy Research (PIER) program to develop best-practice home performance protocols. These ultimately became the basis of a HUD project (PATH 36) intended to build a knowledge base that would move all residential contractors toward greater energy efficiency and then introduce them to the full building-science-based home performance concept. Results of work-to-date were presented at a national Affordable Comfort, Inc. (ACI) conference. The CBPCA feels that the combination of the CPUC and CEC projects will have a broader impact nationally.
- *Electric and Gas Industries Association* The CBPCA is working with the Association to access EGIA financing of retrofits in support of expanded home performance contractor sales opportunities. EGIA staff participate in CBPCA training in discussions of financing options. The CBPCA has also worked with EGIA to deliver a series of Title 24 seminars for HVAC contractors.
- *Jointly Sponsored Home Performance Events* The CBPCA worked closely with *PG&E, Affordable Comfort, Inc., Fannie Mae, and the CEC* to co-sponsor and produce two successful contractor education events.
- *Flex Your Power and Home Energy Magazine* Cooperated on outreach, publicity and technical assistance.
- *Business and Industry* CBPCA has approached some HVAC equipment manufacturers and received some positive feedback regarding the prospects for training of their contractor networks. However, the issue of quality installation is a difficult one and many large players are involved. It is interesting to note that ENERGY STAR is working with the HVAC industry and has at least one quality installation initiative in the field with others under discussion.

4.5 Changes/Adaptations Made in the Process of Program Implementation

The evaluators knew at the outset of Phase 2 that changes to the program theory and adoption in practice had occurred during Phase 1. These continued during Phase 2, as a result of program experience and feedback received by the CBPCA program implementers their field subcontractors, participating contractor trainees, customers, PG&E, the CPUC, and the independent evaluation subcontractor. Throughout the course of the program, the evaluators provided feedback from our in-process data collection and analysis. The feedback was delivered via written reports and informal briefings with CBPCA staff.

The CBPCA has used this feedback to identify problems and to make program adjustments in real time. The following sorts of changes to the program have taken place over the course of the 2002-2005 period:

1. *Marketing* A significant reduction in public education and media activity. Movement toward the use of home shows as primary customer contact points. Efforts to encourage and support contractor-based marketing.
2. *Contractor recruiting* Reduced use of mass contact approaches. Continued efforts to obtain contacts from industry sources. Successful recruiting from co-sponsored events focused on building science and home performance that attract large numbers of already interested contractors. Greater attention to pre-screening potential trainees.
3. *Technical training* Elimination of orientation "business and marketing" session as an introduction/sampler. Revised the curriculum to incorporate sales and marketing throughout the building science elements presentations/exercises. Separated training on the use of simulation software, which was moved to a later point in the training. Shift from significant reliance on classroom training for transmission of content to a combination of classroom plus in-field hands-on training. Emphasized post-training mentoring of contractors.
4. *Quality assurance* Shift from random testing (policing) to close mentoring on applications in the field, with an aim of accomplishing quality assurance via a more supportive role. Accept a reduced amount of test data from contractors available for MIS and evaluation (although a 10% retesting is required for continued Home Performance with ENERGY STAR participation, assuring some continuing objective testing data).
5. *Certification of contractors* The relatively small numbers of active contractors put this originally planned activity on hold. Also, CBPCA has taken a cautious stance toward certification. This is because of a lack of appropriate national standards for training, and a conviction that quality assurance via certification is not an adequate substitute for field mentoring.

6. *Acknowledge difficulties for contractors in fitting home performance testing and CBPCA proposed business model with conventional business practices and organizational realities* Shift essentially to a business consulting role for CBPCA (this goes beyond technical mentoring to working with contractors on business plans and problem-solving, helping them build their businesses).
7. *Limited supply of job and simulation modeling data from contractors* The CBPCA staff has periodically increased the level of personal contact with contractors requesting information. The 14-page data collection form was developed and distributed. CBPCA staff has performed TREAT runs when contractors were unable to do this.
8. *Adaptation of building science principles and home performance practices by contractors in the real world* This involves the use of training (testing, diagnosis, reporting, packed remediation) selectively in parts of the business, on certain jobs, and on parts of jobs. The problems of real world adoption were discovered to necessarily involve *transitions* and *adaptations*. These are discussed extensively in the following chapter.

In the final chapter (Conclusions and Recommendations) we will discuss how well the original CBPCA program theory has fared in the context of implementation and modification from experience and feedback. Partly as a reminder, and partly in response to the adaptive changes to the home performance program model and training content mentioned in items 6-8 above, we conclude this discussion of program implementation with the following considerations. In the Phase 2 program, the CBPCA planned:

> "… [continued training of] residential specialty contractors in "whole house contracting," in which all energy efficiency deficiencies (and related problems such as combustion safety, moisture, comfort and air contaminants) are identified through extensive testing and remedied, typically including both HVAC system equipment and building shell improvements." (CBPCA 2003:1)

The CBPCA argued that a "whole house" approach, when practiced by contractor trained in the application of building science methods, will provide comprehensive services that produce energy savings not typically found in other programs,

> "… [that] tend to focus either on non-persistent occupant behavioral changes (buy CFLs, turn down thermostat, turn off lights, etc.) or single long-term measures (new high-efficiency furnace, a/c monitoring) that have relatively small overall savings without diagnosis and correction of the many other related problems such as leaking or poorly designed ducting, improper ventilation, structural stack effects and air bypasses, moisture retention, poor insulation, envelope faults, etc. …. [In fact]… No other residential program has demonstrated such large improvements in per-home energy performance…with energy savings in the range of 40% of total household use including both electric and gas." (CBPCA 2003:2)

However, the evaluation found that the CBPCA-trained HVAC, window, insulation and shell contractors did not transform their current business practices and wholly switch to a business model centered on comprehensive installations and retrofits that flow directly from a comprehensive whole house diagnosis. Typically, they continued to do business as usual while attempting to slowly integrate diagnostic testing into their portfolio of services. Particularly among HVAC contractors, a good deal of their home performance work consisted of air conditioning system upgrades, although in many cases these were not simple "change outs," but "right-sized" higher-SEER installations with duct testing and sealing. This is discussed in detail in the following chapter (Program Effects).

This is not really "whole house" contracting, but does it involve "home performance?" To address this question, it is useful to review some considerations related to building performance offered by the CBPCA:

> The terms "whole house" and "home performance" both refer to building-science based individual home testing, analysis, and correction of energy efficiency problems in an integrated manner involving both equipment and building shell improvements. There have been other initiatives, both within the CPUC program and elsewhere that have used these terms to represent much less comprehensive and effective home improvements. While such programs may be valuable, it must be noted that they are fundamentally different from true whole-house contracting and should not be considered comparable. (BKi 2003:3)

It is also useful to better define key concepts that make important distinctions among terms that are often used interchangeably in "home performance," "whole house" or "house-as-a-system" discussions. CBPCA offers the following.

> *Home Performance (HP) contractors* are contractors using performance testing as part of their business, but not necessarily doing comprehensive work scopes that include both shell and HVAC improvements.[33]
>
> *Whole House* (WH) *contracting* refers specifically to a focus on realizing comprehensive solutions for performance problems with a combination of HVAC and shell (e.g., insulation) work. "Whole house contractors do home performance work, but home performance contractors may not be doing whole house work" (CBPCA 2003b, p. 4).

So by these definitions, contractors interested in home performance testing may become "a Home/Building Performance contractor" by incorporating testing procedures into their current business models. A single-focus business (e.g., HVAC, shell, or insulation) that

[33] More generically, we would refer to "building performance" and "building performance contractors," in the sense of applied "building science." However, since this is a residential program and the services being offered by participating contractors are tailored to houses and not commercial buildings, we use the narrower term "home performance" in this report.

includes home performance testing may transition to Whole House contracting by offering a comprehensive range of work, either using its own employees or through the use of subcontractors. And a full service contractor (e.g., one that currently does both HVAC and shell work) would be considered a Whole House contractor if they incorporated performance testing into their current business practice.

Given this definition, we can conclude that as long as home performance-trained contractors, such as HVAC installers, use diagnostic tests to improve the quality of a single installation (e.g., conduct any tests necessary to insure the proper size of new equipment, include duct testing with an air conditioner or furnace installation, and educate the customer regarding energy efficient models), and if they provide additional information to inform the customer of a potential array of related issues (e.g., air sealing, safety issues such as combustion or mold, insulation levels, etc.), then home performance contracting is being conducted. However this adaptive response, while providing multiple new benefits, does not provide the level of whole house contracting service that was originally the goal of the CBPCA program. The impacts of those adaptations are considered in the following chapters.

5 Program Effects

An analysis of program effects is central to any energy efficiency program evaluation. The basic questions are what did the intervention *accomplish* during the program cycle and is it possible to determine long-terms outcomes that the program may have produced. In this chapter, we examine (1) the actual retrofit work performed (e.g., jobs reported by contractors and customers, (2) effects on contractors' knowledge and practice, (3) benefits to consumers, (4) market effects, and (5) energy savings impacts.

5.1 Diagnoses and Retrofits Performed

A key outcome of the CBPCA program is actual home performance testing, diagnosis and retrofit activity. Despite reporting problems (discussed above and later in this chapter), we can say something about retrofit activities, drawing upon four different sources of information. These are:

- CBPCA MIS data on jobs reported to them by contractors (e.g., customer information, measures, some equipment information, some test data, energy savings estimates);
- CBPCA's census of contractors in mid-2005 that collected information independent of other reporting on the numbers of jobs being done in which building performance knowledge and skills were applied;
- The EM&V team's telephone interviews with contractors, which included self-reports on numbers of jobs performed; and
- EM&V customer surveys, which included reports on installations and retrofits.

5.1.1 Contractor Type and Job Completion

Table 19 displays the number and types of active firms that were trained by the CBPCA during Phase 2 and the numbers of jobs reported to the CBPCA by each contractor type.

Table 19. Contractor Status and Jobs Reported to the CBPCA in 2004-05

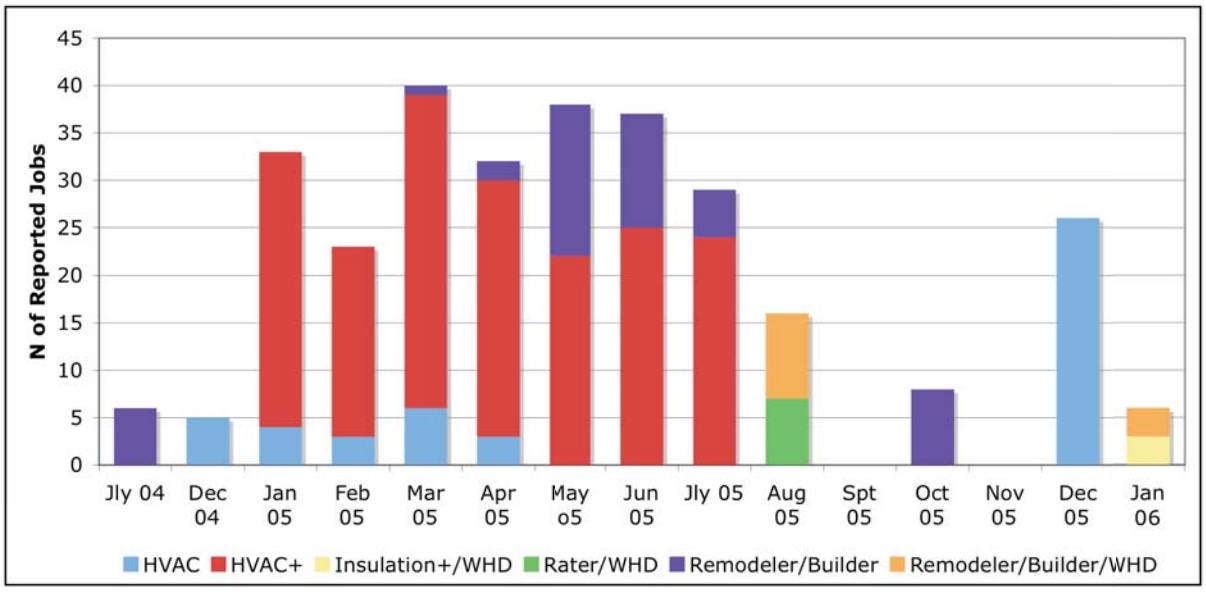
	Total Active	Active Reporting	Jobs Reported
HVAC	12	3	47
HVAC+	3	2	180
Specialty (mold, painting, radiant barriers)	2	1	3
Rater / Consultant	2	1	7
Remodeler / Builder	12	4	62
Weatherization	1		
	32	11	299

Note: "HVAC+" designates a firm offering other services in addition to HVAC systems.

A few of the firms that participated in training in both Phase 1 and Phase 2 were large general contracting firms that offer a variety of services in-house—e.g., ranging from HVAC and duct installation to insulation, air sealing, and /or window replacement. However, the majority of CBPCA trained contractors have been owner-operators of medium or small-sized businesses that offer a single service (which means that they must work with subcontractors in order to complete large whole house retrofit jobs). The contractor mix certainly influences, then, the sorts of jobs being done and reported.

However, there are also reasons to be circumspect about the picture painted entirely by contractor job reports. We have described the limited reporting done by contractors to the CBPCA and it's consequences for program implementation and evaluation. Figure 3 below provides the same information on reporting rates as Figure 2 in Chapter 4. However, it goes further to differentiate reporting by contractor type, which shows very large reporting gaps at different times between types. It also suggests that changes in the type of work, as well as the volume, may not be captured in the contractor reports.

Figure 3. Patterns of Reporting Rate and Contractor Type



To improve upon these data, the CBPCA conducted a contractor "census" in May 2005, attempting to contact the 35 contractors that were then believed to be active in some aspect of home performance work. Of these, twenty were successfully polled. They were asked to estimate the number of jobs that they had bid in the previous month, how many they had completed, and what sorts of measures were typically installed. A summary of responses (Table 20 below) shows a wide range (0-35) in the numbers of completed jobs among the respondents. Information on the length of time between training and the interviews is included to show that the majority (14 of 20 reporting) had had at least 6 months since training to incorporate HP techniques into their business practices.

These two data sources (contractor reports and the census results) both suggest that CBPCA-trained contractors were applying home performance techniques in at least three distinct market areas: heating and cooling, remodeling/retrofitting and building, and home performance diagnostic services (with some partnering with contractors). Continued training in the latter ½ of 2005 and successful start-up of additional contractors resulted in a larger number of active contractors and additional jobs reported by program's end.

Table 20. Contractor Self-Reports of Typical HP Jobs, May 2005

Contractor	Typical Measures Installed	Total Jobs	Months post training
1	A/C Change outs; duct repair and cleaning; home sealing	35	23
2	HVAC focused; duct sealing, sizing, balancing. Attic insulation on some. May mention air sealing.	20	11
3	HVAC repair; duct sealing	10	7
4	HVAC repair, duct work mainly (some insulation, sealing)	8	5
5	Duct performance, HVAC, air infiltration (subs out insulation work)	5	6
6	A/C Change outs; duct sealing; house sealing; ventilation; some Insulation	4	7
7	HVAC, duct repair & seal, some insulation	4	26
8	Insulation, mechanical, ducts, sealing, full package	4	13
9	A/C Change outs; duct repair	2	5
10	Air sealing, duct sealing, subs out a lot of furnace and AC work.	2	6
11	Acts as a general-will sub-out HVAC, insulation, etc. Planning to get his licenses in the near future to keep work in house.	0	2
12	Acts as general and completes inspections and recommendations - subs out HVAC, duct sealing work.	0	15
13	Combustion appliance testing; duct repair; some windows	0	11
14	Furnace change outs	0	10
15	HVAC repair/replace; duct work; air sealing (will sub out insulation)	0	2
16	HVAC repair; Insulation	0	7
17	Inspections only	0	23
18	N/A – consultant working with various small contractors	0	18
19	Sub-out HVAC and insulation to subs; do diagnosis on own and rest on air sealing/window work	0	2
20	Whole house will sub-out HVAC	0	2
	Grand Total	94	

5.1.2 Types of Measures Installed

In addition to identifying the sorts of businesses that participated in the training and the numbers of jobs reported by each, it is important to consider what measures were actually installed—particularly for estimation of energy (and non-energy) benefits. Table 21 summarizes the measures reported by contractors attributable to specific customers.

Table 21. Measures Reported by Contractors

	Count
Single Measures:	
Ducts	2
HVAC	12
Insulation	1
Refrigerant charge	4
Shell seal	4
subtotal	23
HVAC with Home Performance:	
Duct/Insulation/Registers/HVAC tune-up	1
Duct/Refrigerant charge	3
Ducts/Ventilation	1
HVAC/Duct	209
subtotal	214
Whole House - Home Performance:	
Duct/Shell seal	23
Duct/Shell seal/Insulation	5
Duct/Shell seal/Insulation/Radiant barrier	1
Duct/Shell seal/Insulation/Radiant barrier/Lights/Site	1
Duct/Shell seal/Insulation/Ventilation	2
Duct/Shell seal/Ventilation	1
HVAC/Duct/Crawlspace seal	1
HVAC/Duct/Insulation	3
HVAC/Duct/Insulation/Vapor barrier/Ventilation	1
HVAC/Duct/Shell seal	12
HVAC/Duct/Shell seal/Insulation	3
HVAC/Duct/Shell seal/Insulation/Crawlspace seal	1
HVAC/Duct/Shell seal/Insulation/Ventilation/Thermostat	1
HVAC/Duct/Shell seal/Radiant barrier	1
HVAC/Duct/Ventilation	1
HVAC/Insulation	1
HVAC/Insulation/Shell seal/Ventilation	2
Shell seal/Insulation	1
subtotal	61
Grand Total	299

A very large number of those jobs involved HVAC installations, and many of the "whole house" cases involve HVAC and ducts as well. We questioned CBPCA staff and conducted independent research on the question of whether HVAC replacement with duct testing/sealing could and should be considered home performance work, or whether a whole house approach precluded that. In answering those questions, we found a useful primer on the "house as a system" concept in an article written by Rick Chitwood, one of two primary CBPCA trainers. He point out the importance of starting with a consideration of the building shell, but also the crucial role played by the HVAC

equipment and the lowly ducts.

> *When we construct a house using the "House as a System" concept a wonderful synergy occurs between many energy features. We start with a good shell or thermal envelope. By doing building insulation that performs well, installing the correct windows, and sealing air leaks we are able to reduce the size of the heating and cooling equipment. With smaller (and cheaper) heating and cooling equipment we can reduce the size (and cost) of the duct system. With a smaller duct system there is less heat loss from the ducts so we can reduce the size of the heating and cooling equipment even more. …and so on.* (Chitwood 2005)

From the CBPCA's perspective, the fact that shell sealing is reported in 90% of the multi-measure jobs (55 of 61that were not primarily HVAC-related) provides evidence that whole-house performance techniques are being broadly applied by trained contractors. And, in the case of HVAC replacements, duct sealing in conjunction with new right-sized and higher SEER equipment, they can result in significant home performance gains, even though this is not the preferred starting point in the house-as-a-system model.[34]

The Importance of Ducts A variety of independent sources, including some key studies at Lawrence Berkeley National Laboratory (LBNL), have demonstrated the importance of duct sealing (and the fact that ducts are often the "weak link" in space conditioning. From contractor reports of tests conducted after ducts were properly sealed, we find that leakage was reduced to 4-6%, from measured leakage rating as high as 28%. This means that as much as 1/3 of heated and cooled air was being lost to unconditioned space. And we know from interviews with contractors that they are applying home performance techniques during HVAC installations. The following excerpts from two interviews (one an HVAC contractor in a medium-sized firm and the other a general contractor) illustrate this:

First example:

Q. What percentage of your residential calls are for a Home Performance diagnosis and what percentage are calls for direct service (without a HP diagnosis first)?

"Ten to 15% HP customers and 85 to 90% direct service calls, [however,] all sales calls are handled as HP calls."

Q. Do you give direct service call customers any different service now because of the CBPCA training (than prior to training)?

[34] It is interesting to note that the tension between high quality HVAC and whole-house diagnosis and retrofit is not isolated to the California case. National informants say that it appears elsewhere, with the "orthodox" (whole-house) view not always realized, and the HVAC-focused work providing sometimes very significant energy savings (although perhaps not the levels of comfort and whole building performance that might be achieved).

"Yes! Our technicians are cognizant of HP issues and discuss with home owners what services we can offer that may be of additional benefit to them depending on conversation with them."

"[We routinely do a] static pressure test of the duct system. Visual inspection of areas that could indicate air leakage. This visual inspection could lead to the use of the blower door."

Second example:

Q. A home diagnosis might reveal quite a few possible retrofits ranging from HVAC, insulation, ducts, windows, air sealing, a new thermostat, etc. Please describe how you put together a package of retrofits to offer to the client.

I'm just noticing a pattern. We're testing the houses, a lot of them are having the same things going on, so I'm offering very similar retrofits: the crawlspace, it's the attic, sealing the house, and then the heating systems. We'll give some options with that, one is to fix the ducts but that always leads to something else.

A couple of jobs coming up they've got fancy copper-lined systems put in with the same old garbage ducts. It doesn't work. These guys are like 'Can I go back and sue the old contractor?' I'm trying to stay out of that.

A lot of the customers are used to having contractors come in and they get the lowest or second lowest bid and they're in and out within two days. I'm in there for three weeks. They ask 'When are you going to be done?' And I tell them 'Listen, there's two ways we can go about this. We can rush it like standard contractors but I'm not willing to go there. I want to do this thing right, even if it costs me more time and money, I'm going to make sure this house is the way we tell you it's going to be.' You have to train the customers a little bit to get used to this type of service."

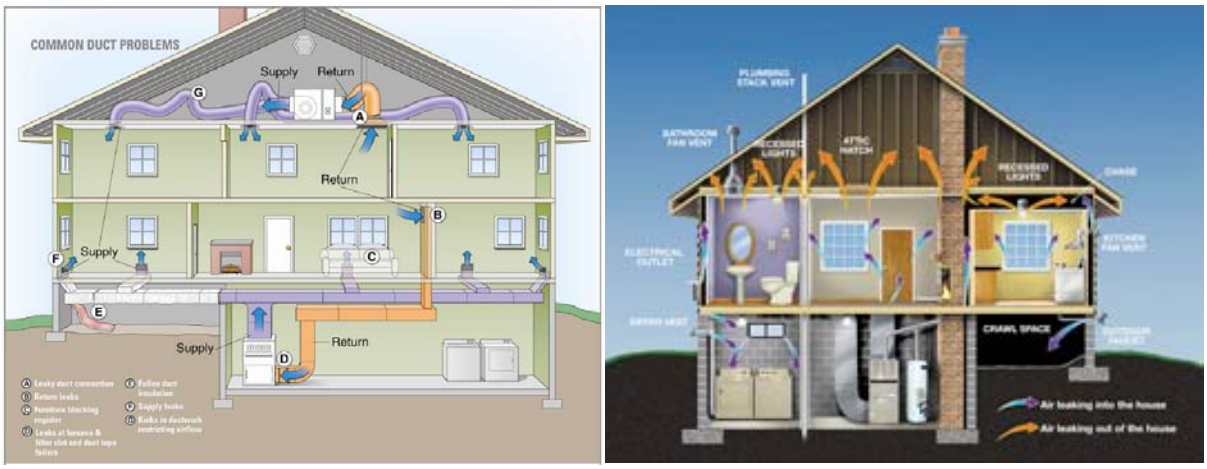
While, initially we had hoped to see a higher proportion of cases reporting whole-house retrofits, the literature that we've examined suggests that duct sealing may be one of the most important efficiency measures among the suite of optional measures typically suggested. For example, Sherman et al. (2000:1) conclude that:

"Field studies … have shown that existing residential systems typically have 30-40% of the total air flow leaking in and out of the duct system. Because these ducts are often outside conditioned space, this leakage corresponds to a similar amount of energy (30-40%) being lost from the duct system instead of going to heating or cooling the conditioned space. In addition, a system with more supply leakage than return leakage causes a greater penalty than just the amount of air lost. Increased infiltration from outside replaces supply air and must be conditioned. There are also comfort, humidity and indoor air quality problems

associated with return leaks drawing air from outside or unconditioned spaces within the structure (e.g., damp crawlspaces)."

And the problem is not limited to older homes. A recent study of *new homes* in the Phoenix area by APS, an Arizona utility, found that the majority had excessive duct leakage–upwards of 30%. At that level, the estimated cost per year in duct leakage in that market was $270. In addition to the LBNL and APS studies, a CBPCA trained HP service provider for a large HVAC+ firm also offers some "ground truth" from his long experience with ducts. "*I can say most of them need ductwork to start with. Probably 90% of homes out there have real duct issues*." Figure 4 provides vivid graphic representations of the importance of ducts, in terms of thermal losses to unconditioned space, and their inter-relationships with air infiltration, issues related to venting of combustion appliances, internal humidity, and so on in the typical pre-retrofit house.

Figure 4. Pre-Retrofit System Dynamics/Interactions



Source: U.S. EPA ENERGY STAR (2006)

From Table 21 above, we see that a large majority (almost 72%) of the jobs that were reported to the CBPCA by contractors were designated as "HVAC" or "HVAC+". These jobs should not to be confused with what CBPCA trainers might call "business-as-usual installations" in the HVAC industry. In CBPCA-trained contractor cases, a duct blaster was used to ensure minimal air loss after the ducts were sealed, and building science techniques were applied to correctly size the HVAC system installed. Fifty-four customers reported on the retrofits they purchased. Of the fifty-one reporting an air conditioner installation, 42 (or 82% of those reporting) were upgrades to newer models that can safely be assumed to be more efficient that the older, discarded models. However, since the contractors did not report the tonnage or SEER of the models removed, overall efficiency gains are impossible to estimate with any accuracy—and we should note that nine customers reported that their new air conditioners were a first-time installations, which actually added some load to the system (these were probably replacements of older window or wall units, likely with quiet low efficiency levels).

Customer-Supplied Information on Measures Installed What else do we know about the work that was completed by contractors during Phase 2? Customer interviews provide one final source of information regarding the measures installed. In general, these self-reports validated the retrofits reported by the contractors. These data sources are suggestive, since both are self-reports from potentially biased samples. However, if they do support each other, we can be more confident in our sources and in the assumption that our reporting groups may not be unrepresentative of their respective groups.

Overall, the contractors reported home performance jobs that included measures that we've defined as 78% HVAC/duct and 22% whole house. However, according to the customer accounts of the measures installed, a smaller percentage, (54%) of the jobs were HVAC/duct related while more than twice as many (46%) were whole-house jobs. From customer reports then, we should consider the strong possibility that a greater proportion of the jobs completed were whole-house jobs than were being reported by the contractors.

We know from interviews with contractors, that customers appreciate the whole-house approach. And after customers review all of the recommended (and optional measures) they often purchase additional retrofits–that is, in addition to the ones that they initially intended to purchase. Given the pressure to report, we surmise that many of the contractors reported an abbreviated list of core recommendations–not the actual retrofits that were eventually installed. Overall, the customer accounts do verify that the contractors accurately reported the nature of the jobs they were doing. Their failure, it seems, was in reporting what might be considered to them to be small details such as envelope sealing, insulation, thermostat replacements, and perhaps new refrigerators, in favor of reports of "big ticket" items such as air conditioners and furnaces.

Customer-Supplied Information on Testing Done The use of building testing equipment is integral to the Building Performance approach to home improvement. Ideally there is an initial testing phase during which the current performance of the home (shell and major appliances) is ascertained and used as a basis for putting together a package of retrofits. Retrofits that work together improve the overall performance of the home with benefits to the owner's comfort, health, energy costs, etc. The Building Performance approach also mandates that building science testing equipment be used during and/or after the retrofit/installation stage as a way to guarantee quality and to verify that all of the retrofits are working properly together (proper air exchanges, ducts highly sealed, no back-draft issues, etc.)

In our customer survey we were careful not to use "whole house" or "home performance" as technical terms, rather we asked customers if they had had a "home inspection"–examples of some of the types of tests that might have occurred was included. However, even a positive response does not ensure that the customer is referring to a "whole house diagnosis." Therefore, in an effort to verify whether "home performance" contracting that generally necessitates the use of testing equipment was being performed, we asked customers if "specialized

equipment was used during the work phase or after it was completed."[35] The question was designed to give customers an opportunity to mention building-science techniques even if they had not had a "home inspection."

A small majority (28, or 52%) reported that testing had been conducted either during and/or after installation. Another 13 said they were "not sure," and 13 said that no testing equipment had been used (24% each). Given that most homeowners are not engaged in the work phase of a home retrofit (e.g., they frequently are not at home, or simply don't observe the actual work being done) these results are not alarming. However, they do indicate that HP contractors need to spend more time explaining the value of their unique services, including testing and verification, to homeowners.

5.2 Effects on Contractors' Knowledge and Practices

As noted, not all contractors who complete the home performance training actively engage in the HP contracting business. Some never attempt to implement what they've learned in training. Some start and stop. Others begin slowly (and warily) and then increase their levels of involvement. Others are self-described as "gung ho" or "true believers" who vow to significantly shift the focus of their businesses toward home performance services. Some are successful. Some are not. Almost all end up adapting building science principles and home performance business practices to the realities of their own markets and circumstances.

Table 22 recaps information about the totals of trained, active and inactive contractors at the end of Phase 2 (including 8 carryover contractors trained in Phase 1 that continued to receive program support in Phase 2). It shows a fairly broad mix of firm types and reasonable levels of adoption of home performance practices by "active" contractors (as reported to the CBPCA and evaluators by the contractors themselves). The overall number of active firms (32) and the overall participation rate (about 40%) is quite good. It is also much higher than at the close of Phase 1, when only a handful of contractors were actively applying building science principles and pursuing a home performance business model. It is interesting to note that HVAC contractors are actively participating at a somewhat higher rate than the next larger group, which is made up of remodelers and builders.

[35] The question was asked of 57 customers who reported the purchase of at least one measure by the date of our interview.

Table 22. Firm Type and Participation Status[36]

Contractor Type	# Firms Trained	# Active Firms	# Firms Not Active
HVAC	23	12	11
HVAC+	5	3	2
Specialty (mold, painting, radiant barriers)	3	2	1
Rater / Consultant	11	2	9
Remodeler / Builder	21	12	9
Weatherization	2	1	1
Total	65	32	33

As a result of the training and mentoring, there are clearly impacts on contractors' knowledge and practices, as well as their businesses. In many ways, it's too soon to assess the magnitudes of those changes or their long-term persistence. However, we are observing improved success at program delivery and an upward trend in adoption. When we examine information from contractor and implementer interviews, we can account for some differences among contractors in levels of basic interest in training and in subsequent adoption. In the Phase 1 evaluation, we looked closely at non-participating contractors. In the Phase 2 evaluation we found that we had largely covered that territory and devoted more attention to the growing numbers of active contractors. In the Phase 1 evaluation we found that: (1) there are *different kinds of contractor interests* or motivations to seek training that are important to understand in terms of participation and non-participation, and (2) there are a large number *of barriers to adoption* of home performance contracting practices and business models.

In the balance of this discussion of effects upon contractor-trainees, we first briefly summarize our Phase 1 findings in the two areas of contractor interests and barriers, particularly as they apply to *non-participating* or "not active" contractors. We then go on to consider program effects on *participating* ("active") contractors, and particularly several fairly distinct patterns of *adaptation* of knowledge gained through home performance training and resulting variations from the CBPCA's original preferred home performance business approach.

5.2.1 Differing Contractor Interests Have Implications for Adoption of Home Performance Contracting

It is useful to consider the different kinds of interests that contractors have in home performance and whole house (HP/WH) contracting.[37] These seem to be influenced by

[36] Among these 32 active firms, 25 participated in training sessions during Phase 2, 2 were trained during a late Phase 1 extension period between January and March 2004 and mentored in Phase 2, and 5 joined the program during Phase 1.

[37] Although we were careful to distinguish "home performance" (HP) and "whole house" contracting in our definitions above and revisit this issue at the end of this section of the report, for the sake of brevity we combine them in the expression "HP/WH contracting," used a number of times in the following discussion.

contractor backgrounds and experience—e.g., experience with energy, efficiency, programs, testing equipment, building science approaches, and related matters. On the basis of our interviews, we have identified five interest orientations related to the adoption of HP/WH contracting business models. These include the: *Disinterested and Passively Interested, Shot-in-the-arm Interest, Cutting-Edge Interest, and Experienced Energy/Performance Interest*. Of these, it seems reasonable to conclude that unless the latter two interests are evident, there is not likely to be a sustained pursuit of HP/WH contracting.

The Disinterested and Passively Interested This is a logical type that seems to be quite large, based upon the number of the contracting businesses identified in the baseline market characterization (Chapter 2). Particularly in Phase 1, CBPCA mounted aggressive efforts to solicit participation in HP/WH training from various contractor lists, but had a very limited response. In Phase 1, we attempted to interview contractors who had been seriously recruited by CBPCA, but who had expressed no interest in participating. Only one was willing to talk to us, and he didn't remember being solicited by CBPCA.

When the program offered an "introductory" orientation session in Phase 1, a number of contractors attended. Many did not participate in subsequent training and the orientation session was dropped and materials covered there (e.g., HP/WH business models and prospects) were incorporated throughout a revised diagnosis and remediation curriculum. The "passively interested" constitute a group that participates in industry training of one sort or another, but primarily to stay informed of current developments. Their specific reasons include "environmental scanning" to see what was on the horizon, checking out potential new competition, or to gain information that they could use for their own purposes. They are unwilling to commit the time to a six-day training course spread over two weeks.

The Business "Shot in the Arm" Interest A number of contractors seem to be interested in attend training in order to improve the success of their businesses. This type of interest is not limited to owners of businesses that are struggling. This is a motivation for some, but others are searching for a more successful/profitable model. This type of interest tends to be accompanied by a focus on finding a business model that can guarantee rather immediate success (profit/return on investment). These businesses may also tend to have one or more capacity barriers (see below) that limit participation.

> *"…I was doing a lot of work with the Housing Authority ... and I thought this might be the next step in it and seeing if we couldn't build our business around that aspect of construction, rather than getting into the building and remodeling itself."* (General contractor)

Cutting-Edge Interest Market actors that have a cutting-edge interest consider themselves to be leaders in the industry. These businesses have key personnel that are (1) interested in the future, (2) able to anticipate changes (technological, economic, industry trends) that may contribute to (or threaten) their long range success, and (3) willing to

invest time and money in professional development and staff training to incorporate these new "best-business-practices" before competitors do.

These contractors seem to have the potential to be early adopters of new technologies. One HVAC contractor had immediately incorporated duct testing (before and after each job) into his business, one was passing along training information to improve employee practices, and one was bringing the whole house perspective into sales by referring clients to CBPCA-trained HVAC contractors. Yet none of these contractors went beyond adopting parts of their training. None became what CBPCA considers to be "full-program adopters," providing HP/WH services on a consistent basis and in contact with CBPCA.

Reasons given varied from: (1) having no interest in changing a business model now focused on new construction, to (2) a remodeling contractor that embraces the WH concept but is satisfied to rely on CBPCA-trained HVAC contractors to test and fix any problems, to (3) an HVAC contractor (happy with training) who was unwilling to purchase the testing equipment and software prior to doing field testing.

Rationales for participating in CBPCA training that were given by contractors with cutting-edge interests in HP/WH included:

> *"Because I believe in cutting technologies and new product lines. I like to stay ahead of old stuff."* (HVAC contractor)

> *"…knowledge and keep abreast of what's going on." "[for him, the training was] …more of perfecting what I already knew and put it to practical use."* (Duct Tester/Rater)

> *"I'm … interested in newer building techniques and processes and ways to make the industry more efficient and more professional. … I'm not applying a lot of what I've learned. …I now have a different perspective on how to look at system and how to talk to my clients about getting an evaluation of a system if they want to do a whole house remodel, for example. Evaluating a whole house is now a much more critical sales tool for me."* (Remodeler)

Experienced Energy/Performance Interest As seen during Phase 1, all of the currently active Phase 2 contractors who are successfully implementing a HP/WH business model have "cutting edge" interests. But they also tend to have some energy efficiency industry experience, previous training, a current business that has at least a partial energy efficiency (e.g., weatherization) focus, a belief in the importance of diagnostics, and/or a conviction that a whole house retrofit approach is the right thing to do in serving customers.

> *"I was getting tired of it [the solar industry]. And I was feeling like there was a lot of opportunity to provide a lot more value for clients, customers than trying to build them big solar systems on really inefficient houses. We started doing forays into bringing*

efficiency into the picture. We've supplemented CBPCA training with a lot of additional training." (Remodeler/Builder)

Some of these characteristics and attitudes were also present in non-active participants who, for reasons discussed in the following section, simply have not had the capacity to a HP/WH business effectively. For example, not every contractor with experience in the energy-related industry (e.g., CHEERS raters, HVAC contractors with PG&E training) expressed a primary interest in leaning more about diagnostics. However, for some HVAC contractors this was their primary interest. Although, as we observed in several non-participant firms in Phase 1, the majority of HVAC firms were interested in a "more workable" [modified] HP model to apply to their current business. The modified model adopted by most HVAC installers does not include whole house diagnosis services but it does incorporate performance-based testing and proper load calculations.

Many of the participants in the "experienced energy/performance" interest category came to the training with a belief that the CBPCA program approach was "the right thing to do," and, rather than fearing competition, believed that "the sooner we get more contractors trained the better off we're going to be." An HVAC contractor in this category had attended training in order to:

"… give our customers additional avenues for energy efficiency. We've been promoting energy efficiency for many years and this is something else to be able to say something that's different…any time you can get yourself exposed to something new that not only are you bettering yourself, but you're also able to solve customer's concerns and problems and better understand the scope of the work that you're doing. And be able to do a better job." (HVAC contractor)

Contractors in the final two interest categories bring with them a desire for new knowledge and a commitment to improved practice. As evidenced by the percentage of inactive firms, these interests are not enough to move them fully into the HP/WH business. However, interests of this type and intensity may be necessary foundations for successful adoption in the face of a number of very significant barriers.

5.2.2 Barriers to Contractor Adoption

Contractors have reported in their interviews a variety of factors that limit their ability to innovate. These "barriers" are not insurmountable, since a number of contractor firms have been able to successfully integrate HP/WH contracting into their businesses. However, they are serious and do defeat many contractors who are otherwise sold on the idea of home performance contracting.

In the following discussion, we consider the limitations imposed by: firm type and size, degree of specialization, culture, technology, marketing, and management capacities.

While the list is not exhaustive, it does reflect a surprisingly wide range of capacity issues experienced by the contractors interviewed.[38]

Type of Business There is a wide range of business types in the residential construction industry. These include general contractors, remodelers, HVAC, consultants, and specialty contractors (windows/doors, roofing, siding, insulation, plumbing, electrical), as well as companies that offer combinations of these services. Although there are no research or evaluation literatures to guide us in this area, it is likely that at least some of these types are more likely than others to adapt to changes in the industry by adopting new business practices, new technologies, new product lines, and/or new ideas.

Unfortunately, there is no direct evidence from active contractor interviews to suggest that business type allows an accurate prediction of which companies will be willing to adopt a HP/WH model. We considered (1) businesses that did not participate in training sessions (after significant recruiting and perhaps attending a Phase 1 orientation session), (2) businesses that attended training, (3) actively participating companies. We found all of the primary business types (e.g., raters, HVAC contractors, remodelers) in each group.

In Phase 1 we found that contractors who were either currently offering HVAC services or those had some background with mechanical systems and energy programs, were most attracted to the CBPCA training. In Phase 2 we observed a broader range of contractor types, although there continued to be a large representation of HVAC contractors along with remodelers/builders, and many fewer specialty contractors.

Size of Firm The size of the contractor's organization—particularly small size—can offer significant barriers to CBPCA training participation, and to HP/WH model adoption among those who have been trained. Small size translates into limits on manpower available to allocate to HP/WH services vs. other tasks. Size is also certainly related to issues of workflow and capitalization (discussed below), although it is probably not perfectly correlated with those factors. One-person owner/operator businesses are the least likely to complete the training, while those who ultimately adopt a HP/WH model are more likely to be businesses ranging in size from 6-10+ (up to 50+) employees. The size advantage particularly benefits HVAC contractors and remodeler/builder firms, as opposed to raters/consultants, who tend to be quite small businesses.

Specialization Related to business type and size is the degree of specialization of both of the services offered in the market place, as well as in the differentiation of roles within the organization. Both types of specialization can influence acceptance and adoption of HP and WH contracting.

HP/WH work requires the use of specialized equipment. But this may also be novel equipment for the firm (or, at least, for some of the employees in the firm), depending on its specialization(s). Home performance work also requires attention to details that have long been claimed by other specialties (particularly HVAC). So, both particular

[38] These topics were discussed in detail in the Phase 1 evaluation. They are briefly summarized here and updated from Phase 2 contractor and implementer interviews.

specialization (e.g., in windows, roofing, kitchen/bath remodeling) and lack of a specialization (e.g., insulation, HVAC) can limit the ability of the contractor to seriously consider HP/WH as a business model. A remodeling contractor active in both phases told us:

> *"I think it depends on what kind of experience level people have who are getting into the program. One of the handicaps I have is that even though I have a general contractors license and multiple other licenses, I don't have the hands-on experience that I think you need to have to do the work. Not so much the testing, but doing the work. For somebody like me, I need more handholding than somebody like [other contractor]. He's a true 'do-it' contractor and remodeler and can actually do all of the work that's required, and I can't. So I have to rely on sub-contractors."* (Remodeler)

Specialization may bring with it difficulties in learning the fairly wide range of the necessary techniques involved in home performance assessment and retrofitting. However, a long-standing technical capacity, and even an HVAC specialization do not guarantee either the ability to grasp the importance of (let alone the nuances of) HP practices, or the willingness to incorporate these practices in the business. This limitation is particularly relevant to the discussions in this document of reporting issues and the non-use of building simulation software (generally not adopted by contractors in Phase 2, nor was the paper alternative developed by the CBPCA).

The following excerpt illustrates just how "radical" the CBPCA training can appear to be. Little wonder that some contractors are not interested in re-tooling themselves (and their professional egos) at this level:

> *[Training was}…'the most amazing thing I've ever seen in my life. I'm so a proponent of this program. If you wanted to be a heating and air conditioning contractor it should be mandatory to go through this program." .... And now I tell everybody: I felt like I knew nothing when I left this class. That everything that I had learned I had to relearn. It was completely interesting but very depressing because you feel like you haven't been doing the right job."* (HVAC contractor)

On the level of specialization of the firm itself, we also find that moving completely into whole house contracting and pushing beyond the conventional boundaries of specializations may run afoul of consumer expectations.

> *"I would love to be able to implement [performance testing] on every call. Obviously some calls you're not going to be able to take that approach. You know, you get rental properties; they don't care. A person moving out of a house will say "Hey I just need a unit" I mean, so you got to kind of tailor it to the needs of your customers."* (HVAC contractor)

Culture – Nature of Current Practice An area that is closely related to specialization has to do with the ways in which the trades have negotiated their division of labor across the construction industry. When we talk about "culture" and "current practice," we're speaking of the taken-for-granted ways of doing the work in the trades that include: the sequential ordering of tasks, the separation of "technical" and "manual" work (and workers), the importance of plans, codes, and the routinization of conventional practices, and (perhaps ironically) limited acquaintance with (and patience for) paperwork, reporting requirements, etc.

Unless the integration of tasks and building elements is carefully planned at the outset and monitored throughout the job, issues related to building system interactions and quality of execution can (and do) "fall through the cracks" between the trades. HP/WH is concerned precisely with these things that fall through the cracks in current practice. It is a new approach that requires new ways of thinking that run counter to conventional wisdom and divisions of labor.

> *"The rest are real reluctant. I mean it's like…their attitude…seems to be that 'you can't tell (me)', 'I've been doing this for thirty years.' You know? I've even had a couple that I had to quit testing for the builder because the installer just would not comply. He would not get away from the duct tape, he didn't use mastic with it, he just would not comply. … Those are the types of things that I run across."* (Tester/Rater)

The HP/WH integration approach also runs counter to the conventional installation business model, particularly in the HVAC industry.

> "*Probably our biggest battle is getting the customer to understand the need for this type of work. Probably [more help from the CBPCA] on the marketing side of it, maybe some more customer awareness away from the actual contractor. Because, you know, the customer feels that we're just trying to sell them something. They just don't realize that if I threw a $20 bill on the ground they'd pick it up; they lose ten times that much every month and don't even know it."* (HVAC contractor)

Poor Network Development A related problem, when attempting to adopt a new whole house retrofit approach that requires the combined work of technical and installation people in the areas of HVAC, windows, insulation, and so on, lies in the lack of network connections among the trades. General contractors tend to know and work with multiple subcontractors. Subs may encounter one another on the job (although efforts are made to keep them apart). Remodelers often have to master multiple trades themselves, although they also have to work with a variety of specialists (e.g., HVAC contractors, interior designers, plasterers, painters, etc.) in doing their work. Overall, however, the industry is not tightly networked along the supply chain. Because an integration and combination of improvements are required by the HP/WH approach, it is necessary that successful contractors either perform all of the required work in-house (using their own crews), or carefully coordinate the work of various subcontractors, as indicated by each job.

Semi-stable networks of subs that have experience working together on WH projects can alleviate some of this. However, current poor network development reinforces narrow perspectives on the work that hinders current specialists in developing a sustaining interest in the WH concept. In fact, a number of the small and/or specialized contractors we interviewed lacked the experience and comfort in working with specialty subcontractors. One remodeler put the problem this way:

> *"It would be nice if some of the contractors that went through the program were not just HVAC contractors. We end up having to find insulation contractors who will comply. It's always an argument in terms of what will work and what won't work. These guys are used to doing what they think is the right way to do it. It's just troublesome."*
> (Remodeler)

Work Flow, Pre-Existing Commitments, Scheduling Problems Under the best of circumstances, the flow of jobs is matched with the assignment of employees leading to tight schedules and efficient use of human resources and equipment. This means that, except in large firms, time is limited for owner and/or technician HP/WH training. In most cases, however, contractors seem to face backlogs of work and shortages of labor that make participation in training and venturing into new areas of service even more difficult. The dynamic tension between training and getting the work done is illustrated by a comment made to us by a remodeler:

> *"... we're looking for some one day tactical seminars on like air sealing techniques that our guys could go to. ... we sent our crew out to do the six day training and they went to the first three days and bagged the second three days because they thought it was a little over their heads. Whereas I'd love to give them some training that they could really apply, they don't need to know the building science 100%. They need to know the basics: how a blower door works and how to use it."* (Remodeler)

The non-participants and partial participants interviewed, almost to a person, reported that "lack of time" as a common barrier. Most of these contractors had very small operations and were unable to find a block of several days in a row for training—making this barrier almost insurmountable, in their view. There are also unpredictable fluctuations in consumer demand for work, as well as seasonal factors at play. So during some periods there isn't time for training, while during others there may be.

Price/Commodity-Driven Estimating and Bidding Practices Work flow and time constraints can also be traced, at least in part, to commodity pricing. An illustration is the change-out of HVAC equipment—drop in a new box, same size, same BTUs, lowest price, shortest installation time, and highest profit. Not only have contractors come to adopt this approach, but also they expect that consumers now expect it as well, demanding the lowest possible bids for commodity equipment and services. To offer a

non-commodity package is seen to risk customer "sticker shock," that pushes them toward more conventional competitors. To take a concrete example, an HVAC contractor faced with balancing the problems of cost, size, and air flow might recommend an oversized unit to a customer, rather than risking losing the job by suggesting a more appropriate plan that includes two smaller units that will cost somewhat more, but in the long run be much more energy efficient.

Moving away from a commodity (high-volume, predictable-margin) pricing model is often perceived to be risky, with the very existence of the firm at stake. Threats to cash flows, payrolls, lines of credit, and tax payments, etc. can result. Lack of familiarity with cost estimation in areas outside of comfortable specialties (e.g., HVAC replacement), and having to solicit coordinated bids from subcontractors, raises concern, as does the potential for large amounts of technician time devoted to diagnosis, estimation and reporting.

Low Capitalization and Significant Cash Flow Issues In part because they are trapped in a commodity model, many small firms lack the capitalization and cash flow needed to cover the required investment in new HP testing equipment. These firms are also not able to routinely fund professional development and/or employee training, to cover the costs of lost business during training time, or to front the resources that may be needed to support new marketing costs. These barriers represent the practical limits many firms face that prevent them from pursuing cutting-edge interests.

> *"To actually get a mechanic trained in it was going to cost me close to five thousand bucks, and …the tools—another six thousand. To be able to go out on a [new venture with] what appeared to be a, very, very limited market. … we were talking about doing a joint venture in this area as a separate entity. And it just didn't pan out. It just didn't make sense. Not enough for me to invest four days of mine or my mechanic's time and to buy thousands of dollars of tools."*
> (Mechanical/General contractor)

Human Capital, Organizational Skills, Management, Planning Reports from both small and large contractors underscore the importance of employee professional development. As the construction industry has become more complex (in terms of technology, regulations, etc.) it has become increasingly difficult for contractors to manage all aspects of the business equally well. The number of training sessions offered by manufacturers, trade associations, private consultants, and utility companies attest to the need to constantly update skills.

Among those interviewed, we found that companies with at least several employees (including technical and office support staff) were more likely to complete training, and were more likely to begin to transition toward a HP/WH business model. While adding home performance testing to the business may not require additional personnel, the transition to whole house contracting does require a somewhat higher degree of management, organization and planning skills than are available in many very small companies.

Our interviews also led us to believe that HP/WH businesses owners require a sense of purpose or a vision for the future of the company. Having a plan and a sense of direction that allows for innovation may be a key difference between businesses that innovate and those that barely keep up with daily business. However, simply being on the lookout for opportunities to innovate does not seem to be sufficient. In our typology of contractor interests, those with the "shot-in-the-arm interest" are looking for business innovations, but they generally lack the capacity to adopt them. Successful or transitioning contractors, on the other hand, have a business model and a plan for the future into which whole house contracting fits.

The business owner with the vision must also have the authority to change the future direction of the company, and be willing to invest resources and time to implement their plans. This means that they sometimes must make significant resource commitments to get though the development stages that involve purchasing equipment and training staff not only in new ways of acting, but also in new ways of thinking.

> *" I would probably say (I've invested) $30,000 to $35,000. That's the equipment, the training (of self and employees), and the time away from work, all of it."*
> (General/HVAC contractor)

Successful whole-house contracting also requires skillful management of disparate groups of employees and/or subcontractors to ensure that complex work scopes are done well, within budget, and on time. A highly developed combination of the needed skills is hard to find, even in larger firms. Several successful contractors seem to be moving strongly in that direction. However, the most successful firms seem to be the larger ones that have the capacity to do most of the work 'in-house.'

Marketing and Sales (In)Experience Many contractors claimed considerable sales expertise in our interviews. However, HP/WH contracting seems to require more in the way of marketing than selling—and sales and marketing are distinctly different undertakings. For example, in most conventional HVAC, remodeling, repair businesses, "leads" and "jobs" are generated by past dealings, a good reputation, referrals, and perhaps an advertisement in the Yellow Pages. However, marketing new products and services requires more, including public and customer education. When this happens now in the industry (e.g., when a new furnace technology or window system enters the market), the marketing responsibilities are largely borne by product manufacturers and wholesale distributors.

As in Phase 1, the CBPCA continued to spend considerable effort to incorporate business and market strategies into its training in Phase 2. But some contractors had a difficult time seeing its value (e.g., we found very few using CBPCA marketing materials), and others failed to understand how to sell a service on the basis of anything but price. However, most active contractors clearly understood the value of educating their customers. According to one whole house contractor, educated customers are a valuable source for new referrals, despite initial negative reactions to price:

"… when we go out to talk to somebody who has been referred to us [by previous customers], they're almost sold before we get out there. … it's just a matter of kind of taking them through a few steps to let them know what we find about their particular house and what issues need to be resolved and what it's going to cost. … and they were just absolutely astounded at what it was going to cost to do the repairs. … However, I was able to show them, and give them some referrals, and even though what we actually did for them eventually cost about double what they were planning on spending, they did it, and they're extremely happy." (Remodeler/Builder)

Degree of Integration of Computers and Information Systems A final potential problem area for contractors interested adopting in the HP/WH approach involves the use of computers and information systems. We assume that even the smallest business uses computers for at least accounting and billing, and that many use them for inventory databases, internet searching, and other common business functions. However, the fact that businesses own and use computers for office support does not mean that they possess the hardware, software, or technical skill-sets necessary to do computer-based whole house modeling, system simulation and sizing, complex estimating, financial planning, job/bid coordination and tracking, or web-based reporting. Possession of at least some of these capacities is a definite advantage in adopting HP/WH approaches, and their absence is a definite handicap.

We learned from many of the contractors that mastering the TREAT software was a significant challenge. In fact, in the case of one of the most successful HVAC+ contractor firms, the owner told us that: *"Most of the guys [5-6 of his employees] who went to the training, flopped with TREAT software. I finally learned TREAT… [and] found one guy with the temperament, gifting and patience needed to run the software."* In this firm, the responsibility for testing, data input, report production, and the review of the report with the customer was handled by two persons (who subsequently left the firm, taking their skills elsewhere). Also as noted several times earlier, by the beginning stages of Phase 2, active contractors were no longer required to do *TREAT* runs, and were permitted to complete the 14-page data collection form (although few did so).

"I have TREAT and I don't use it. I wish I didn't buy it. I don't estimate energy savings now." **[**Why not?] *"We just haven't gotten that far I guess. We haven't done the calculations.*" [Do you use…the CBPCA's 14-page datasheet when doing the home diagnosis?] *"Well, we use parts of it. ... "It shows a test in and test out. We enter it on that form."* (Remodeler/Builder)

On the other hand we did hear from some HVAC contractors that have incorporated the use of other technology packages to do load calculations (e.g., Wrightsoft).

5.2.3 "Successful" Contracting: Transitioning and Adapting

Contractors who have "successfully" moved toward home performance contracting with the assistance of CBPCA are a mixed lot. We believe that they have some common characteristics, including particular interests/perspectives and adequate resources to

overcome some fairly daunting barriers that prevent most contractors from entering the business. However, "becoming active," "adopting the business model," and "becoming successful" in home performance work, is not something that happens overnight, and the *transitioning* to HP/WH contracting often proceeds in fits and starts. Active contractors may turn to other demands and return to HP/WH work when they can. Some firms have gone out of business, particularly through retirement. The integration of HP/WH principles and practices into ongoing businesses (often when these are actually thriving concerns in their own right) is not a straightforward process, and it often does not have a linear trajectory. At the end of the day, the "fitting" of HP/WH involves "fitting in," and this process has resulted, we believe, in the contractors "morphing" into several types of active HP/WH practice.

In the balance of this section, we explore some of these dimensions of (1) active contractor interests, (2) fitting in or adapting HP/WH principles and practices, and (3) resulting patterns of HP/WH contracting.

Active Contractor Interests All of the active contractors have embraced the home performance contracting approach because they identify themselves as being on the cutting edge, they want to boost their business, and they have previous experience, a current business that has at least a partial energy efficiency focus (e.g., proper duct sizing and sealing), a belief in the importance of diagnostics, and/or a conviction that a whole house retrofit approach is the right thing to do in serving customers. Attempts were made to interview all active contractors—including both those who were trained in Phase 1 and were continuing in the business and contractors newly trained in Phase 2. Most were interviewed several months after they had completed the training in order to allow some time for their HP/WH businesses to develop. A number were interviewed on several occasions in order to gain some perspective on the impacts of the training and mentoring on their businesses. They expressed their motivations for taking the training and moving toward HP/WH contracting in a variety of ways:

> *"I tend to be a little more oriented toward the engineering end of things than the other guys are. So to me it's not that daunting of a challenge to do the diagnostics. I think it's an excellent sales tool. I think it's good for diagnosing the house pretty safely, giving them exactly what they need. I think the program is very good. So I wanted to participate in it"* (HVAC contractor).

> *"The whole purpose of the company is to retrofit homes to be healthier and to save energy. So this program really fits in quite well with the entire theme and mission of the company"* (HVAC contractor).

> *"…it really was just kind of right up my alley and it put it in all into one basket and I thought "Boy this an organization that's going to provide training for us and support in one way or another," of course, they didn't know to what extent they were going to help us, help support us, but that's really why I did it. We really love what we're doing and we enjoy being able to solve people's problems that nobody else has been able to solve."* (HVAC contractor)

"…it's a totally new field for me. I don't have any experience in HVAC or insulation so there's quite a huge effort in terms of getting up to speed in terms of any kind of basic knowledge. But that's not a big deal…We're just getting the experience at this time" (Repair and remodeling contractor).

But the process clearly involves some important changes in conventional practice. As one contractor put it when we asked him to describe the split between his traditional work and the HP work he was performing:

"I'm transitioning, but I don't necessarily turn away other work. Although I'm not necessarily seeking it." (Remodeler)

Adoption as Transitioning Our contractor interviews led us to understand that adoption is a process of transitioning from conventional "business-as-usual" to new forms of practice. In this process, there are some important issues related to *timing, peripheral adoption,* and *spill-over benefits* to conventional practice. The following excerpt from an interview with a remodeler/builder regarding transitioning is fairly typical:

[Since taking the training, are you doing anything differently in your business?]
"Not yet, but we plan on buying on all the equipment. You're blind if you don't see where the market is going right now. It's either you make the transition now or you make it later. It's just little by little now, the direction that we're going. We're a relatively small company and it's what we've been slowly growing toward, you know, pushing the home performance package with clients."
(Remodeler/Builder)

Timing Even contractors with strong commitments to HP/WH work and strong capacities to deliver, may delay adoption or move at a fairly slow pace. When we asked the owner of an HVAC service (that he has operated for 27 years) why he decided to take the CBPCA training his responses (below) illustrated the importance of timing.

"Well I took it because I've had an interest in this direction for quite some time and I've tinkered in it in the past. It sounded as though this might be a way for me to do more than just tinkering."
[Did you have any interest in or experience with green buildings or building science or the "house as a system" before attending?]
"Whole house diagnostics. Actually at one time seven years I went through the 'retrotech' training and we purchased a blower door from them. We tried to get that off the ground and running and really couldn't get much off of it."
[Because people just weren't into that at the time?]
"I think it was probably a little too sophisticated for the customers. I think it went to market incorrectly." (HVAC contractor)

In another case, gradual adoption and slow initial demand was replaced by a rapid expansion of HP/WH services, while the firm continued to provide parallel conventional HVAC services (although with an eye toward home performance issues). During our first interview with the contractor, we discovered that this firm did not charge for the diagnostic service—not even the $100 suggested by the CBPCA. Rather, the owner wanted "to offer this service to whoever needs it, based on their ability to pay. And often times I'm in somebody's home that really can't afford the whole diagnostic and yet, they need to know what's going on, so I'll do it anyway." He did this even though the income generated by individual technicians at his firm was not enough, sometimes, to pay that person's salary. However, by the time of subsequent interviews, the owner was able to report that the return on his investment (in terms of time and money) had been "phenomenal." His firm "…spent probably close to $30,000 after having gone through this program a year ago [2003], and we've paid for this equipment several times over." A problem that strains the capacities of a medium-sized company like his is actually too much business.

Peripheral Adoption By "peripheral adoption" we mean fitting in HP/WH services "along side" of conventional services. For example, the owner of a large firm had taught courses on home performance contracting at a recent conference and at the time of the interview was preparing to present at home shows and fairs. However, the HP diagnosis has the status of an optional service—only one of a number of services that firm provides. This is due less to low profitability of HP-linked services, than the need to keep the other parts of the business healthy. In this case there is an under-utilization of capacity to do building performance contracting.

Peripheral adoption is common among the HVAC firms. They typically adopt all aspects of the training related to their "piece" of the whole-house puzzle by right sizing, testing and sealing ducts and in a few cases insulating. The following excerpt typifies this level of adoption:

> [In homes where you have ended up mostly providing the same products and services that you did before starting the HP approach (e.g., a new AC installation) - are there *any* specific things you now do differently because of the training?]
> *"Duct blast test as part of job."*
> [If you are offering different products or services (since starting HP testing), what are they?]
> *"Data logging, CO2 monitoring, insulation upgrade, blower door test. .... load calculations [using]Wrightsoft."* (HVAC contractor)

Spill-over Benefits to Conventional Practice A limiting factor in this case involves the current business practices of a (very large) trade ally. Besides generating it's own clientele, the contracting firm provides "in-house" air conditioning services contractor for a major hardware store. As a result, the firm "…[does] a lot of just air conditioning . . ." through this arrangement. At the same time, they try to tie in diagnostics with AC installations, but usually only to the extent of testing and sealing ducts. The arrangement with the retailer prevents them from addressing issues related to insulation and windows,

since different contractors provide those services for the retailer. In fact, in much of their own air conditioner replacement work, full diagnostics are not used—a pattern that we found to be fairly common among HVAC contractors.

Although a firm may be proficient with diagnostic equipment and simulation software, they may use these in selective ways—at the same time believing that they are providing appropriate HP benefits. For example, one of most expert of the active contractors with the TREAT software (e.g., reporting an average of 45 minutes to input data and do a TREAT run), much of his work involves "changing out ACs" where a full-diagnosis is generally not performed:

> *"… I don't really do a full diagnostic. There have been a few that I have but I make that very clear that we're doing a full battery of diagnostics for them and then I will charge them. But typically, just on a regular air conditioning sale, no I don't charge them for that."* (HVAC contractor)

Like all of the active contractors, this firm *tailored its approach to customers and does full or partial diagnostics based on the needs of the customer.* If given a choice, customers may buy parts of retrofit packages (e.g., duct sealing which tends to be less expensive and have a good pay-back).

Using an example from a remodeling contractor, we find different sorts of spill-over effects on jobs where HP/WH work is not explicitly being conducted. One contractor described a traditional roofing job that involved repairing two surfaces (putting a new coating on one and fixing a leak on another). But applying his HP/WH training, he knew that this was the best time for the homeowner to consider adding insulation since the roofs had limited access (to insulate later would require putting a hole in the new roof).

> *"…my whole house approach let's me think beyond [just the traditional work scope] and realize that this is an opportunity to do this [add insulation]. I've done that through the years–if someone's going to paint their house, this is a great time to drill and insulate the walls and then paint. It's harder to go back. I've always had a sort of whole house approach but certainly now I've got a lot of the training and diagnostics and can practice it at an even deeper level."* (Remodeler)

Alternative Patterns of Home Performance Contracting It is clear that, instead of adopting one single "ideal" pattern of WH/HP diagnosis and retrofit, active contractors have implemented a variety of adaptations. This is hardly surprising, since the evaluation has assumed from the outset that the WH/HP model would have to "fit into" ongoing business and technical practices.

One example is the development of the extensive data-logging form for use by contractors when it was learned that there were significant barriers to their use of all of the CBPCA's 14-page data sheet when doing the home diagnosis, the contractors reported: **"**. . . we fill them out as much as we can…," ". . . we use parts of it…," ". . .

I probably fill out a third of it. They've got formulas and stuff in different boxes that really we're not doing…," "…at the moment I write information down on paper. My ultimate goal would be to have a PDA…," and "…we don't use it at all." As we have noted at several points earlier in this report, contractors' non-use the data sheet and not collecting and/or recording pre- and post-retrofit test results means that the CBPCA has received little data about actual jobs and retrofit performance.

Again, our interviews with contractors tell us that this really should not be surprising. The use of experience, "craft" approaches (learned practices substituting for technical measurement), not having time for record keeping, failing to report, etc. are all part of business-as-usual for most of the contractors. They have skills and are learning new ones—a craft—that they want to apply in ways that make sense to them in their businesses.

It is also clear that they are serious about incorporating HP/WH practices, insights and principles into those businesses. They conduct formal testing when required or when it may be indicated, but they also use experience and rules of thumb in other cases. As one contractor reported: ". . . a lot of [the homes] are having the same things going on, so I'm offering very similar retrofits: the crawlspace, it's the attic, sealing the house, and then the heating systems. We'll give some options with that, one is to fix the ducts but that always leads to something else." It's fair to note that most of the California housing stock was built post-WWII and mostly by mass-production merchant building methods. Housing "tracts" in California contain many nearly identical buildings that would be expected to have similar problems and solutions. This is not to advocate a "cookie cutter" approach that short-circuits HP/WH methods or to suggest that house-by-house diagnosis and testing is not necessary. It does suggest that some experience-based craft methods are to be expected and are not likely to produce misleading diagnoses or poor retrofit results when applied with conscious attention to HP/WH perspectives that see the "house as a system."

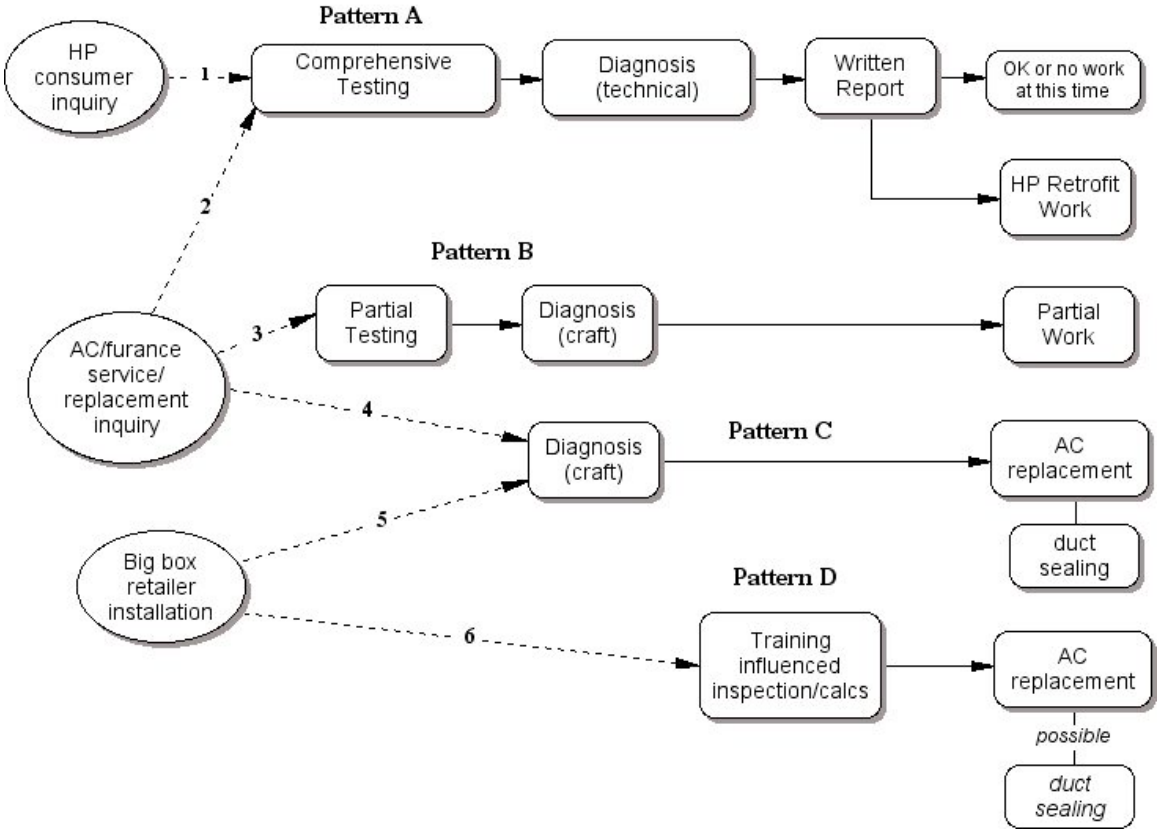
At the end of the day, these active contractors are in business, and this is generally *not* exclusively the home performance business (although there are some notable exceptions). The contractors are in the HVAC business or remodeling business or windows business. HP services turn out (again with some exceptions) to be a part of their business. It remains to be seen how their particular patterns of adaptation—and their own shifts between patterns for different clients—affects the HP process and the ultimate HP product, the retrofitted home. More will be said about this in the following chapter.

However, it is clear that time is needed for newly trained contractors to either move strongly in the HP contracting direction, or to modify their businesses to more fully incorporate HP, or to learn how to juggle HP services with other business products, or to move away from HP and back to business-as-usual in their usual businesses (whether these might be HVAC, remodeling, or inspection businesses).

A Graphic Model of Adoption Patterns We have started to think about a model of differential HP/WH adoption and adaptation along the lines of the graphic in Figure 5

below. It displays rough stages in the HP process as well as access routes for customers to HP services. The challenge, in terms of the latter, is how to move homeowners and contractors from entry path 3 to path 2, from path 4 to paths 3 & 2, and path 6 to path 5.

Figure 5. Graphic Model of Differential HP Process Adoption



Here's what we mean. "Pattern A," is essentially the CBPCA "ideal" approach—it is approximated by only a few contractors full-time and some contractors part-time. "Pattern B" is a more common form. It involves technically competent (but also selective) incorporation of testing and building science into HP work, as well as elsewhere in the firm's services. "Pattern C" is a more ad hoc approach and "Pattern D" is essentially change-outs of HVAC units. Both of the latter two patterns may incorporate some level (which we stress is *still novel in the industry*) of CBPCA-inspired attention to unit sizing and ducting.

Contractors also move between patterns, depending on the sources of referrals and what the customers are asking for. We know that very few customers seek out HP services, since these are not widely known.[39] Contractors sometimes recommend HP diagnosis,

[39] Only 3 customers, when asked in our several survey waves, reported that they had specifically sought out a contractor for HP services.

but they also are hesitant to "sell up" if customers do not seem receptive and they risk losing the sale. A few contractors don't want to compromise and offer less than a full HP services package. But they are in business and can hardly be faulted for selling a lesser product if that's what the customer demands (and what happens to be common practice in the industry).

We do not have pre/post building performance information to draw upon to test our hypothesis. However, we surmise on the basis of our interviews that all patterns provide HP benefits, even when only what may seem to be conventional change-outs are taking place.[40] In our Phase 1 evaluation, we raised the question of what the consequences (including health and safety) of partial adoption might be. We still are not certain, although we do have some evidence of concern for health, safety, energy savings, and other consumer benefits from contractors' self-reports of how they approach their jobs and how they think about quality home performance-beneficial work.

5.3 *Benefits to Consumers of Home Performance Services*

In this section, we consider benefits to consumers who received home performance services from CBPCA contractors. The primary source of data in this analysis was customer survey responses that built upon in-depth interviews with customers in the Phase 1 evaluation. The following topics are covered in this discussion: profiles of participating homeowners, routes of initial customer contract, the nature of customer concerns and motivations for pursuing home performance retrofits, contractor/customer interactions, and customer satisfaction with services and outcomes.

5.3.1 Customer Profiles

Who are the customers who purchased whole house diagnosis and/or home performance work in Phase 2? Are they different than the average homeowners living in the PG&E territory?

For successful program marketing, as well as for estimation of the potential energy benefits achievable through HP contracting, it would be useful to know if the homeowners who make retrofit and remodel decisions based on the HP approach are unique in any ways. If so, ideally we would like to develop a typology that describes those consumers who are more likely than others to contract for home-systems retrofits (e.g., air conditioner or furnace replacement), building improvements (duct sealing, ceiling or wall insulation, air sealing, etc.), or major retrofits (e.g., window replacement). With a segmentation typology, we can then use population data to better define the likely size of the market and the potential for future energy efficiency gains.

[40] In fact, 91% of 185 air conditioner installations reported by contractors to the CBPCA included duct sealing, and in 78% of the cases where SEER data were reported, the units were at the SEER 14 level or higher—in both cases presumably significant improvements over the efficiencies of the systems being replaced.

Our current sample (N=74) is too small to support detailed segmentation. However, our findings to date are suggestive and may be relatively robust, given the characteristics of program sample households compared to the general population. We were pleased to have an unusually high response rate on the income, race, and ethnicity questions in Section 3 of the survey.

Every case in our sample had these characteristics in common.

They occupied single-family detached vs. multi-family dwellings
They were homeowners vs. renters
They had older homes (all were built prior to 1992)

If these were the only distinguishing characteristics available for refining the potential market, we could, for example, estimate that the potential market in California might include 4 million households–the approximate number of single-family, owner occupied, pre-1997 homes (CEC 2004). However, by also considering length of residency, income and other socio-demographic information, we will likely be able to better refine estimates of the sizes of target markets for purposes of collecting baseline information on market conditions for the final EM&V report.
Among those surveyed, seventy-two (of 74 or 97%) respondents reported on the age of their home. It turns out that all units surveyed were built prior to 1991, with the year built ranging from 1890 to 1991. There was no significant difference in the array of house ages between those who reported having a HP inspection vs. those who did not.

Length of residency offers an interesting case in point because it varies in California depending on home ownership and housing characteristics. From the 2000 U.S. Census of Population and the California Energy Commission's Consortium Residential Appliance Saturation and Unit Energy Consumption Study (CEC 2004) we know that 14-21% of the population in California moves every 12-18 months. In other words, the length of residency is quite short—around a year—for up to one fifth of the population. Additionally, RASS data suggest that, in recent years at least, 43% of the population had a residency of 4 years or less, while 57% had a residency of 5 years or more (23% with 5-10 year residency and 34% living in their present dwelling for more than 10 years). In addition, single-family owner-occupied homes have a different residency profile than the general population–especially in the "more than 10 years" category. For this subset, RASS results estimate that 67% of single-family homeowners are in residence for 5 years or more (20% with a 5-10 years residency, and 47% with a residency of more than 10 years). In a sub-sample of surveyed customers who purchased retrofits, the vast majority (80%) report living in their homes for 5 or more years, with a notable majority (65%) having lived in their homes for 10 years or more.

We would also be interested in how many of these home owners are involved in remodeling activities, and how many may own major systems—particularly central air conditioners—that may be old enough to be candidates for replacement. Due to the limitations built into the KEMA-XENERGY online RASS query-system, it is not possible to generate cross-tabulations that consider further the potential relationships between *residency and remodeling*. However the RASS data do show that among an

estimated 4 million older (pre-1997), single-family, owner-occupied homes in California, approximately 1,100,000 (27%) have central air conditioners that are 14 years old and older—homes that could possibly save a significant amount of energy by upgrading their older air conditioners to the newer, higher SEER models presently available.

It has frequently been theorized (e.g., most recently in the California AB549 study process) that home retrofits tend to occur when people first move into an older home (with upgrades financed at the time of sale). However, retrofits are also likely to be undertaken by homeowners who have been in residence for some period of time (and are able to purchase retrofits outright or can finance them through a second mortgage). Based on the length of residence among our sample of homeowners who actually upgraded their older homes, the data suggest that the likely target market for retrofits/remodels are among homeowners with a longer rather than a shorter length of residency.

With small samples representativeness and bias must be addressed. While we would expect that our customer sample would be different from the general population, we might hope that it would be somewhat similar to the population of Northern California homeowners living in single-family detached dwellings. The study sample, including diagnosis customers that may or may not have purchased retrofits, is very similar to the RASS sample on a number of key dimensions. These include length of residency (60% of sample vs. 47% RASS more than 10 years), household size, and household composition (slightly more with no children, 45% HP sample vs. 31% RASS), and income. However, there are two notable differences. First, the level of higher education, on average, is higher among those who participated in the evaluation—31% post graduates degrees vs. 23% in the RASS sample. Second, 10% of our survey respondents self-identified as Latino while in the RASS survey 18% of the heads of households among single-family homeowners are reported as Latino. In terms of race, our sample is 60% "White," 7% "Asian," 1.4% "Black," and 3% "Other." Thirty percent (30%) opted not to respond to the race question. This distribution is similar to the RASS single-family PG&E homeowner distribution of reported race/ethnicity of heads of household: 66% "White," 9% "Asian," and 4% "African-American"—values that are quite different from the overall California population, of course.

5.3.2 Routes of Initial Customer Contact

We have fairly limited information from our surveys regarding customers' primary reasons for contacting their contractor. In Phase 1, the primary route was assumed to be the CBPCA toll-free number that customers would call because they were interested in having a comprehensive home inspection prior to contracting for possible retrofits with a contractor. In Phase 2, contractors reported various diagnoses and reporting methods, and different routes by which they came in contact with customers–from CBPCA referrals, to calls for HVAC replacement bids, to responses to yellow page ads.

Exploring Reasons Why Customers Contacted Contractors When these new routes of contact became apparent, we made some modifications to our survey instrument between survey waves, to include a question about how the customer contacted their

contractor (for a home inspection, a bid for major work, etc.). Because the question was added mid-course, not all customers had an opportunity to respond. So about 50% of the total sample was asked, "What was your primary reason for contacting [_____ your contractor, name inserted]. Thirty percent reported that they called in order "to get a bid for major repair or replacement work" (N=14 with 10 reporting that they did get a diagnosis), thirty-four percent contacted the contractor specifically "to conduct a Home Performance inspection" (N=15) or "to check on air quality improvement" (N=1)–all 16 in these two categories reported having a diagnosis. Several reported they wanted both a bid and an inspection (N=3, all reporting a diagnosis), and in 1 diagnosis case the contractor recruited the client.

These limited results suggest that customer demand seems to be fairly evenly split between routine replacement or repair and a broader interest in comprehensive Whole House/Home Performance testing. This is hardly surprising, since few customers would be expected to even know about the WH/HP process in the absence of public information in Phase 2. A very thorough and supportive article in the *San Francisco Chronicle* in March 2005 (and archived on the California Home Performance Program website) did create some public exposure and led some customers to seek out an HP contractor as a result. And probably to a smaller extent due to circulation, a comprehensive article about Home Performance contracting in the *Home Energy* magazine (March/April 2005) also helped to expand public awareness.

Customer Information Sources When surveyed, customers were also asked where they found out about home testing and contracting services. The following sources were cited (multiple responses allowed):

- Internet (6)
- The Yellow Pages (3)
- Newspaper, TV, or Radio (5)
- Friend or colleague (3)
- Home Show (4)
- A HP consultant or contractor (8)
- Other (14)
- No response or didn't get a home inspection (29)

The other responses included (1 each) "we were contacted by X (the contractor)," "while researching air home quality," "did test as part of sales pitch," "energy-window technician," "Home Depot," and "I'm employed by the contractor." Overall, these results tell us relatively little about sources of information, except that they are quite varied and none are predominant.

5.3.3 Consumer Interests and Motivations

The social benefits of home performance retrofits are relatively clear: greater energy savings and reduced environmental harm. However, these may not be the most important benefits to consumers. Consumer choice is strongly influenced by what consumer's value, and what they value depends upon what they perceive to be valuable. Home

performance customers sometimes refuse to pursue simple cost-effective retrofits, while at other times they can invest considerably more than would be justified by energy savings alone. So the evaluation has been particularly interested in better understanding consumers' *interests* in home performance and their *motivations* for pursuing retrofits.

In this discussion, we first consider some of the complexities involved in pinning down interests and motivations. Second, we recap findings from Phase 1 in-depth interviews with consumers that served as the basis for our exploration of motivation in the Phase 2 customer survey. Third, we report results from that survey that give us a better understanding of why consumers pursue home performance services and products. Finally, we consider methodological issues for program evaluation that these findings raise.

The Problem of Conceptualizing and Measuring Motives This study of consumer motivations for pursuing retrofits offers an opportunity to test an assumption that the energy efficiency community has long held. That is, that interest in *reducing energy costs* is the prime motivator for consumer purchase of retrofits and equipment upgrades with higher energy efficiencies. When consumers make "irrational" decisions about energy efficiency investments, this is usually met with either puzzlement or a shrug. These "irrationalities in consumer calculus" around energy costs and investments have been recognized for some time, of course.[41] For example, it is often said that consumer discount rates are unreasonably high. And most analysts can probably empathize with consumer "sticker shock." However, energy costs are still assumed by designers, implementers, and evaluators of efficiency programs to be fundamental motivators of efficiency choice.

Energy cost savings is an important factor for many HP Program customers. However, our interview data from Phase 1 showed clearly that it was not *the* prime motivation for those customers. Many certainly have high bills, but they also apparently sought out HP services to address other perceived needs as well.

When we asked CBPCA trained contractors about their views of customer motivations, one experienced contractor (in the HVAC business for 22 years) said:

> *"That was a question also that came up in [our CBPCA training] class: 'Individually each one of you tell me what has been your experience that customers have as their most important need. Is it energy efficiency? Is it comfort? Is it what?' And, since doing this for several years now I have a pretty good background in customer's responses, both during the interview with the customer and during the repair work and after the repair work. Most of the time it's energy efficiency that people talk about. Once in awhile you'll hear something about health. ... Yet as the work progresses and gets completed most of the people are absolutely amazed at the improvement in their comfort. Naturally there is energy savings in almost everything that we do, but comfort*

[41] This is also as true for firms as for individual homeowners (see Biggart and Lutzenhiser 2006).

seems to be the one issue that surprises them the most. Now I can't say that it's most important on their list but that's one that they talk about with deeper emotion, the difference in comfort."

This one opinion encapsulates two important conceptual questions that raise methodological issues. First, what do people mean when they say "energy efficiency?" Are they concerned about the cost of energy, are they resource conscious, or do they mean a combination of the two. Second, which responses should be included in an analysis of customer motivations? Should an analysis be limited to initial responses to a *direct* question about motivations (e.g., "*First I'd like to find out WHY you were interested in having your house tested?*), or should motivations (solicited and unsolicited) mentioned throughout the interview be included? Wherever possible, the evaluation team attempted the latter. We made every effort to understand what people really meant when they referred to "energy efficiency," by prompting for more detail and considering other open-ended responses. Also it is worth noting that in-depth interview respondents had a tendency to report different motivations (or to elaborate upon their initial motivations) throughout the interview.

In fact, customers' responses generally indicated that *several* related questions *must* be posed if researchers hope to capture a fully considered response regarding motivations. In the case of a few customers, their replies to the first "WHY" question "told their whole story". But even then, as seen in the second example below, a follow-up question regarding health issues serves the purpose of validating the initial response:

WHY: *"We were using lots of energy and so we decided to do a few things: new roof, all new double-pane windows. And after all that our energy bill didn't go down! We almost gave up on doing any more projects. My husband also has allergies and asthma. We're pulling out the carpets and used to have lots of animals, but now we only have one. So that was a concern, but mainly we were concerned about energy efficiency."*

WHY: *"Because I'm not getting sufficient airflow in one end of the home."* **Does anyone in the household have health issues like asthma or allergies?** "No. It's strictly a comfort issue. *A little too hot in the summer and a little too cool in the winter at one end…."*

For other customers, their replies (to the first "WHY" question) only "told part of their story." As seen below, additional questions are needed in order to flesh out a more complete picture of their motivations:

WHY: *"Because I was interested in finding out if there were any, I guess you could say gaps on the environmental side. For example, like dust, that sort of thing. I was probably concerned more about dust than the efficiency of the heating and air conditioning."* **Does anyone in the household have health issues like asthma or allergies? "***Yes, … wife has asthma."* **And is that one of the reasons why you wanted the [house] checked out?** *"Yes it was, actually."*

WHY: *"We were uncomfortable. Parts of the house weren't getting air-conditioned. We knew we had to replace the air conditioners and were taking*

bids, and would probably have to replace the furnace." **Overall, would you say you're more interested in "healthy house, energy, comfort, cost, environment" or some combination of these?** *"Well, comfort and energy efficiency, of course. Our bills are so high."* **Does anyone in the household have health issues like asthma or allergies?** *"My son has asthma, but I let him deal with it. He'll have to clean his own room. It' a mess! So if the dust accumulates, that's his problem."*

WHY: *"Because the price [of the test] was cheap and I've got to come up with a furnace replacement in a few years."* **Overall, would you say you're more interested in "healthy house, energy, comfort, cost, environment" or some combination of these?** *"Vaguely they all touch on it. It's just primarily I know I'm coming up on a replacement."*

An entire HP diagnosis and retrofit process can take several weeks (scheduling and conducting the diagnosis, contractor analysis of test results, customer/contractor consultations, scheduling of retrofits, etc.), and our interviews with customers occurred when they were at various stages in this process. As a result, the motivations that customers report for being interested in the test may be somewhat bound up with their reaction to home diagnosis results and their reasons for purchasing (or not purchasing) the recommended retrofits. For example, when we asked if there were things she had wanted done to her house prior to the test, one customer replied, "*What I thought I wanted to change versus what the actual problems were was not the same*." The interviewer noted that the customer thought the problems were the windows and leaks, while the diagnosis pointed to leaking ducting and lack of insulation in the attic as the problems.

As social psychologists know well, motivations and rationales can and do change as events unfold. Changes in the relative importance among typical motivations such as cost, resource conservation, home-improvement, comfort, health concerns and the like undoubtedly did occur in our interview sample, no attempt could be made to discern those effects in our analysis of motivations.

Interview Findings About Motivations In Phase 1, customers were asked in telephone interviews to identify their primary motivations for seeking home diagnosis and retrofit services. These were open-ended response opportunities, and the results were analyzed and coded into a set of motivation categories. Since customers reported multiple interests/motivations, we were able to identify some clusters. These are graphically presented in Figure 6. The most prominent motivations reported included:

- Concern about the functioning of particular *systems/building* ('S/B' in the figure below) was the most frequently identified reason for seeking HP services. These customers believe that they had specific technology and design problems that they want to address if possible. Their interest suggests a degree of awareness of the built environment (or at least their own home), and an interest in ways to improve it.

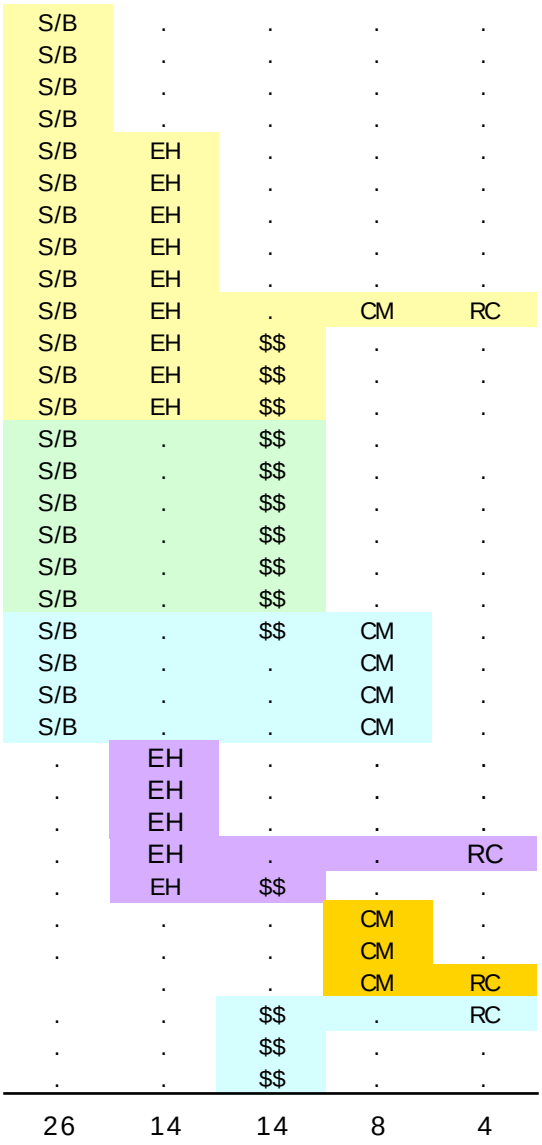
• *Environmental health* ('EH' in the figure) was a fairly widespread concern. It occurred largely in association with a systems/building concern, although sometimes alone. This category of concern includes asthma, allergies, mold, and 'sick house.'

• *Energy cost* ('$$') concerns are mentioned about as frequently as environmental health concerns, and much less often than specific systems/building concerns. When cost was mentioned, it was in association with other motives, particularly environmental health and systems/building problems.

• *Comfort* ('CM') may be a possibly minor concern. However, there is some indication that the value of comfort improvements from HP retrofits are mostly appreciated after the work has been done. Interest in comfort was reported either alone or in conjunction with specific systems/building problems. It was rarely mentioned along with energy cost concerns, and was not associated with environmental health.

• *Resource conservation* ('RC') was mentioned by several homeowners, but was found only in conjunction with other motivations. It was not found in association with energy cost concerns.

Figure 6. Patterns of Reported Motivations from Phase 1 Interviews



Survey Findings About Motivations In designing a mail survey instrument for the Phase 2 evaluation, efforts were made to give opportunities for homeowners to provide more nuanced responses about motivations and values. First, we offered customers a 13-item checklist of possible motivations (with an open-ended option also available), and asked them to assess each as either: "Not Important," "Somewhat Important" or "Very Important." In a follow-up question, respondents were then asked to put in rank-order their three most important motivations. All but two of the respondents followed these instructions and provided the requested information.

Table 23 shows the results of customer reports of relative importance across the range of possible retrofit investment motivations. It shows that a number of motivations are quite

important; some are nearly universal. To "save money on energy bills" was certainly important, but so too were: replacing older equipment, improving comfort, being more efficient (on principle), improving health and indoor air quality, and preserving and/or enhancing the value of the home.

Table 23. Importance of Reasons in Customer *Decision* to Complete Home Improvement Project (Frequency of mention)

57 Retrofits Cases (Home Performance[42] and HVAC)					
Retrofits[43]	**Not Important**	**Somewhat Important**	**Very Important**	**NR/NA[44]**	**Total**
Replacement of older equipment [S/B]	6	2	47	2	57
Reduce energy bills [$$]	1	6	45	5	57
Improve home's comfort [CM]	0	6	50	1	57
Be more efficient (save energy & resources) [RC]	1	6	47	3	57
Improve indoor air quality/ [EH]	4	11	36	6	57
Address health issues [EH]	16	9	25	7	57
Rebate available	11	15	24	7	57
Contractor affiliated with E-Star	9	15	26	7	57
Retrofits indicated by contractor	11	11	15	20	57
Add additional space	30	3	2	22	57
Improve home's appearance	29	4	13	11	57
Increase / preserve home value	10	11	31	5	57
Work recommended by HP test	9	6	11	31	57
Interest buy down program (PG&E)	0	0	1	56	57
Reliable windows	0	0	1	56	57
Contractor's knowledge and reputation	0	0	1	56	57

After identifying all of their reasons for pursuing retrofits, respondents were then asked to identify and *rank their top three motives*. Table 24 shows these rankings of the relative importance across the range of possible retrofit investment motivations. And since the customer base we were able to survey is small, the table also includes totals for the top three mentions.

[42] Home Performance defined as retrofits including air sealing, windows, or insulation regardless of other work reported by customer. HVAC installations generally included duct sealing.
[43] Closed-ended options were rotated (presented to respondents in different orders). The first 13 items are from closed-ended questions and the final 2 are open-ended responses.
[44] NR/NA = no response/not applicable

Table 24. Priority Ranking of Top Three "Very Important" Reasons for Pursuing Retrofits (frequency of mention)

Retrofits	1st Priority	2nd Priority	3rd Priority	Total in Top 3	% of Mentions
Replacement of older equipment	14	1	7	22	13%
Reduce energy bills	8	14	12	34	20%
Improve home's comfort	15	8	8	31	18%
Be more efficient (save energy & resources)	5	15	5	25	15%
Improve indoor air quality	4	1	4	9	5%
Address health issues	1	5	1	7	4%
Rebate available	0	1	2	3	2%
Contractor affiliated with E-Star	0	0	1	1	1%
Retrofits indicated by contractor	0	0	0	0	0%
Add additional space	0	0	0	0	0%
Improve home's appearance	1	0	2	3	2%
Increase / preserve home value	4	5	4	13	8%
Work recommended by HP test	0	0	1	1	1%
Interest buy down prg (PG&E)	1	0	0	1	1%
Reliable windows	0	0	0	0	0%
Contractor's knowledge and reputation	0	1	0	1	1%
NR	4	4	4	12	7%
NA/Skip	0	2	5	7	4%
	57	57	57	171	100%

These data also suggest that "saving money" (assumed to be *the* primary motivator in much of the energy policy discourse) is reported as the *most important* motivation in only a small number of cases. At the same time, it is found in association with all of the other important motivations across nearly all of the cases). It is also interesting to note that "replacing older equipment," while a nearly universal motivator in the Table 23 analysis ("very important" in 47 of 56 cases), falls out of the three "highest priority" analysis (Table 24). It seems reasonable that both of these motivations are important in combination with others, but by playing key supporting roles.

For example, it may be simply *assumed* by those homeowners who are "in the market" for testing and retrofit services that their heating and cooling systems (and possibly other appliances and the house itself) are "too old," "not in good shape" or "in need of replacement or 'upgrade'." This may be a very basic understanding and motivation that precedes and underlies all of the others. It is a *necessary*, but not necessarily sufficient, motivator. It is a *threshold condition* for pursuing improvements or retrofits.

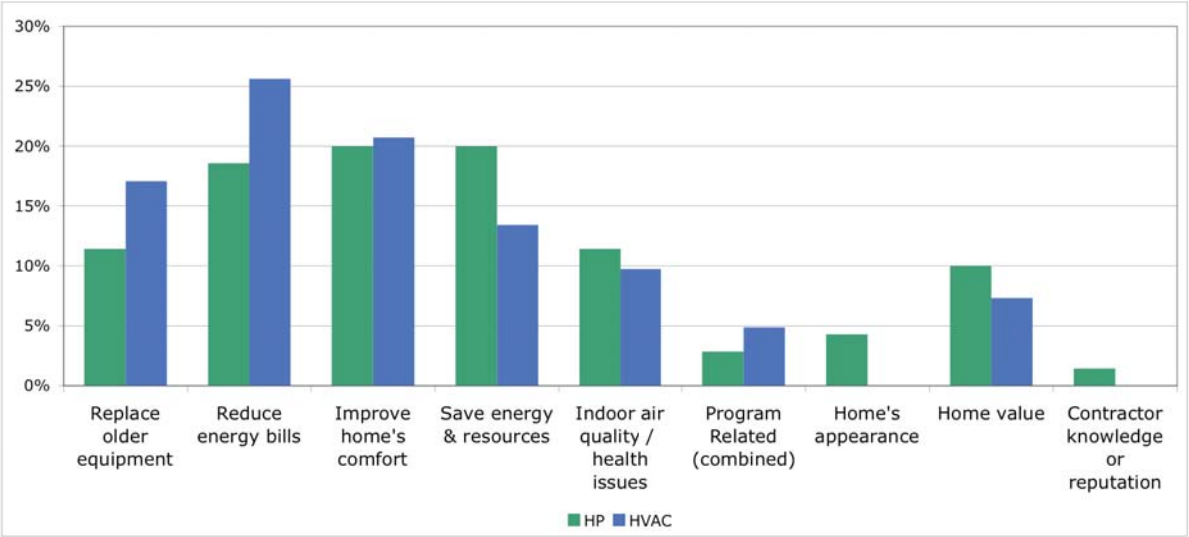
Energy cost savings may play a similar role. On their own, the prospect of savings may not be sufficiently motivating. But coupled with aging systems and additional benefits, this may become a pivotal consideration. If needed upgrades are affordable, particularly accompanied by a range of other benefits, the energy savings potentials make this a very "rational" and "economic" set of choices—even if the energy savings can never come close to recovering the costs of the upgrades. With more data and a more sophisticated analysis, future studies *may* come to see "energy cost savings" as a "tipping point" in the choice. However, we also note that there are some cases where saving money is *not* identified as an important factor.

We do not have sufficient data with this sample size to propose a typology of customers, however the following tables show the results of an effort to distinguish between customer motivations based upon the type of retrofits purchased – either Home Performance or HVAC.

Differences in Motivation by Retrofit Customer Type A significant amount of attention has been given in the evaluation to trying to understand *why* homeowners sometimes choose to spend very substantial amounts on HP retrofits, particularly when these do not have what would be considered "reasonable" pay-backs in terms of energy savings alone. There is considerable evidence in both the social science and program evaluation literatures that a variety of "non-energy" factors come into play, with a variety of "non-energy benefits" being very important to consumers in energy efficiency-related decision-making. Figure 7 summarizes information from Table 24 on the most important motivations, but also differentiates the responses by retrofit customer group—i.e., HP services vs. HVAC w/ ducts.

In aggregate, the top three "very important" motivations reported by customers for deciding to contract for retrofits shows that a smaller percentage of HP customers (work including air sealing, windows, or insulation regardless of other work reported by customer) gave top priority to "replacement of older equipment" and "reduce energy bills," while a higher percentage gave top priority to being "more efficient (save energy and resources." It is also interesting to note that both the HP and the HVAC customers report similar levels of concern for "improve home's comfort" and "indoor air quality / health issues." Considering the high cost of many of the HP packages, it is not surprising that HP cases more often reported "home value" as a high priority.

Figure 7. Percentage of Top Three Motivations by Type of Retrofit Purchase



Considerably more work needs to be done using factor analysis, scaling, and related techniques, to identify homeowner types on the basis of motivation clusters, and subsequently to associate those clusters with socio-demographic segments and retrofit packages. But these types of analysis require larger customer samples. As survey data become available from future evaluations of these types of programs, a more detailed picture of consumer motivation and response may be possible. This can provide information that would be quite useful in policy discussions, program design, target marketing, and evaluation of program interventions of this sort.[45]

Implications for Evaluation The evaluation team has been made aware by the implementers of program assessment and funding issues that bear on the question of consumer motivations to make retrofit investments. The problem involves the generally-accepted portfolio planning technique of aggregating total retrofit costs (e.g., program costs plus consumer costs) and evaluating those costs in terms of estimated energy savings from those measures. In CPUC parlance, this is considered the "total resource cost" (TRC) test of a program's cost-effectiveness.

Because our evaluation interview and survey results show that home performance consumers are motivated by a variety of non-energy as well as energy (and energy cost) savings potentials when making retrofit decisions, it would seem reasonable in making impact assessments to either (1) value non-energy benefits as well as energy cost savings, (2) apportion total expenditures along the range of energy and non-energy motivations (so that only the *energy-motivated portion* of costs are associated with energy savings in TRC calculations), or (3) consider only the marginal added costs of higher efficiency

[45] We have shared out Phase 2 survey instrument with the Wisconsin home performance program, where some of these items are being incorporated in their customer surveys. A wider use of these items might allow building a much larger data set that would allow more sophisticated segmentation analysis (assuming that customer motivations are not too different in different program areas and time periods).

choices (rather than the base costs of equipment that would be replaced anyway at lower efficiencies). All would seem plausible, and any would represent a more realistic understanding of what it is that consumers are actually buying—along with and/or in addition to energy savings.

However, there will be some serious problems encountered in that effort and some caveats are in order. Motivations are not only numerous and clustered, but are not necessarily discrete or stable. We have learned that the motivations for retrofits and their relative importance seemed to evolve over the course of a complex decision process in which, not one single decision, but several that are mutually contingent must be made. The process begins with customers' pre-existing opinions about their homes and their reasons for seeking a home diagnosis—although, already influenced to some degree by Home Performance information (e.g., brochures, newspaper articles, websites, etc.). However, as seen in Phase 2, the interactions across time between pre-existing opinions and new information may be quite unpredictable since not all customers receive the same type of diagnosis or the same program information (e.g., Energy Star affiliation, varying levels of information generated by various levels of diagnoses, etc).

Subsequent interactions with contractors, levels of trust developed, the testing reports, and cost/savings estimates (as well as the potential benefits identified, or not identified, in the report), also shape their understandings, motives and desires. At various points in the process, written materials and contractors' sales efforts explicitly stress energy savings, comfort, health, safety, property values, and environmental benefits. They seed and cultivate these ideas as possibilities that may not yet have been imagined. After the upgrades are completed, customers' satisfaction with the work performed and their subsequent experience with the house and systems, with their energy bills, and with comments and reactions from friends and neighbors, all shape their ultimate assessments of what "was important" in making their choices.

Does this mean that persons' simply don't know "why" they chose to install these sometimes quite costly measures? No—particularly since the responses to questions about motivations and values do not seem to be random. They are patterned, as revealed both by scales of relative importance and forced-choice priority selection. In the face of complexity can we retreat to economic rationality and cost-saving motivations? Hardly. The complexity and patterns of consumer response suggest that this is, in reality, far from the case.

At the end of the Phase 2 evaluation, we were not able to move the analysis of motivations to any level of precision that suggest *degree*. However, we have been able to differentiate motivations, and to find that some (e.g., comfort, resource conservation, replacement of older equipment, energy savings, and health benefits) rose above others in salience (e.g., the availability of rebates, and other program-related issues such as contractor knowledge and ENERGY STAR affiliation). Future evaluations of these sorts of programs should be able to better understand the different roles (e.g., necessary,

sufficient, key, supporting) played by different factors, considerations, values, and motivations, across different consumer segments.

5.3.4 Customer Experience and Satisfaction

Customers who reported that their contractor had conducted a "home inspection" were asked a series of survey questions regarding the written report, discussions with their contractor about test results, and the cost of the inspection. Customers who actually complete retrofit projects also provided information on their satisfaction with various aspects of the jobs. We briefly report the results in each of these areas.

Reports and Interactions with Contractors According to the CBPCA's Phase 1 program theory (and the directions given to contractors during training), written reports would be prepared for all HP clients. Ideally, these reports would present HP test results, identify safety issues, outline suggested remediation packages, list potential rebates, and estimate energy savings. As noted above, some contractors supplied HP customers with written reports, some gave verbal reports, and some provided both. Of those who had gotten inspections, 84% reported receiving a written report, and 96% reported discussing the HP testing results with their contractor (regardless of whether or not they received a written report).

As seen in Table 25 below, opinions regarding written reports suggest that the majority of clients were satisfied with the level of information and its delivery (timely and well written). If there is a weak spot, survey results suggest that some contractors could do a better job of providing their customers with potential rebate information.

Table 25. Customer Satisfaction with Contractor Reports

The written report…	Disagree	No Opinion	Agree
was too technical.	81%	17%	3%
provided useful information about my home.	3%	3%	94%
didn't have enough detail.	81%	11%	8%
was well written and prepared.	9%	14%	77%
was provided to me in a timely manner.	6%	8%	86%
identified rebates I might be eligible for.	39%	17%	44%
listed retrofit options & poss. energy savings.	6%	11%	83%
identified health and safety concerns.	6%	14%	80%

Table 26 shows the results from questions posed to the respondents *who reported discussing HP test results with their contractor*. Again we see evidence that the contractors appear to be doing a good job of communicating with customers on the

strategic issues emphasized in the CBPCA training: efficiency, comfort, health, safety, and costs.

Table 26. Customer Satisfaction with Test Results Discussions

While discussing test results…	Disagree	No Opinion	Agree
issues were clearly explained.	5%	2%	93%
contractor seemed biased toward certain options.	52%	26%	21%
contractor answered all of my questions.	5%	5%	90%
he seemed like an expert in energy efficiency.	2%	12%	86%
contractor got back to me in a timely manner.	5%	10%	85%
we talked about energy efficiency improvements.	2%	2%	95%
we talked about improving comfort.	0%	12%	88%
we talked about health or safety issues.	2%	20%	78%
cost of each retrofit option was explained.	10%	12%	79%

Satisfaction with Services Delivered Several specific satisfaction questions were asked of respondents who reported having a home inspection regarding the contractor's testing and sales processes, the cost of the inspection, and possible referrals to other potential customers.

Testing process: 26 of 44 respondents were "very satisfied" (59%), while 10 were "somewhat satisfied" (almost 23%), 5 were "neutral" (11%), and 3 were "somewhat" to "very dissatisfied" (almost 7%).

Sales experience: 21 of 44 respondents were "very satisfied" (almost 48%), while 12 were "somewhat satisfied" (27%), 5 were "neutral" (11%), and 6 were "somewhat dissatisfied" to "very dissatisfied" (almost 14%). However, those reporting some dissatisfaction were fairly evenly divided between those who purchased equipment and those who did not.

Cost of the inspection: 15 respondents report paying a fee for their inspection. Of those 8 were "very satisfied" with the cost (53%), 3 were "somewhat satisfied" (20%), 1 was "neutral" (almost 7%), and 3 were "somewhat" to "very dissatisfied" (20%). Eight reported that the cost was rolled into the cost of the retrofits while another 9 reported not being charged for the inspection.

Recommended to others: in terms of unsolicited referrals to friends and family, 28 respondents had recommended the service to others (64%), while 16 (or 36%) had not.

The group of respondents who had actually purchased retrofits (N=57) were asked a further set of questions related to satisfaction with the work performed by the contractor (see Table 27).

In general, these respondents agreed with positive statements (and disagreed with negative statements) regarding their contractor. However, even the small percentages of negative opinions suggest that contractors' communication efforts/skills could be improved. Areas needing work seem to center around *consumer expectations* related to energy efficiency and bill reduction, understanding the costs associated with recommended remediation, and the breadth of the retrofits offered. These responses are consistent with the reported levels of satisfaction with the sales process (above).

Table 27. Customer Satisfaction with Retrofit Work Performed

The contractor I hired …	**Disagree**	**No Opinion**	**Agree**
responded to me in a timely manner.	2%	7%	91%
seemed like an expert in energy efficiency.	5%	15%	80%
made my home more efficient (resource-wise).	4%	9%	87%
made improvements that reduced my energy bills.	11%	15%	74%
made my home noticeably more comfortable.	4%	13%	83%
made my home more healthy to live in.	4%	37%	59%
explained the cost of each retrofit option.	12%	20%	69%
explained the options in terms I understood.	2%	16%	82%
seemed biased toward certain retrofit options.	33%	44%	22%

5.4 Market Effects

Both Phase 1 and Phase 2 Evaluation Plans proposed assessments of program market effects. The program design does intend "market transformation" changes, primarily in the growing of a well-trained and competent home performance contractor corps and a population of homeowners who have purchased home performance diagnosis and retrofits and spread the word among their friends, neighbors and coworkers. The nature and magnitudes of these effects are discussed thoroughly above. However, the question to be addressed in this section arises from the CPUC staff and master evaluation consultant's interest in what is sometimes called "spill-over" effects. For example, have home performance contractors' trade allies, supply chain vendors, subcontractors, and/or competitors been affected in any way by the program? Is it changing standards of conventional practice by introducing a new competitive element into the market place?

Short answers to these questions are: "data are not available to allow us to say much about this with any certainty" and "probably not very much." Nonetheless, we present a few insights that we do have about potential market effects, along with a short list of market conditions that may influence spill-over effects in these markets. We also point out, as we did the Phase 1 evaluation, that it was probably wishful thinking by the CBPCA, the evaluation contractor and the CPUC to hope that market effects from limited

public awareness activities and contractor technical training might turn up, even across 3½ years of program effort.

5.4.1 Effects on Non-active Contractors and Competitors

Non-active Trained Contractors A reasonable place to start is with the set of contractors trained by the CBPCA program and now defined as "inactive." Is there any evidence that their work has been affected in any way?

Recall that if they had been pursuing home performance contracting in even modest ways (i.e., a few jobs, some aspects of jobs, etc.), support was available from the CBPCA and it was in the program's interest to work with these contractors and to define their work as at least partial performance for information and reporting purposes. On this basis, we suspect that there has been little application of HP/WH principles in those contractors' businesses. Earlier in this chapter, we considered a number of limitations/barriers *within the contractor firm* that kept trainees in the "non-active category." Many of these factors powerfully constrain the ability of contractors to implement HP/WH, even to a modest degree.

We interviewed contractors who had taken the training but were not actively pursuing home performance contracting. With the exception of a few disgruntled early Phase 1 contractors, all were strongly supportive of the program's goals, all praised the training (and any mentoring) that they had received, and all were convinced that the improvements to conventional practice that the HP/WH model offers are needed and important. As two of these non-active contractors reported: "Well I think it's the right thing to do. I think it's important that we install the equipment the way it's designed to get the most efficiency out of it." and "I'm interested in green building and a component of that is indoor air quality. So the diagnostic program is something that I'm interested in." But these statements also reveal that these contractors are deeply anchored to particular businesses and submarkets (HVAC in the first case and remodeling in the second). There is no reason to believe that their products under business-as-usual circumstances are in any way defective. In fact, their statements and the fact that they had participated in the training show that they are concerned about quality issues. It is imaginable that their exposure to building science perspectives and techniques and the resources identified for contractors in the training (e.g., utility rebates, a network of HP trained specialty contractors) has had effects on their conventional practice and may even have had effects in terms of energy, quality, and non-energy benefits. However, there is no evidence to support this.

The inactive contractors are convinced of the value of HP/WH approaches, and would pursue that contracting model if they felt that they could. At minimum, the HP Program has certainly "gotten the word out" (into the retrofit market) about new and better ways of doing business and providing customer value. In order to even speculate about what effects this might have on the industry in either the short or the long term, it is necessary to know something about how information travels in the industry (and sub-industries). We know something about the increased visibility of green building, energy efficiency and home performance topics in the national trade press (Chapter 2 above). We know

much less about how information moves among competitors in local markets. None of the contractor types involved in the CBPCA program (HVAC, remodeling, specialty subs) have well-organized trade associations (e.g., compared to new home builders with their powerful National Association of Home Builders and its local chapters). So we really have no way of knowing, for the purposes of this evaluation, how information flows from training, modified business practices, role modeling, etc. actually work in the markets of interest. Without that information, it is impossible to assess program effects via either the non-active or the active contractors—with one exception. The active contractors do seem to be affecting their suppliers in some cases (discussed below).

Active Contractors Several rounds of interviews with active contractors revealed that, while they are committed to the home performance approach, they did not find much interest in the construction industry in their particular areas. They like to think that their work is visible and possibly noticed. But they do not have well-developed understandings of why competitors are not offering HP/WH services. They identify "old habits" and "traditional ways of doing business" as reasons why they "…don't see anybody out here other than CBPCA trying to do this work." Several offered some interesting views of the situation:

> *"It's perceived as too expensive to people [in the industry]. However, done right, it will be the best money spent…most of my customers lament with me on the whole thing and they talk about it and they plan on doing it. But, you know, when you have to go out there and deal with the contractor to do it and he has his way of doing it and he's been doing it that way for years. It's frustrating [for the homeowners]."*

> *"… I recruited three other contractors but they're awfully hard to find because they're pretty set in their own ways and they don't want to change their behavior and they don't want to work to performance standards"*

When one contractor was asked why he thought he has interests in HP/WH and other contractors in the area do not, he replied jokingly: "[Because] I don't have a construction background (laughs)." To a follow-up question (Do you think it's a cultural or educational thing?'), he replied:

> *"…no, some of these contractors are very well educated. I think they get into a basic habit of doing business where they're making pretty good money and they're upgrading everything and that makes them more money and the concept of treating the house as a system is the furthest thing from their mind. Particularly subcontractors. They are contracting to do a certain thing. They come in and do their thing by code and they don't care what impact it has on the rest of the house."*

Another contractor described the industry somewhat differently, referring to tradition:

> *"I think it's usually your father teaches you how to build a house and his father taught him and him and him, there's a lot of ego involved with these people and they don't know what they're doing. They're not willing to open up to new things. And I think if people are willing to learn, they'll learn. It's like any other industry."*

A few contractors did identify some competitors who do not offer HP/WH services, but who are starting to use "buzz words" such as "home performance." However, the CBPCA-trained contractors who mentioned this were very critical of this competition as simply being another form of business-as-usual. For example:

> *"There are some companies out there that are using, shall we say, buzz words. You know, for instance, I go out and I talk about airflow and, first of all, I interview the client. You know, what are your concerns? What are your basic areas of real concern? In talking with them, often times they'll tell me something that will prompt a question for me that I'll ask so I'll get more information from them and so we go into really deep conversation about issues that a homeowner might have. And sometimes issues are revealed that the homeowner has decided to ignore because they haven't been able to correct it in the past. And I'll bring them up. And so when I write the proposal it's not uncommon for me to get the homeowner calling me back and saying 'Okay, I want you to do the job. And, by the way, so and so said he could this and this and this and this. But, you know, he didn't talk about it in technical terms like you did and so I really don't feel like he knows what he's doing."*

Another contractor made a similar observation, but went on to criticize competitors who were also trained in related fields and had failed (in his view) to put that training to use in their product offerings and practices.

> *"I hear some people use buzzwords like building performance but, you know, I haven't necessarily perceived it as real. … I'm surprised that all of the people that go to the 'house as a system' class at PG&E wouldn't be more interested in this. And heating contractors, I know there's enough training with enough heating contractors that I'm continually unimpressed"*

5.4.2 Supply Chain Effects

Where the active HP/WH contractors begin to have some concrete market effects is in the new demands that they make on their trade allies and business partners. We believe that all of the active contractors we've interviewed have made changes in their business relationships. For one large contractor firm, it was a matter of changing the brand of air conditioners that they carried because "…we liked the higher quality equipment that we're using now." We imagine that this could have other potential "upstream" effects as well, as their suppliers and the large retailers they work with are required to take into account the changes in their product preferences.

One small contractor's network has also changed in a positive way: "I've met some people with common interests that I want to keep in touch with and that I'd like to make a point of talking to and learning from and sharing with." Although he feels that most of the supplies and equipment that he needs are available, he has made a point of requesting certain items (an energy efficient skylight, low VOC paint, and certified wood) from his local suppliers.

A medium-sized firm has actually ended business relationships that have not been supportive of HP/WH contracting.

> *"[relationships ended] with equipment and material distributors who don't have the quality of equipment that I need now that I'm into this, and I didn't know there was a difference in the quality before. Like ventilators, heat recovery ventilators, energy recovery ventilators and those sorts of things. HEPA filters, you know, there are a few companies out there that provide whole house HEPA filtration and actually before CBPCA I didn't recommend that they consider that because filtration for the whole house with a HEPA filter would take a huge, huge filter if you put it in line in the return. But, that's not the way it's supposed to be put in and, of course, I've learned that since training with CBPCA. It's done differently so I can recommend that for those people who would like to have HEPA filters."*

When asked if any suppliers had done anything accommodate requests, he reported a more nuanced story:

> *"For the most part it's leaving them and finding somewhere else. However, there is one supplier here in town, you know, we do a lot of duct systems because we have a lot of houses that are 25 years old or older and the duct systems were either flex-duct systems and they've had cable guys or plumbers or what not crawling across them and damaging those ducts, or even in the days when they used hard pipe, the hard pipe leaks horribly. And the amount of time it takes to repair those or seal those is just incredible. And I've talked with one of my suppliers, he had been stocking the cheapest sheet metal equipment or material that he could find because it's always been a price issue before, and so after talking with him several times about why we need something different—we do a lot of business with him—he actually went out and found a supplier that supplies him with sealed elbows and Ys and things like that, and a heavier quality, he was using very thin material that you couldn't put a pin on without squeezing it and changing the shape of it, and so he's actually carrying better duct system material now because of it."*

Other contractors have had a more difficult time with suppliers and subcontractors:

> *"Suppliers don't know anything about it and our subs, I don't know that they care except that we make them do things differently sometimes. We have a hard time subbing things out."* (Remodeler/Builder)

"The suppliers are looking more at the bottom line." (HVAC contractor)

"No new suppliers. We seem to have to find a new subcontractor every job because we hate the ones we get. Very rarely do they work it. I mean, they do okay, we've got a couple of winners, but for the most part we're stilling looking for them. . . . A lot of people are very set in their ways. They think they know what the hell they're doing but they really don't. So it's finding people that are willing to work to our specifications." (Remodeler/Builder)

If there have been market effects in this very short period of time, they have included the CBPCA's intended effects on contractors and consumers, as well as some added effects on suppliers with increased demand for specialized materials, products and higher efficiency equipment. In the absence of new regulations mandating greater energy efficiency in residential retrofits (e.g., as proposed by the AB549 study, in which mandated point-of-sale home energy efficiency inspections and possible required upgrades were evaluated), changes in the market can come about through increased consumer demand and changing supply side conditions. In the absence of a significant increase in media attention to home energy efficiency issues (see our discussion of baseline conditions in Chapter 2), it is not clear where the consumer demand might come from. On the supply side, without government mandates and/or industry initiatives (e.g., voluntary greenhouse gas emissions reductions), it is not clear from where supply side initiatives might come. Also, there are a number of conditions in normal, functioning residential retrofit markets—in addition to those identified by the active contractors when discussing conventional practice—that contribute to inertias that slow innovation in the industry. Some of these merit brief mention.

5.4.3 Conditions that Limit Market Impacts

These terms, market "conditions" and market "context", point to factors that reside outside of firms, in the environment within which businesses have to operate. These conditions are largely outside of the control of contractors, but they can strongly influence what contractors do (and when and how they do it). We identified several of these "external barriers" in the Phase 1 evaluation and summarize that discussion below, since it is still quite salient to the market transformation problem.

First, an important fact about barriers or impediments in markets is that they are not uniform or static in their influence. They have variable impacts, perhaps affecting small contractors and large contractors differently. They may also have different effects in different locales. They fluctuate through time—whether this might involve seasonal cycles or business cycles. And they evolve or trend over time, as macro-economic and technological changes interact to produce new products and new markets.

A few of these conditions were mentioned directly in contractor interviews (e.g., escalating workers' compensation rates). However, contractors, who are largely concerned with day-to-day business and short-term prospects, not sweeping changes or economic cycles, did not offer most as explanations. Nonetheless—on the basis of theory

and the observation of sources of change in many other markets, as well as some of the examples offered by interviewees—we identify some of the conditions that are most important to the residential retrofit industry. They include the following:

Ebbs and flows in economic conditions Changing levels and nature of consumer demand, "hot" and "cold" housing markets, economic downturns, in-migration and job growth, out-migration and unemployment, changing character of labor markets (e.g., skilled labor shortages), rising and falling interest rates, etc. Uncertain and downright bad conditions can make market actors more risk averse. And even success (perhaps particularly success) can dampen innovation. As one active contractor sees it, conditions can sometimes be "too good" to allow change in business practices. In his view:

> *"…it has a lot to do with our economic climate. Everyone's making money right now and everyone's busy so why rock the boat? Everything's fine. Like an HVAC contractor, for instance, if they're going along and doing what they've always done and been taught, unless they're really interested in quality and the consumer, then they're probably not going to be real interested because they're making money. They don't really have to compete. When the economy slows down, that's when the quality of work goes up because you have to, you know, it's a lot harder to get the work and usually the guys that stay working are the guys that do the high end work, the quality work. So I think in California we've got a different situation than other parts of the country. Things are almost too good. That's my opinion."*

Seasonal factors These include shifts in demand for different types of work and changing rates of demand across the year (e.g., summer is the busiest time for HVAC installers, in winter few customers are interested in air conditioner performance).

Macro actors' demands on businesses This involves escalating government reporting requirements, changes in the regulatory environment, changing technical requirements from product manufacturers, and related factors. A source of uncertainty and concern mentioned by several contractors was rising worker's compensation costs and the ability to provide volumes of work need to meet these and other employee expenses.

Local competition The presence of competitors and new competitive pressures in core business (HVAC, general contracting, windows, etc.) can both stimulate and slow innovation (risk-taking vs. defensive strategies). Concern about increasing competition in the HP/WH niche is also warranted as some large firms are organized in markets elsewhere in the U.S.

Institutional dynamics and constraints Market actors, interest groups (e.g., trade associations), unions, and educational institutions continually reinforce divisions of labor among trades, and reinforce them through certification, licensing, regulation, codes, inspection, etc.

Utility roles Utility support or absence of support for energy efficiency in general, and HP/WH approaches in particular, affects the perceived legitimacy and importance of efficiency (including how "seriously" it is taken by market actors). There is a long history of ebb and flow of utility interest, and program support levels in the past have changed significantly with little notice, making some contractors wary.

Government role Visible support (and lack of support) for residential retrofits is also an important context factor. The seriousness of government interest in retrofits (for energy system stability, economic development and environmental policy purposes) is strongly reflected by the presence, absence and amount of available rebates and incentives for HP/WH work. It is also reflected by the strength of codes and standards, and the visibility of these to consumers and supply side actors.

5.5 Energy Savings Impacts

Information-only programs are not required to produce verifiable energy savings. However, because improved energy efficiency is the aim of all of CPUC programs and is an explicit goal of the CBPCA program, efforts have been made to estimate energy savings benefits that may have resulted from CBPCA-trained contractors' provision of retrofit services to consumers who have demanded them.

As noted earlier, the Phase 1 and Phase 2 Program Implementation Plans called upon contractors to provide information to the CBPCA on all of their jobs, including test-in and test-out diagnostic results, energy savings estimates, packages purchased and installed, and utility bill information that could be used to verify savings. The original intention was that most of the jobs would be comprehensive whole-house home performance diagnoses and retrofits. Energy benefits would be estimated for these jobs using building simulation modeling based on inputs of diagnostic measurements and calibration to utility bills.

In our Phase 2 Evaluation Plan, we did not propose any independent data collection related to energy performance or savings. We proposed to use the same MIS data provided by the contractors to CBPCA to independently estimate potential program energy impacts. We did not propose to conduct any sort of cost effectiveness analysis, nor was this requested by the CPUC.

To address the energy savings question according to that plan, we have acquired the complete set of contractor reporting data from the CBPCA and have conducted an independent analysis that includes assessments of the following elements:

1) Data quantity and quality
2) CBPCA estimation methodology
3) Plausibility of the estimates
4) Additional estimates (beyond contractor reports and 1 year savings)

We consider each topic in turn.

Data Quantity and Quality As we have seen, several distinct patterns of adoption of home performance principles and practices have evolved over the course of the program. Also, particular sets of retrofits were more likely than others to be completed and reported, depending on the contractors' primary business (e.g., HVAC, remodeling, specialty contracting). Diagnostic testing, particularly duct testing, is commonly practiced. But the use of other technical diagnostics is less common, as is the use of building simulation software (e.g., the TREAT package). In addition, the amount of reporting by contractors has been fairly uneven, both in terms of timeliness (e.g., rather than a smooth flow, an infrequent reporting of "batches" of jobs) and the reporting of particular contractors and contractor types (and non-reporting of others). There are good reasons for all of this (e.g., no carrots, no sticks, contractor constraints, risk aversion, etc.). But it makes estimation of energy impacts very difficult for the implementers and well as the evaluators.

Also, the quality of the reporting, when it has been done, has been very uneven in terms of level of detail. In some cases, energy savings estimates were provided by contractors from detailed analyses. In other cases, craft estimates were offered (e.g., 30% AC energy savings or 50% overall kWh savings) on the basis of contractors' experience. In very few cases was utility bill information provided. The CBPCA is aware of the poor reporting—and, therefore, limited information—problem. The program implementers and the Home Performance with ENERGY STAR program report to the evaluators that many other home performance programs have experienced the same problem as well.

The implementers believe, on the basis of periodic polling of contractors and the observations of field mentors, that the amount of actual work being performed is greater than the amount being reported. Given the uneven patterns of reporting and types of work reported, we tend to agree. The CBPCA believes that the reported work may represent only 1/5 of the total number of jobs actually completed. That number is possible, but probably not plausible (discussed further below). If it were only1/2 of the work completed, this would still represent a large gross of work being done and a significant under-reporting problem.

As for the quality of reporting? We have no way to independently verify the accuracy of overall reporting. However, as mentioned above, we did compare contractors' reports with customer's reports of work on the same jobs. They were roughly in agreement, with some over-reporting and under-reporting by contractors. This is probably inevitable, unless some sort of strict monetary and/or legal accuracy in reporting requirement was in place. Contractors may not have reported work that was subsequently ordered by the customers. At the same time, they may have sometimes reported what they suggested, rather than actually installed. Consumers were quite satisfied with the quality of work, professionalism of contractors, etc. (as noted above). They also sometimes recalled work items such as air sealing—a potentially very important energy efficiency upgrade—that was not mentioned by the contractors (who, we believe, may have been inclined only to report the most "important" or "big ticket" items to the CBPCA).

The CBPCA periodically stepped up efforts to secure data from contractors, stressing its importance to the program. The implementers also visited sites of completed work, retested and modeled some of these jobs, and reviewed the evaluators' findings from customer surveys and contactor interviews regarding work reported to us vs. work reported directly to the CBPCA by the contractors. At this point in time, we are fairly comfortable with the quality of information contained in the CBPCA jobs database in terms of accuracy of listing of measures installed, job/customer location, and dwelling size. In terms of the latter, we can only assume that experienced contractors, working on a housing stock that was primarily built using conventional tract designs, can make accurate estimates of building sizes.

CBPCA Estimation Approach The contractors who reported jobs to the CBPCA also reported estimates of energy savings for each of those jobs. Those estimates were based in some cases on detailed testing and simulation, with examination of actual energy bills for the households. Much more frequently, however, they were based on duct testing results, knowledge of the performance characteristics (e.g., SEER ratings) of equipment replaced and new equipment, Manual J sizing calculations, and/or rules of thumb provided by the CBPCA trainers. The savings estimates were sometimes made in annual kWh and therm values. In other cases, they were percentage savings estimates (25%, 30%, etc. of annual consumption).

The CBPCA made efforts to check the plausibility of the more precise estimates. The implementers also attempted to quantify "craft estimates" (e.g., percentage guesses) by bringing in information from other sources. These included modeled and measured performance of similar houses in pre and post-retrofit periods. They also referred to industry standard protocols (e.g., the DEER database), the experience-based judgments of trainers and field mentors, examination of bills (rarely available), and more precise estimates made for similar houses in the target locales. The latter was relatively easy, given the large number of cases in and around Fresno and the balance being mostly in the Bay Area. Weather and behavior could not be directly measured, although both were to some degree roughly taken into account in the use of comparator cases and in comparing modeled and measured results in a few cases.

Plausibility of Estimates A number of reasonable (and even somewhat creative) efforts were made by the CBPCA to come up with plausible estimates of energy savings from limited contractor reports. We examined the resulting savings estimates. They ranged from a low 315 kWh and 15 therms to a high of 10,600 kWh and 670 therms. The means were 2887 kWh (with a standard deviation of 1580 kWh) and 220 therms (with a standard deviation of 110 therms).

We examined the relationships between energy savings level and three other key variables: dwelling size, climate and measures installed. There was a correlation between energy savings building size (larger dwelling, greater savings). This was expected, since most home performance retrofit measures (e.g., air sealing, insulation, duct sealing, higher efficiency HVAC, right-sizing HVAC) affect shell and system performance, heat/coolth loss, etc. All of these benefits generally increase with building

surface size, which is correlated with square footage (although not in a linear fashion). There was also an association between savings estimate and climate, expressed simply as CEC climate zone (zone 3 for Fresno and zone 4 for the Bay Area). This is also hardly surprising, both because of differences in summer and winter temperatures in the two locales, but also because of the predominance of HVAC systems work done by HVAC contractors in hotter Fresno vs. shell/insulation work done by remodelers/builders in the more temperate Bay Area. The important point is that the general relationship between savings and known influences on energy demand are in the right direction.

What about the magnitudes of savings proposed? We have little job-specific pre/post performance and energy data. We do have duct test results reported in a small number of cases. Here the losses were reduced from unknown pre-treatment levels (estimated by CBPCA trainers to be at least 20-30% and sometimes higher) to 4-6%. We also have contractor reports of HVAC installations at the 13-16 SEER levels (with 14-15 SEER being the most common). The California *Database for Energy Efficient Resources* (DEER) contains a broad listing of measures and energy savings. DEER uses an 8.5 SEER as the baseline for air conditioning equipment being replaced in Fresno (CEC 2005).[46] From some contractor reports in which SEER levels of replacement HVAC equipment are noted, we find tonnage in the 2.5 to 6 ton range. DEER assumes 3.6 tons for the model house in Fresno. DEER calculations would estimate the energy savings from replacing an 8.5 SEER air conditioner with a 14 SEER unit at approximately 45%, with no improvement of ducts or shell sealing.[47] In Fresno, this would result in DEER-estimated savings of only about 500 kWh—a result that seems implausible when back-of-the-envelope calculations easily estimate monthly summer AC usage at 2,500 to 4,500 kWh/year (45% of which would represent savings of 1000-2000 kWh).

We can also compare CBPCA savings estimates for retrofits involving HVAC plus other measures with some known/assumed consumption characteristics of HVAC-equipped dwellings in Fresno. Probably the best source of information in this regard is the 2004 California Residential Appliance Saturation Survey (RASS). However, the power of the analysis is somewhat limited, since the RASS data set itself is not publicly available and the tables generated by the sponsors are not directly suitable for the comparisons that we would like to make. There is access to the RASS data through a limited web interface, which we used to locate information that is at least suggestive.[48]

RASS reports a wide range of variation in observed energy use (as do other residential consumption surveys). For example, in the Fresno climate zone, the *average* single-family detached residential customer account uses 9,075 kWh per year. The standard deviation is 4000+ kWh/year (the *range* or extremes are not reported, but we believe

[46] DEER estimates of energy savings per ton of cooling at the 14 SEER level are in relationship to new construction code requirements of 13 SEER, which do not apply to the retrofit market.
[47] DEER does not presently include estimates for these measures, although studies in progress will produce those estimates by 2008.
[48] Averages (mean values) for certain sets of variables in combination can be estimated (with some difficulty). But information on the distribution of those statistics (e.g., kWh for Fresno AC-equipped residences) in terms of measures of dispersion is not available.

from other research that 2-3% of the cases consume more than 20,000 kWh/year and that there are many cases in the population in the 10,000-15,000 kWh range). The evaluators also know from our own research using similar data, that the underlying distribution is not normal—i.e., it is strongly skewed toward the high end. So our interpretation of the RASS standard deviation is simply that somewhat less than ½ of the distribution is above the mean, however, a very large proportion have higher usage than mean—some much higher usage.

RASS developers have also produced estimates of cooling load for the Fresno climate zone. However, these "UECs" are regression-generated estimates, and not the result of actual end-use measurement.[49] So at best, they too represent limited *averages,* about which no further information is offered about their dispersion (e.g., the standard errors of coefficients). So, despite the fact that the RASS data are the best available, the RASS statistics certainly cannot be assumed to be valid estimates for the CBPCA sample households—either of their total consumption or their cooling energy use. The RASS central AC cooling electricity UEC (for owner-occupied, single family detached dwellings in the Fresno climate zone) is 1749 kWh/year. This (again, *average*) kWh consumption estimate is closer to the low end of our back-of-the-envelope estimate, but still seems quite low.

When we compare the CBPCA savings estimates for different sorts of retrofits and dwelling sizes (Table 28), we see that averages of the savings estimates are 20-50% of the RASS *means* for those dwelling size categories. When we compare the distribution of dwelling sizes in the CBPCA sample with the RASS sample, we find that somewhat smaller units (e.g., 1000-1500 square feet, which were built in the 1950s and 1960s) were more common in the contractor sample than in the RASS. It is reasonable to imagine that older units are better prospects for retrofit and that many of these are smaller than newer dwellings. Their relative consumption may be somewhat higher (based on being built prior to energy codes) and somewhat lower (based on size of conditioned space). Nonetheless, we believe on the basis of contractor reports, interviews and surveys that most of the retrofits reported by contractors are probably for households with older than average (and less efficient than average) equipment and likely somewhat higher than average energy usage. Therefore, we would imagine that the CBPCA-adjusted contractor estimates are at the level of overall savings somewhere in the 20-30% range. This appears to be a reasonable level of projected energy savings, from which we have no basis to propose more plausible estimates.[50]

[49] UEC = Unit Energy Consumption estimate in weather-normalized kWh/year.

[50] The previous discussion focused on electricity consumption and kWh savings. Examination of RASS natural gas data shows a very similar pattern. Average annual consumption levels are around 600 therms, with a considerable number using gas at higher levels. Most CBPCA gas savings estimates are in the 200-250 therm range, from a combination of duct sealing/replacement and upgrade to more efficient furnaces. These results are plausible.

Table 28. Estimated Annual kWh Savings and RASS Total Consumption

Dwelling Size (sq ft)	RASS kWh/yr	HVAC w/ duct (kWh savings)	HVAC w/duct & other meas. (kWh savings)
1001-1250	5,860	2,148	
1251-1500	6,873	2,510	1,713
1501-2000	7,508	3,470	3,360
2001-2500	8,373	5,173	4,305
2501-3000	8,684	6,009	
GT 3000	11,553	8,405	
Annual Avg.	7,854	3,134	3,126

Alternative Estimates In the program final report, the CBPCA estimates annual energy savings of 862,773 kWh and 65,498 therms from measures installed in 299 diagnosed homes. The report does not project those savings to future years. It also does not estimate energy savings from new work performed by home performance contractors in subsequent years. As an information-only program, these energy savings estimates were provided by the CBPCA to show "momentum toward saving 5 million kWh/year and 100,000 therms/year" (CBPCA 2006, p. 1). The evaluators are required to provide multi-year estimates, however, and we have done so using the CPUC-provided "Sum of Energy Impacts" form (attached).

Given the long useful life of home performance measures (e.g., shell sealing, duct sealing, insulation, new HVAC equipment), it is reasonable to assume that these savings will persist for some time. The DEER database provides estimates of 15-20 years for these measures. There will likely be some deterioration in performance over time, as well as some "take-back" effects (e.g., increases in comfort levels with new equipment) in the population of retrofitted homes. However, there are no reasons to expect either of these effects to be large; and given the fact that the estimates are roughly measured to begin with, we see no reason to estimate these effects a priori. Therefore they are not included in our projections.

Table 29 presents the CBPCA estimates in the required CPUC reporting format. Projections to "out-years" (to 2023) are held constant at the 2005 level. No peak demand reduction estimate has been provided by the implementers and none is included here. The evaluators offer alternative estimates that are somewhat higher.[51] There are several reasons for this difference.

[51] The columns for evaluator input are labeled "evaluation verified" savings in the CPUC template. Since no field verification or billing analyses were performed by the evaluators, that language would be misleading. In its place, we have provided "evaluation estimated" savings in this report.

Our energy savings estimation methodology involved creating a database of contractors and work reported to the CBPCA during 2005. All contractors who were active at the close of the program in December 2005 were included, as were several other contractors who had completed training late in 2005 and could not yet have begun home performance work when the program period ended. Contractor firms were broadly classified as "HVAC" (basically HVAC contractors providing right-sized equipment replacement, duct testing and sealing, and incidental diagnosis), "HVAC+" (HVAC with insulation and window replacement capabilities), "raters/consultants" (providing diagnostics and coordinating subcontractors), and "remodeler/builders" (full service shell work, subcontracting HVAC). Because of the small numbers of raters/consultants, and their close operational similarities to remodeler/builders, those cases were rolled into the latter category.

Two additional types of information on measures installed supplemented information on actual jobs reported by contractors. The first was CBPCA census data collected in mid-2005 that asked contractors about their activity levels, trends, and plans for the future. The second was information from evaluation interviews with contractors regarding numbers of diagnoses performed since training, number of retrofit jobs completed, commitment to home performance contracting, and future plans. This allowed us to make estimates of rates of diagnosis and retrofit for each of the 12 most active contractors with proven performance records. In the first round of the analysis, no job rate estimates were made for the remaining 10 contractors who had yet to establish track records. Appendix D Tables D-1 and D-2 show the allocation of jobs across contractor firms and types for the broad target areas of the Central Valley/Sacramento and the Bay Area. The lowest level of proven production was 2 jobs per month (a remodeler who was committed to working at that rate). The highest was 20 (a very large HVAC+ firm with home performance as a small part of its overall work load).

The types of jobs performed by each contractor were then categorized as either: (1) HVAC equipment change plus ducts, (2) shell/insulation/windows/ducts without HVAC change, (3) shell/insulation/windows/ducts *with* HVAC change. On the basis of their reports and interviews, the relative proportions of each type of work were calculated. The results ranged from 100% HVAC only to 90% shell/etc. + HVAC. The CBPCA and contractor-estimated kWh and therm savings estimates for each of the three types of work were then averaged within two broad climate zones for the Central Valley and the Bay Area.[52] For example, HVAC installations, which were most common in the hotter zone 3, had average estimated savings values of 3100 kWh and 217 therms there. In the more temperate zone 4, more comprehensive shell/etc. + HVAC jobs were more commonly reported, averaging 2504 kWh and 261 therms per year. The tables in Appendix D provide details of our assumptions and estimates on a contractor-by-contractor basis (using contractor codes, rather than actual firm names).

In order to estimate annual "out year" energy savings for the active contractors, the average savings rates were applied to the particular job mix and work production rate

[52] CEC forecasting climate zones 3 and 4.

assigned to each particular contractor. Energy savings in kWh and therms could then be aggregated for each work year.

Critical assumptions in this analysis include the following: (1) that the savings estimates are valid (see above) on average, (2) that a conservative estimate of the volume of likely future work by contractors is appropriate (i.e., that there are no reasons to believe that either much larger or smaller work volumes than have already been observed are likely), (3) that no work level should be assigned to contractors without track records, (4) that degradation of measures and take-backs will be modest and need not be estimated, and (5) that prediction of contractor behavior beyond the medium term is not prudent. In terms of the latter, since contractors retire, die, go out of business, sell their businesses, etc., and given the mix of ages of the trained contractors, we cannot estimate work rates with any confidence past 6 years from the close of the 2005 program. We have every reason to expect that contractors who are committed to home performance work and who are successfully making money doing that work will continue at some level that makes sense for each particular contractor. However, we have no reason to expect that their activity will continue for 20 years. In some cases it will. In others, it will not. Our choice of 6 years is essentially arbitrary.

From Table 29, we can see that the above analysis produces estimates of current and future energy savings that are substantially larger than the CBPCA estimates, since the latter counted only sporadically reported contractor reports of savings, and made no assumption of future rates of home performance work by the contractors. We are fairly confident that our analysis makes appropriate (and conservative) adjustments for past contractor non-reporting, as well as for reasonably-expected future rates of home performance contracting activity (again, conservative estimates) by the most active contractors. Our estimates of 245,642 MWh and 19,980,800 therms saved in aggregate by 2023 as a result of CBPCA program activity in 2004-2005 can be compared to the CBPCA estimates of 16,397 MWh and 1,244,462 therms aggregated over the same time period. Our model caps contractor job production in 2011 (again, an arbitrary, although not unreasonable, choice). If this model is even roughly accurate, it would appear that the CBPCA's informal kWh and therm goals would be met by 2007. An important caveat: we were not able to perform rigorous or verified estimation. The results in Table 29 should be considered illustrative of the possible levels of energy savings that are possible for a program with the CBPCA program's history—and that may be occurring in the case of the CBPCA program.

An additional (and more speculative) model was constructed that added (again, conservative) estimates of new home performance work that might be contributed by contractors trained late in 2005 and not included in the analysis above. The results were intriguing. Assuming only modest levels of production for these new remodeler/builders (e.g., 2 jobs per month) and HVAC contractors (e.g., 6-10 jobs per month), the aggregate savings predicted by including these contractors in the model would be much larger—on the order of 350,000 MWh and 30 million therms. In the electricity case, this would represent a 40% increase in kWh savings over the 18 years, and 50% in additional savings for natural gas. These projections are speculative and the details are not

presented here. Also, achieving even those modest production levels and would also likely depend upon those contractors receiving some level of mentoring and monitoring that is not being provided by CBPCA, absent the CPUC support for those services which ended with the close of the 2004-05 program.[53]

Table 29. Illustrative Estimates of Long-term Energy Savings from Program-Stimulated and Enabled Home Performance Work

Calendar Year	Program-Projected MWh Savings	Evaluation Estimated Program MWh Savings	Program-Projected Therm Savings	Evaluation Estimated Program Therm Savings
2005	863	863	65,498	65,498
2006	863	3,328	65,498	266,964
2007	863	5,793	65,498	468,430
2008	863	8,258	65,498	669,896
2009	863	10,723	65,498	871,362
2010	863	13,188	65,498	1,072,828
2011	863	15,653	65,498	1,274,294
2012	863	15,653	65,498	1,274,294
2013	863	15,653	65,498	1,274,294
2014	863	15,653	65,498	1,274,294
2015	863	15,653	65,498	1,274,294
2016	863	15,653	65,498	1,274,294
2017	863	15,653	65,498	1,274,294
2018	863	15,653	65,498	1,274,294
2019	863	15,653	65,498	1,274,294
2020	863	15,653	65,498	1,274,294
2021	863	15,653	65,498	1,274,294
2022	863	15,653	65,498	1,274,294
2023	863	15,653	65,498	1,274,294
TOTALS	16,397	245,642	1,244,462	19,980,800

6 Conclusions and Recommendations

In this final chapter, we summarize the evaluation's findings, identify continuing questions/problems/issues, compare the California program to home performance programs underway in other states, and offer some recommendations to the CPUC,

[53] The CBPCA is, however, now in the process of launching a similar program funded by the CPUC in Southern California.

CBPCA and others who may be interested in policy issues and implementation of home performance programs.

The program design outlined in the original program proposal offered a comprehensive, but fairly straightforward, set of program elements in this "information-only" program (CBPCA 2002). The program theory, although nuanced, was also fairly straightforward: the strategic provision of public awareness information and high-quality training in building science-based assessments of home performance would stimulate consumers to seek out HP/WH services and contractors to embrace a new, profitable, business model.

The program was intended to provide results through voluntary market-based actions—results that might otherwise only be achievable either through large-scale regulatory policies (e.g., pre-sale retrofit laws) or public sector programs (e.g., state or ratepayer-financed testing). The program theory anticipated changes in consumer and industry actor behavior by addressing information deficits through public education, training, testing, and verifying retrofit benefits.

Program experience to date shows that the task of implementing and coordinating the mix of program elements and information flows involved is actually quite complex. It turns out that the California home performance program is aiming high and navigating in largely uncharted waters. Over the course of its 3.5 years, the CBPCA program has encountered a number of unanticipated challenges to its program theory, its design and implementation strategy. However, the CBPCA recognized problems fairly quickly, and acted to make appropriate changes where possible. And the California program is not alone in regard to working through challenges and market realities not anticipated in program theory. Related (but somewhat different) home performance programs have been initiated in other states, and the Federal ENERGY STAR program has created a "Home Performance with Energy Star" designation for selected HP/WH programs (including the California program).

We also stress that no one should expect the developmental path of market transformation to be easy (see Blumstein et al. 1998). But we believe that the effort is worth pursuing in the residential sector. Existing residential buildings, and particularly owner-occupied detached dwellings, represent a significant source of energy waste and greenhouse gas emissions. Relatively little energy efficiency remediation is taking place when they are repaired, improved, bought, or sold. The costs of business-as-usual (financial, environmental, health, safety, and comfort) are not readily recognized by consumers or industry actors. The home performance program is one of very few efficiency efforts directed to the residential sector, and the only one that attempts to both understand home performance in building science terms and to optimize energy and non-energy benefits with comprehensive retrofit packages.[54] Doing all of that as well as possible is, of course, the challenge.

[54] There are certainly some well-funded programs directed toward residential consumers, such as direct installation of CFLs and improved HVAC installation. However, their focus on single measures overlooks other savings potentials.

6.1 Findings

We summarize findings from the previous chapters. They are offered in a bullet form to make them as accessible as possible, and with the assumption that readers can find supportive detail in the body of the report and its appendices.

Background

- The CBPCA home performance program design was ambitious and unique in many ways. The start-up phase was slow, due to sponsor funding issues, staffing-up, planning, and climbing a steep learning curve in the roll-out. By the end of the first phase, a number of different marketing efforts and training sessions had resulted in relatively small numbers of active contractors and completed jobs. We found evidence of problems in contractor recruitment and significant barriers to adoption of the HP/WH model among trained contractors. We also found evidence of quality work, committed contractors, satisfied customers, and an adaptive program that was learning from its experiences. A Phase 2 program was funded by the CPUC for the 2004-05 time period.

- Over the course of our evaluation of this project, we have experienced very good cooperation from the CBPCA. We have had ready access to all personnel and data, including program documents, reports, MIS databases, marketing materials, etc. We have had good access to the contractors and good quality customer contact information to support our interviews and surveys. The samples of both have sometimes been smaller than we would have liked (and smaller than the implementers would have liked). However, they were adequate to support the evaluation's data requirements. Feedback to the CBPCA from the evaluation work in progress was solicited, well received, and incorporated in the implementation of the program.

Baseline Market Information

- Baseline studies reveal large markets for home performance work in Northern California. In addition to significant populations, there are large numbers of owner-occupied homes. Many are of vintages and conditions that would benefit from retrofits such as insulation, window replacement and air sealing. Many have older HVAC systems and leaking ducts that could benefit from replacement and repair. Segmentation of these markets also reveals a range of incomes that will limit the ability of some homeowners to make significant investments in retrofits. Nonetheless, there are large potential energy savings to be realized in this sector.

- Baseline studies reveal large numbers of HVAC contractors, remodeler/builders, specialty contractors, and allied businesses working on the repair, upgrade, inspection and sale of existing homes in the CBPCA target market locales. This suggests both a large target market for upgraded home performance services, and a large volume of home-related work routinely underway. There is also evidence of considerable do-it-yourself activity by homeowners.

- Baseline studies also reveal very low levels of awareness and coverage in the popular press—particularly mass circulation magazines and newspapers—regarding home performance, building science, indoor air quality, green building, etc. The trade press, however, suggests higher levels of awareness and interest, with most of these topics being seen as non-trivial issues for the various trades, and as business opportunities for some. Some are more resonant than others with subsets of contractors (e.g., mold liability vs. VOCs). But all seem to be taken seriously somewhere in the industry, and we could find no negative treatment of these topics in industry association/trade press sources.

Program Theory and Design

- In terms of program theory and design, there is little precedence and few models for home performance program implementers to draw upon (e.g., in the limited and non-scientific "energy audits" of the 1980s). There is little of relevance in the energy program evaluation literature that we reviewed. The California AB549 study pointed to some fairly obvious problems that home performance programs would have to solve, including lack of information, lack of trained contractors, inertia in markets, etc. The social science literature deals with this complexity in a more sophisticated and analytic way, but can offer no specific advice about how to structure an intervention. So program theory was, for this program, a matter of making the best judgments and expecting surprises.

- Nonetheless, the program had ambitious aims. The CBPCA saw great opportunities for energy savings and grass-roots/market-based business development. There was a lack of awareness of savings potentials and non-energy benefits from HP retrofits. There was a pool of contractors waiting to be trained. There were resources in building science perspectives (e.g., "house-as-a-system") and tools (e.g., diagnostic testing, building simulation) waiting to be deployed. There were synergistic benefits to be realized from multiple energy improvements (e.g., to shell, systems, ducts, etc.). So the program articulated its goals as: (1) building contractor commitments and capabilities, (2) creating consumer awareness, interest and demand, (3) facilitating contractor sales efforts, and (4) developing market momentum and self-financing. Offering no financial incentives, these goals were a departure from the norm for efficiency programs.

- The primary strategy for accomplishing these goals was the creation and management of information flows among contractors, consumers and the CBPCA. Again, this was what the CPUC had designated as an "information only" program. The specific program elements designed to implement the strategy included: (1) administration and coordination, (2) marketing and public information, (3) contractor outreach, (4) professional training, (5) information and referral for customers, and (6) monitoring, quality control and evaluation.

Program Implementation

- An ambitious market development effort was undertaken in Phase 1 that was designed to create customer awareness and bring callers to the program hotline. A number of referrals to contractors were made in this way throughout the program. A shift in marketing approach took place late in Phase 1, however, that shifted emphasis to the production of marketing materials, the use of home show booths for initial customer contact, and particularly encouraging contractors to generate their own "leads" from current customers and ongoing marketing efforts in their locales.

- A building science-based training curriculum was developed and offered to contractors in a series of six-day sessions over the course of the program. The trainers are highly qualified and experienced professionals. The training was comprehensive and included theoretical, technical and practical/applied (hands-on) elements, as well as consideration of issues related to marketing home performance services, interacting with customers, and integrating home performance work into existing business models. Technical topics included: fundamentals of building science, occupant interviews, site inspection, combustion safety testing, infiltration, ventilation, insulation, heating, air conditioning, and ducts. The use of test equipment was covered at various points in the course, as well as calculation methods and the use of building simulation software programs. The training also involved hands-on testing and diagnosis of actual homes and development of specific work scopes for those cases.

- A program of active mentoring (via telephone, email and field visits) by CBPCA trainers was instituted when it was recognized that: (1) the level of technical sophistication was beyond some contractors who were quite committed to developing a home performance business, (2) hands-on testing and solving real-world problems were different from classroom examples and required experienced advice at first, and (3) many of the problems contractors were having were business-related and required individually crafted business consulting assistance.

- Contractor assessments of the classroom training were uniformly good, although the level of technical sophistication of the material and high expectations of the trainers made the course quite challenging for some. Active contractors also had very high praise for the quantity and quality of mentoring available to them. Customers reported high levels of satisfaction with the professionalism of the technical work, knowledge and communication skills of the contractors.

- Contractors were expected to report test results and job details to CBPCA as they completed work in the field. Reporting turned out to be sporadic. At first (e.g., in Phase 1 and early Phase 2), this was due to the small numbers of active contractors and challenges in using the TREAT software and finding time to report. Later, with more contractors, the flow of reports improved somewhat, with a total of 299 jobs reported by the end of the program in 2005. However the flow of reports continued to be sporadic, and the level of detail varied significantly from case to case. This created some serious problems in terms of availability of program management

information (i.e., in terms of what contractors were doing in the field) and evaluation (which relied upon these reports for data on work flow, types of work, energy savings, etc.).

- Interviews with contractors revealed that comprehensive testing and modeling was not common. In Phase 2, contractors were not trained in the use of the TREAT simulation software, because it was understood that they lacked time and/or recognition of need and/or the necessary skills (there were also some problems of over-predicting energy savings, unless careful bill analysis and calibration of results was performed). Instead, the CPBCA devised a 14-page paper form that could be used by contractors to enter home inspection/diagnosis/test data for the CBPCA to run through TREAT. Only a few contractors adopted the form, and then often only partially.

- In terms of coordination with other organizations, the CBPCA pursued mutual interests and partnership opportunities fairly broadly and openly (with greater and less success). Coordination was undertaken with utilities, other third-party CPUC program implementers, the ENERGY STAR national home performance program (HPwES), other home performance programs around the country, the Building Performance Institute, California Energy Commission, Electric and Gas Industries Association, Affordable Comfort, the California *Flex Your Power* public information program, and a few other business and industry actors. The CBPCA cosponsored (with PG&E and Affordable Comfort) a major conference on home performance that drew large numbers of interested California contractors, solving earlier quality-contractor recruitment problems.

- Over the course of the 3.5 years of the program, the CBPCA made significant adjustments to its program theory, design and implementation strategies in many areas. These included: marketing/market development, contractor recruiting, training, quality assurance, certification, acknowledgement of problems for contractors to radically change their business models, limited ability to secure modeling and test results from contractors, and adaptation of building science principles and practices in real-world adoption by contractors.

Program Effects

- A number of documented home performance jobs were completed by contractors during the 2004-05 period, likely more than the 299 reported to the CBPCA. Jobs ranged from simple air sealing jobs to large comprehensive HVAC replacement, duct sealing, air sealing, insulation, window replacement jobs. Contractors adopted a variety of styles of job delivery. Some used all subcontracted services, others did some work themselves and subcontracted specialty work, still others offered all services in-house.

- A very high proportion of all jobs reported involved HVAC work. Even simple air conditioner replacement benefited from home performance training, with duct

testing/sealing, right-sizing, and optimized efficiency (e.g., high SEER) installations. The importance of duct testing/sealing should be emphasized.

- Information from contractor reports/interviews and customer surveys regarding testing and retrofits are generally in agreement. In some cases, contractors reported work completed that were probably recommendations, while in others the contractors under-reported work (likely a combination of being more likely to report "big ticket" items and customers opting for additional retrofits after the contractors had reported).

- About ½ of the trained contractors went on to become "active" (by CBPCA definition) in pursuing some level of home performance contracting. This means that about ½ did not. In terms of contractor types, there are nearly equal numbers of active HVAC contractors and remodeler/builders (about 45% of the total each), with a small number of other specialty contractors (insulation, mold remediation, painting, raters, consultants) making up the balance. The HVAC and remodeler/builder contractors were, by far, the most likely to become active.

- We identified a very long list of barriers to successful adoption of some form of home performance contracting. The kind and level of contractor *interest* or *motivation* is a key determinant, with contactors who share both "cutting-edge" interests and "energy efficiency industry" roots being much more likely to pursue HP contracting than those who only have "shot in the arm" interests. During Phase 1, the CBPCA invested a considerable amount of time, effort and money in the latter group. During Phase 2, this proportion was reduced considerably. In addition to interests, however, a number of other barriers are salient. These have to do with type of business, size of firm, degree of specialization, culture/nature of current practice, poor network development, work flow/commitments/scheduling problems, price/commodity-driven practices, low capitalization/cash flow, human capital, marketing/sales experience, and degree of computer integration in business.

- Successful contractors (those who started doing home performance work as a serious part of their business) did so not by changing overnight, but by *transitioning* all or part of their work toward home performance. We identified stages of this process and several patterns of home performance adoption. These include: full whole house testing and retrofit work, partial testing/craft diagnosis and retrofit work, partial testing/craft diagnosis and HVAC replacement (with duct sealing), and HP-informed high quality HVAC replacement (likely with duct sealing). The CBPCA active contractors exhibited the first three patterns, with some work falling into the fourth category (mostly not reported to the CBPCA). The key here is that contractors rarely transition fully to whole house testing and retrofits, but perform a mixture of work, depending on consumer demands.

- In most cases, contractors expressed a high degree of commitment to the best quality home performance work that they could do. They believed that this has changed their usual practices, and in the cases of complete whole house diagnosis

(mostly by remodeler/builders) and high quality HVAC work with ducts (HVAC contractors), we are relatively satisfied that the effects of CBPCA training and mentoring can be seen. In the case of possible spillover effects on routine HVAC work, we have no evidence to conclude one way or the other about the impacts on common practice.

- Consumer profiles suggest that the home performance customers are similar to the Northern California homeowner population, although a bit better educated (more graduate degrees represented) and somewhat less likely to be Hispanic. No particular routes of contact with contractors could be identified. A number were used, including internet, yellow pages, mass media, and personal referrals. A majority did not contact the contractors specifically to inquire about home performance testing.

- In terms of consumer motivation, those who purchased home performance services and retrofits reported a combination that included: concern for specific system or building condition (e.g., aged equipment, building problems), environmental health (e.g., indoor air quality), energy costs, comfort, and resource conservation. These motives occurred in combination with one another. There are several implications of these findings: (1) the assumption of energy analysts (and current CPUC program assessment methodology) that cost savings and investment returns are primary for consumers is clearly false; (2) there is likely a complex relationship among motives in which energy price plays an important but ambiguous role; (3) consumers are seeking and receiving considerable non-energy benefits along with the energy benefits of HP services and retrofits; and (4) program evaluations in this arena should be aware both of the complexity of motivations and benefits, and the difficulties of measuring and weighing both. The fact that standard assessment methods cannot take into account important non-energy consumer benefits and motivations represents an institutionalized penalty for home performance programs.

- Customers were, overall, quite satisfied with contractor testing and reporting, the sales experience, and the quality of the work performed. They were quite willing to refer friends, coworkers and neighbors to home performance contractors, and about 60% had done so.

- In terms of market effects—impacts on other market actors who compete with or have vendor or subcontractor relationships with the trained contractors—we have only suggestive evidence. In part, this may reflect the fact that only modest effects have been felt (or, perhaps, can be felt) by this sort of change in active contractor practices. But it may also reflect the fact that contractors have no way of knowing what influences they may be having. Nonetheless, contractor interviews revealed some attention by competitors, some influences upon suppliers, and some changes in subcontracting patterns (and subcontractor competencies). A number of conditions that limit market effects were also identified, including: economic ebbs and flows, seasonal factors, regulatory demands, local competition, institutional constraints, utility roles, and direct government roles.

- Although not required of "information-only" programs, the CBPCA offered energy savings estimates to the CPUC in their program final report. These estimates were based upon contractor reports of job-by-job estimated savings (rarely reported to customers), with some ground-truthing and reality-checking by CBPCA on the basis of expert experience measure-by-measure, independent retesting of a small sample of jobs, and modeling of actual and prototypical dwellings. The CBPCA did not project savings for either non-reporting contractors or for those reporting contractors who seemed clearly to be under-reporting the actual volumes of their work.

- We examined in detail the contractor reports and CBPCA-submitted energy savings estimates. We considered issues of data quality and quantity, finding both limited, but adequate for rough estimation. We evaluated the CBPCA estimation approach and the plausibility of the estimates. We found the approach reasonable and the estimates plausible, comparing them with information from other sources (e.g., RASS and DEER). We examined the patterns of reporting rates and agree with the CBPCA's conclusion that the overall numbers of jobs reported is likely less than is actually being performed. The CBPCA estimates that this may be 5 times the number reported (on the basis of their census and informal contacts with contractors, some of this after the close of the program when job output seems to be increasing for some firms). We constructed independent estimates based on individual contractor reporting rates, job types, average savings by job type, and possible/likely minimum workflow. This analysis produces estimates more in the neighborhood of 3 times the 2005 reported number of jobs likely in the "out years" (e.g., 2006-2011).

- Although only illustrative of an alternative analysis—i.e., this is not proposed as what the CPUC would term a "verified" alternative to the CBPCA energy savings estimates—we find it reasonable to assume not only that the contractor job output around the end of the 2004-05 program is higher than reported, but that if they continue at that rate for at least 5-6 years, a significant number of new retrofits will be added each year to an increasing total. So, where the CBPCA would estimate (based on reported cases only) 16.4 MWh electric savings and 1.2 million therms saved by 2023 (the CPUC planning horizon), we can imagine plausible estimates of 246 MWh and 20 million therms. These are both much larger estimates than those proposed by the CBPCA for program energy impacts. We further estimate that if contractors who were newly trained and interested (and presumably capable) at the end of 2005 were also to add reasonably modest numbers of jobs to the total starting in 2006, that that overall MWh and therm savings could be 40% and 50% higher respectively as a result of added home performance retrofit. This would likely require continued support in the form of mentoring and monitoring that is no longer funded, however.

6.2 Persistent Program Problems and Challenges

Marketing and Market Development The CBPCA from the beginning recognized the "chicken and egg" problem of creating consumer demand for HP/WH services and having contractors to offer those services. Following early market development activities (with some success, but at significant cost) and limited contractor availability, a shift in strategy was made to support contractors' own marketing efforts to generate demand. It is apparent that balancing supply and demand can be quite challenging early in a growth process as one alternately lags behind the other, and this strategy seems to have panned out in the short run. It is also clear that there is limited use by contractors of CBPCA marketing materials, and an unknown level of local marketing of home performance services per se by the contractors.[55] Coordination by the program with *Flex Your Power* and the utility is encouraging, but to date home performance has had little visibility in those quarters. It is far from clear that a program without concerted marketing efforts, at least at certain stages of its development, can support continued home performance work and/or expansion of home performance contracting in the market place. If marketing and market development is not a problem area now, it may well be in the future.

Contractor Recruitment Early and persistent problems in recruiting contractors to training were solved by the large pool of interested and capable contractors who participated in the joint CBPCA/PG&E/Affordable Comfort home performance conference in the winter of 2005. This pool has presumably yet to be exhausted. However, it cannot be expected to supply quality trainees indefinitely. Unless similar or additional recruitment strategies are developed, the early problems with recruit quantity and quality are quite likely to return. One promising development along these lines that the implementers reported after the close of the program was the CBPCA offering continued HP/WH training through the PG&E Stockton Energy Training Center in 2006. All of these classes have been over-subscribed.

Conversion of Trainees into Active Contractors A significant number of persons and contractor firms have been trained in a fairly complex and challenging field, in a fairly short period of time, with a fair degree of intensity. This has required a significant investment of resources, staff/contractor time and money. The active trained contractors would say it was worth it to them. Even the inactive contractors speak highly of the experience and the information provided. But many of the trainees do not pursue home performance work in any form. Another group starts and stops (and may start up again at some point, but probably not). Another proceeds, but in fits and starts. And even the most successful contractors tend to move into home performance work as a somewhat uneven *transitioning process*. Along the way, the support and monitoring of mentors seems to be crucial.

[55] We didn't get good explanations for the limited use of CBPCA marketing materials, beyond the sense that they "weren't needed." An exception was one contractor who commented that the materials were "too CBPCA branded" to suit his needs.

We have not proposed to perform any sort of cost analysis as part of our evaluation, and do not do so now. We do note, however, that considerable investment has been made in the current training model, a significant part of that investment in contractors who do not seem to put that training to use (at least in any consistent way). This will be a persistent problem that will make continued funding and policy priority problematic for the program unless solved in some way. It is certainly inevitable that some trainees will do little with their training, no matter how promising they may seemed to have been at the start (the educator's perennial dilemma). But this poses a particular (and serious) problem for a program that requires significant investment in selected firms in order to support high quality training and mentoring.

Partial Adoption and Adaptation We might expect (even hope for) some selective adoption of HP principles and practices among trained but non-active contractors. However, among active contractors who are actually selling and performing HP services, selective adoption raises some possible concerns. The first is a lack of a "uniform product"—i.e., a situation in which possibly quite different bundles of practices and products can be said to constitute Home Performance services. The second is possible loss of the "house as a system" perspective and the loss of benefits (to consumers, as well as energy benefits, social and environmental benefits, etc.).

We know that only a few contractors are pursuing HP contracting exclusively. Most are offering HP services along with their usual menu of products and services. And many are adapting the process, selecting some elements and not others. We know that customers are also selecting items that they can afford and putting off or rejecting other retrofits. In terms of testing and diagnosis, we know that most contractors are not conducting comprehensive HP diagnostics. They often conduct tests related to the specific work under contract (e.g., HVAC contractors testing duct performance related to air conditioner change-outs, remodelers testing shell infiltration). Few are doing any simulations (and none using TREAT).[56] There is little attention to, or interest in, estimating energy savings for customers (sometimes for some good reasons discussed above). Written reports are being produced, but we do not have a sense of the level of detail in those reports. These are not necessarily bad things. But they are developments not anticipated in the program theory and design.

A fairly detailed and nuanced program theory predicted widespread adoption by trained contractors of a financially successful HP contracting business model. Subsequent program experience and evaluation findings led to a number of modifications to the program theory and the acceptance of more limited expectations for the contractors and their adoption of home performance principles, practices and business approaches. We believe that the program has itself adapted in developing a better understanding of contractors' business realities, and in the process has adopted a more realistic set of expectations and goals.

[56] The implementers did report that late 2005 cohort trainees are doing more load calculations.

As evaluators, we have raised at various times the question of the impacts of contractor modification. To some degree, this remains an open question. We do not conclude that failure to approximate the "ideal type" of whole house contractor first imagined in the program theory (and currently imagined by other HPwES programs) is a fatal program flaw. With the CBPCA only able to offer training and mentoring (and with few carrots and virtually no sticks), in retrospect it is hard to see how it could have been any other way.

In fact, the idealized model of the home performance contractor (called the "orthodox model" by one national observer we interviewed) may be very rarely approximated anywhere. California may be one of the least likely places for it to appear with any frequency—whether CBPCA training exists there or not.[57] The realities of home remodeling, repair and retrofit are that different contractor types are involved, with different skills and orientations and networks, and that they all currently thrive in that environment (or at least get by) without doing home performance work. So the problem may lie as much with the expectations of program implementers (and energy policy planners) as with the contractors and their adaptations.

At the same time, too little is known about what the contractors are doing and what (if any) home performance benefits are being missed as a result. We are willing to believe that significant benefits are being gotten by CBPCA-enabled home performance work in California. But we have no firm basis on which to ground that judgment. This brings us to the problems related to contractor reporting and data quality.

Reporting and Data Quality Because contractors frequently are not selling full-blown WH diagnoses, we know that they are often not doing detailed testing. But the vast majority of active contractors reported doing a full range of tests *when they actually performed a WH diagnosis*. However, in both formal diagnosis and craft diagnosis, we aren't sure what exactly they are recording or how they are using it in their "work-ups" of the case or in their actual reporting to customers. We have the clear sense that they are not running simulation models or collecting billing information to "true-up" models for particular households. They are not using the CBPCA data collection sheet for reporting (or are partially using it for their own purposes). Most important, from an EM&V point of view, they are not reporting jobs with regularity or in much detail to CBPCA.

While the CBPCA has been told by contractors that they have done a large number of home performance diagnoses and have large number of new jobs lined up, the supporting data have not been supplied. Where data do exist, the details are often sketchy (e.g., in terms of extent of work, SEER of old and new equipment, etc.). As noted, we have had full access to these data, which is crucial, since CBPCA contractor reports are identified in our evaluation plan as our only source of customer contact information and detailed information on work performed and potential energy savings. Whenever we have had this information from contractors, we have been very successful in securing cooperation

[57] The unlikelihood would be due to the state's high growth rate and dynamic markets, high current levels of energy efficiency, and the relatively moderate climate (certainly absent the extremes of temperature and humidity found in other parts of the U.S.).

from customers. In order to work around some of these problems, the consumer survey instrument was designed to capture self-reports of the measures customers installed. As we noted, there is reasonably good agreement between the contractors and the customers about work done. But we have been continuously frustrated (as have the implementers) with the limited amount of reporting data, and the limited amount of detail in those reports. Again, this has created serious problems for program monitoring, management information, and evaluation.

Funding While the program was funded twice (2002-03 and 2004-05) and at a reasonable level for the work proposed, the marketing efforts were significantly under-funded for a serious market transformation program. Also, the uncertainty about funding, the late program starts that delayed funding, and the lack of funding for support (e.g., contractor and consumer subsidies/incentives, diagnostic equipment, market development, contractor network development) certainly handicapped the program. The lack of utility rebates of any significance was not helpful. The lack of interest rate buy-downs and other financing options (aside from an industry loan program) meant that the program could only hope to target those homeowners who had ample incomes, longer time horizons, and non-energy interests (e.g., in comfort, health or home value).

While it is possible to imagine a functioning program supported by private sector resources exclusively (except for the training, of course), this is not a model in widespread use across the U.S., and it is not one with which efficiency programs have much experience. At the very least, a reasonably long-term funding commitment, even at modest levels but perhaps in a single pilot locale, would have presented a funding arrangement that would encourage long-term implementer and contractor commitments, and communicated a sense that energy policy makers were willing to seriously invest in an effort to leverage large private sector investments by homeowners and businesses.

It is true that consumers did opt for expensive retrofits without subsidies. But, as noted, a variety of non-energy motivations were involved, and a number of less affluent homeowners were not able to take advantage of a purely market-based home performance program. A lesson-learned, then, is that rejecting financial incentives for consumers and contractors may be no better recipe for market uptake than the "unsustainable subsidies" that were of concern to the CBPCA in its program theory. A workable balance may be a preferable approach.

6.3 Comparing the CBPCA Program to Home Performance Programs in Other States

Because we were uncertain whether the CBPCA program prospects and problems were the product of market realities that are fairly widespread, were related to California-specific conditions, the program design and policy environment, or the actions of the implementers (or some combination of these), we investigated a number of similar programs across the U.S. We have noted the existence of the HPwES program, of which the CBPCA is a partner. We have also pointed out the fact that home performance

programs have proliferated across the country over the past 4-5 years. So there is a basis for comparison. Also, we benefited from the national program survey conducted by CEE, and we were able to quite readily update those entries and supplement them with information on several other programs. Because of time and budget constraints, we did not interview program representatives and relied (as most consumers and contractors would) on public information materials/statements presented on their websites. We also were able to examine a formal evaluation of the New York program and have exchanged information directly with the evaluators of the Wisconsin program, with whom we have shared data collection instruments and protocols.

Briefly, we present the following findings from this review, in the areas of program coverage, targeting, marketing, training, funding, and performance goals. We have also included an Appendix E, which contains descriptions of some of the most salient features of twelve of these programs, particularly as they relate to contractors and consumers. In the following, we focus primarily on the HPwES programs in Austin (Texas), California, Colorado, Massachusetts, New York, New Jersey, Rhode Island, and Wisconsin. The point of making these comparisons is to determine whether the experiences in these other states—where a variety of different program approaches have been pursued—can shed additional light on the strengths and weaknesses of the California program.

6.3.1 Program Elements

Program Coverage The CBPCA program has targeted first the Fresno and San Jose market areas, with an expansion to other parts of central California and the Bay Area. The Austin and New Jersey programs are very local (single metro areas). The other programs are statewide in coverage.

Funding and Management The CBPCA annual Phase 2 budget was about $900k per year. In comparison, the Austin budget was approximately $1.7 million, Massachusetts about $5.7 million, Rhode Island $1.8 million, New York $6-7 million, and Wisconsin $2.5 million. Some of the difference is due to the fact that several of the other programs include funding for homeowners financing, incentives to contractors and customers, mass marketing, and significant central administrative structures.

The New York program is operated by a state agency (NYSERDA), as is the Wisconsin program. Austin, Massachusetts, and Rhode Island are operated by utilities. The others are administered by non-profits agencies.

Incentives and Rebates Significant program incentives are offered in Massachusetts and New York, with smaller incentives in Wisconsin and significant rebates in Austin. In comparison, the utility rebates available to CBPCA's California consumers and contractors are quite modest, and there have been, of course, no direct incentives offered in the California program to contractors or to customers.

Targeting and Marketing The CBPCA program primarily targets contractors. That approach is also true of programs in Colorado, New Jersey and Wisconsin. The other

programs focus primarily on consumers. Several use mass mailings, television and print advertising, public service announcements, and local one-on-one outreach programs.

Training The CBPCA program provides training as a primary program focus. Training is at least one of several key focal areas in the Colorado and Wisconsin programs. Others either do not incorporate specific home performance/building science training, or use the Building Performance Institute (BPI) to provide certification to locally trained contractors who want to participate in those programs. Mentoring is included in most training across programs with training elements. In several of these cases, contractors must pay (sometimes substantial amounts) for their own training. In others, training is provided.

Contractor Role The programs vary considerably in the degree of autonomy that contractors have in working with clients. In Wisconsin, independent consultants do much of the actual testing and diagnosis, with approved contractors brought in at the homeowner's option. In New York and New Jersey, contractors do home inspections and work, but report directly to the sponsors in order to be eligible for financial benefits. In Austin, contractors submit inspection results and recommendations to the sponsoring agency (the city electric utility) for approval. In Massachusetts contractors do diagnoses and may do follow-up retrofit work, or it may be done at the homeowner's option by other contractors. Contractor reporting is required in most programs, and is backed up by withheld payments and other sanctions in many cases. In others cases, reporting is largely voluntary.

Energy Savings Goals The Austin program is seeking 3,500 MWh in annual savings for the past year. The goal for Massachusetts is 5,400 MWh, and Rhode Island 3,700 MWh. CBPCA had no specific goal, but estimated 863 MWh in savings (which we believe may actually be, if contractors had reported, something in the neighborhood of 3,300 MWh in 2006). There were no explicit electricity or gas saving goals published for the Colorado, New York, or Wisconsin programs.

Job Completion Rates Few programs published forecasted job completion rates for current or future years. An interview with HPwES staff suggested that informal job goals for the coming year communicated to ENERGY STAR by the HP programs were in the neighborhood of the following: New York 4500, Massachusetts 1600, Wisconsin 1500, Austin 1500, California 900, and the other fifteen programs 50-75 per year. This places the California program in the upper tier of HPwES programs in terms of likely home performance job yield.

6.3.2 Conclusions Regarding HPwES Program Comparisons

The funding level of the California program is comparable to other programs in the U.S., and is dwarfed by the budget of the most successful New York program. It has operated with fewer incentives and subsidies for consumers and contractors. Its marketing efforts are not distinctively different from or weaker than those of other programs. The CBPCA

program has a much greater focus on training, and across all programs mentoring has been found to be a key ingredient in producing quality contactors and quality work. The California contractors operate with a comparatively high degree of autonomy. Lacking the rewards and sanctions available in other states, the California program may experience lower contractor reporting rates. But this seems to be a persistent problem for a number of programs.

The energy savings goals for several other state programs are fairly ambitious, but the actual California savings may actually be comparable. Finally, the job completion rates and targets for the California program[58] are not out of line with those of other states, particularly considering that some are funded at higher levels and deploy a variety of strong incentives.

In sum, the California program stacks up fairly well to those of other states on a number of dimensions, and its problems are not unique. Differences in program design, sponsorship, and funding level are certainly responsible for differences in performance across programs. It should also be noted that none of these programs have been in existence for very long, and most have been introduced only within the past 3-4 years.

At the same time, several of the other programs are clearly in the home performance business for the long haul, having taken a serious market transformation approach to program design and funding, with rigorous systems of quality assurance, reporting and verification (features which have not been realized in the California case). By comparison, the CBPCA program has been funded piece-meal and on a short-term basis, with little future security and no discernable long-term support from the state or utilities. There have been no market transformation investments in home performance made in California compared to the New England states, Texas and Wisconsin.

6.4 Recommendations

We offer a number of recommendations for future program improvement. In terms of the 2004-05 program, these are moot, since funding ended for that program with no immediate prospects for renewal (and continuing CBPCA support for Northern California contractors is now being offered only on a fee-for-services basis). Nonetheless, there are aspects of that program that should not be ignored (e.g., trained contractors who continue to do home performance work). And future programs in Northern California, Southern California or elsewhere will benefit from the experience of the CBPCA in 2002-2005.

These recommendations are not only directed to program implementers. The prospects for these sorts of programs depend heavily on the levels and kinds of support available

[58] Two CBPCA's performance goals included: 1) The demonstration of trained contractors' momentum toward 5 million kWh/year and 100,000 therms/year by 2006, and 2) Similar evidence of continued trend for the program-trained contractors to double that annual level of savings by 2010.

from state agencies, utilities and other sponsors. So the recommendations are directed to multiple interests, who can contribute to them in different ways.

Marketing and Consumer Education Invest in serious consumer education and awareness activities. Partner with *Flex Your Power* in mass-market campaigns. Employ at least one full-time marketing professional whose sole responsibility is to place news articles in the popular press and electronic media. S/he should be completely devoted to "creating buzz" around home performance services and products, and her/his work should focus as necessary on particular local target markets, strategically employing a range of media to communicate with homeowners and, indirectly, with contractors and other market actors.

Contractor Recruiting and Legitimacy Identify and recruit successful, mid-sized contractors among the HVAC and remodeling/building communities. Look for market actors who are already opinion leaders and have the organizational capacities to add home performance contracting as at first a peripheral element in their businesses, with eventual integration across all of their activities. Screen out, to the extent possible, "shot in the arm" trainees, even if this means offering fewer training cycles or perhaps charging fees for training. Invest strategically in contractors with high success potentials and provide close mentoring support (with high quality feedback and real time information from mentors). Continue efforts to use industry networks (e.g., HVAC manufacturer distribution channels) to recruit contractors who have high success potentials.

Building Science, Testing and Reporting Stress the importance of fully competent and comprehensive building science perspectives. Encourage and support testing wherever possible. Work to streamline testing and recording of results (e.g., using field-friendly data collection/input devices such as PDAs and laptops). To the extent possible, make the estimation of energy savings an important aspect of home performance diagnosis and sales. Create a culture that supports reporting (as a professional activity) and encourages close communications between the contractors and the program implementers. The use of contractor chat rooms and listserves is a move in the right direction.

Understanding Adaptation A better understanding of the sorts of home performance adaptations being done by different contractors and contractor types would be useful. It would allow a more confident understanding of the impacts of those adaptations. It would also allow better tailoring of curricula, training content and mentoring support to optimize benefits to contractors, consumers and the energy system.

Documenting Energy Savings and Non-Energy Benefits Encourage the documentation (e.g., in test results and reports to customers) of energy savings potentials, as well as novel ways to verify and quantify non-energy benefits of home performance retrofits. Strongly encourage contractors to use (and share with the implementers) customer satisfaction surveys that evaluate post-retrofit consumer experiences and perceived benefits.

Reporting, Carrots and Sticks Reporting of home performance diagnostics and retrofits are critical for program management and evaluation. Contractors must be rewarded in whatever ways are possible (e.g., incentives, requirements, awards, etc.) and sanctioned for non-reporting (e.g., withholding recognition, participation, incentives, professional disapproval, advertised contributors and non-contributors in contractor networks, etc.). Failure to report work can simply be due to competing claims on time and attention. But it can also indicate lack of serious interest in the enterprise and possibly lack of commitment to doing home performance work at any level. It is important to be able to know if the latter two cases are true.

Funding and Support Funding for the program should be at an appropriate level for a major state with a large stock of existing housing that has significant energy-savings potential. Funding should be stable, targeted, carefully evaluated, and proportionate to potential energy savings—both from whole house work by remodeler/builders and high quality building science-informed HVAC work. Serious attention and analysis should be focused on the possible use of loan buy-downs, subsidies, incentives, rebates, etc. of the sort used in other states. Questions of climate and cost-effectiveness will, of course, be important in that analysis (e.g., targeting particular climate zones for program implementation, rather than state-wide roll-out).

Evaluating Energy Savings Careful attention to energy savings, even from this sort of "information only" program, with consideration of data quality, estimation methods, and reasonable out-year behavioral assumptions for contractors and consumers, is clearly called for. The potential energy savings from home performance diagnosis and retrofit are large. The real question is how to achieve those savings (and document them).

Reaching the Hard-to-Reach Our Phase 1 evaluation recommended more concerted efforts to reach the hard to reach population. Since the program has been designed to mobilize the private resources of homeowners, persons with low incomes would ordinarily not benefit. Efforts could be made to reach more affluent Hispanic homeowners, however, who are under-represented in our samples of consumer survey respondents. In terms of lower-income homeowners, it would be worthwhile to investigate stronger connections with weatherization programs as a delivery system for significant home performance services.

Stranded Efficiency Assets It is a sad thing that a number of motivated and trained contractors were essentially abandoned by the CBPCA and the CPUC at the end of 2005 for lack of support for mentoring and monitoring. If these contractors, many of whom expressed serious interest and commitment to us in their interviews, are successful in home performance work, their contributions to 20-year energy savings would increase the overall 2004-05 program energy impacts by 40-50%. It is hard to believe that savings of this magnitude are being left on the table. We strongly recommend that funding be found to provide support to these contractors, and to secure high quality job reporting from them, as well as from their colleagues who have been active for some time.

Research and Program Design It is important that the large $3 million+ public purposes funding invested in the California home performance program experiment from 2002-2005 not be lost with changing funding priorities and portfolio design criteria. It is still possible to identify and monitor the long-term building performance and energy consumption profiles of program participants. It is also still possible to revisit contractors and to secure information on their work since training. The possible persistence of savings and continuing production of savings by trained contractors represent possible important assets to California energy efficiency portfolios. The value of these savings, the potentials of similar savings elsewhere in the existing housing stock, and the persistence of these savings are important research and evaluation topics that will not be answered unless the CPUC, the CEC and the utilities believe that they are important questions to answer and worthy of research investment.

Policy and Valuation of Home Performance Work The Total Resource Cost (TRC) methodology that calculates total cost of efficiency investments as program cost plus consumer cost (e.g., cost to train the contractor plus the cost of the homeowners investment in retrofits) and compares this number to total estimated energy savings should be critically examined and alternatives considered. This calculation discounts consumer's investments in non-energy benefits (NEBs) and disadvantages programs like the CBPCA home performance program by inflating its costs and minimizing its benefits vis a vis competing efficiency portfolio investments. Alternatives are imaginable, including (1) valuing NEBs in total benefits, (2) removing NEB-related investments from TRC calculations, and (3) valuing only the marginal additional costs of efficiency improvements over costs that would otherwise be incurred for retrofits and equipment upgrades undertaken as a matter of course.

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8 APPENDICES

APPENDIX A Evaluation Plan: Research Questions

4.a.1. *Coordination and Operations*

- What is the nature of the coordination of the CPBCA program with related utility, CPUC and industry programs? How effective is it? What problems, if any, can be detected? What changes might be indicated to improve coordination and delivery of non-program resources to support the Whole House (WH) approach?

- How effective are the quality assurance, complaint and mediation elements of the program?

4.a.2. *Contractor Response*

- What are the characteristics of participating contractors (e.g., in terms of size, experience, specialty, etc.)?

- What are contractors' reactions to and suggestions for improvement of training and mentoring support?

- What are the variations in ways that the "Whole House package" is implemented in actual business practice? (e.g., adopted across the firm, adopted only within specialized sub-units such as HVAC, spun off as a subcontracting unit) What types of linkages (and disconnects) are observed within firms between sales, testing, installation, and quality control/customer satisfaction/call-backs?

- Why did some contractors consider participation, but chose not to? Why did some drop out after completing training?

- What roles are played by trade allies and supply chain partners in enhancing and/or retarding adoption of the WH package?

- How do market developments and environmental changes (e.g., competitor behavior, triggering events such as widely publicized mold lawsuits, weather conditions such as protracted heat storms perhaps) influence adoption and promotion of WH package by participating contractors?

- What sorts of adaptive changes (both positive/innovative and negative/counter-productive) are made in both conventional business practices and in the WH package? (e.g., innovations in testing, short-cuts in application, partial packages offered contrary to program expectations/requirements)

- Do participating contractors, at the end of the day, sell primarily what they sold before (e.g., single measures such as windows, HVAC, insulation, siding, green remodeling), despite their involvement in the WH project?

- How are sales, installation and call-back interactions with homeowners improved (or not) by use of the WH package?

- Do participating contractor communicate with non-participating contractors about program features and benefits, either through direct contact, or through trade associations, supply chain actors, or clients? Are they aware of any new home performance services being offered in their local markets? If so, do they think that the development of their own business has had any effect on what others are doing in the market place?

- Are there significant differences among locales in market function and program performance at the contractor level?

- How well do the program theory and its assumptions about contractor and market network motivations, organization and behavior hold up in light of actual experience? How can the realism of the program theory be improved?

4.a.3. *Market Development*

- How has market research, message development, delivery-strategy planning, segmentation, testing, delivery, and feedback been conducted?

- What are contractors' views of marketing materials, strategies and messages? Do they see the market development activities delivering leads and clients?

- What are homeowners' perceptions of messages and delivery/dissemination routes (e.g., in terms of resonance, vividness, actionability, trustworthiness, etc.)?

- How useful is the customer hotline to homeowners? How did they use it?

- How are clients actually delivered to the program (e.g., via usual sources such as client referral, neighbors, contractor advertising/direct marketing, or via novel routes influenced by the market development activities)?

- Did clients actually buy the sorts of retrofits emphasized in the marketing messages? (if particular retrofits are presented vs. general awareness messages about problems with existing houses and/or availability of testing and general retrofit services)

- Can we detect general changes in awareness and interest in building performance (among all types of market actors) that might be produced by market development efforts and that might be important for future choices, even if they are not

instrumental in delivering particular clients to participating contractors in the immediate future?

- Can we identify "spill-over" effects on the practices of contractors who have not participated in the program, but who have learned about it through networking contacts with participants, clients and/or other market actors? If so, can we develop a better understanding of the mechanisms at work (e.g., communication, emulation, market trends)?

- Are there significant differences between locales in market development activities, opportunities, perceived successes, and difficulties?

- How well does the program theory and its assumptions about market performance hold up in light of actual market development experience? How can the realism of the guiding program theory be improved?

4.a.4. *Consumer Response*

- Why did homeowners seek out retrofit contractors? What changes/improvements did they want to make to their dwellings? (e.g., to take care of a cold spot, a poorly performing air conditioner, because of health concerns, safety issues, part of major upgrade undertaken rather than moving, specific room remodel, etc.) Why those things and not others? Can a *hierarchy of motives* be identified?

- How did they find out about the WH package? (referral, public agencies, contractor marketing, program hotline) What attracted them to the package? Who inquired about the WH package via hotline or contractor direct contact, but *did not* buy the service or other products? Who bought retrofits without the WH package? Why?

- What did they expect? What were they sold? What did they think they bought? What did they actually get? How satisfied were they with the results?

- How (if at all) has the retrofit package produced conditions and experiences that are new and different? What are the improvements? The problems? Disappointments?

- If they have complaints, have they actually complained? If so, to whom? Have they filed a formal grievance with the program? A complaint against the contractor with public officials? Initiated legal action?

- Have they told friends, relatives, coworkers about their retrofit and experiences? About the WH package? What have they told them? Have they given positive feedback to the contractor? To the program?

- Did they have prior experience with other contractors? Positive? Negative? Did past experience color the interactions with the contractor? How was this experience different?

- Are they aware of any similar home performance services offerings in the market place? If so, did they consider those services as well? With what results?

- Are there important differences in knowledge/belief about building/system performance (e.g., "high tech" orientation, "mechanical" or "fix-it" orientation, claims of technical ignorance) that influence interest in and adoption of the WH package.

- Are there other key socio-cultural differences (e.g., age, gender, income, education, ethnicity, length of residence) that make a difference in interest/adoption?

- Are there significant differences among locales in consumer response and consumer evaluation (e.g,, of contractors, of the WH package, the program, the retrofits)

- How well do the program theory and its assumptions about consumer motivation, choice and experience hold up in light of actual consumer behavior? How can the realism of the program theory be improved?

APPENDIX B Contractor Interview Guide

Opening Script

General introduction (interviewer name, affiliation, purpose, etc.). Let me start by saying that everything we discuss will be confidential. The CBPCA wants feedback from us as soon as possible so they can fine-tune the program, and the state will see a copy of our final report next year…your individual comments will not be identified.

It is really important that we get your views since there are relatively few active contractors with your program training. We're basically interested in two things: (1) we want to find out how the program is working, and (2) we want to see what we can learn from your experience that will help improve these sorts of programs in the future.

If it's OK with you I'd like to record the conversation only so that I can make sure that my notes are complete. It's hard to take notes and talk on the phone at the same time. If you don't want me to do that, that's fine too.

First, I want to ask a few quick questions about your business and how you got involved in the Home Performance Program. (I know from other interviews that it is easy to get sort of sidetracked, but we can get through this pretty quickly if we can go just through the questions in order….)

Contractor Characteristics & HP Program Participation:

1. What kind of contracting do you do? (Get list of all services offered_____)

2. How long have you been in the business? _____

3. How many employees does the company have? _____

4. How many people in the company are *directly involved* with Home Performance work?
(this might include HP technicians/testers as well as office support)

5. Can you recall *how or where* you heard about the California Home Performance Program?

6. *Why did you decide to take the training class?*

7. *Did you have any interest in or experience with green buildings or building science or the "house as a system" before attending?*

8. Did you have any reservations about participating? _____ If so, what were they?

9. As part of the training did you get 2 days of "in-the-field" training with Tim Locke or Rick Chitwood or someone else from the CBPCA – (where you actually conducted the Home Performance tests)?

10. Would you briefly describe the tests or skills that were emphasized during this part of the training?

11. Please describe any continuing support (e.g., help with diagnoses, troubleshooting, business or marketing assistance that happened after your training class) that you've gotten from Tim and Rick or other CBPCA staff. *(this may covers business and marketing issues as well as technical problems, and may occur in a contractor's office or home as well as on the job.)*

12. About <u>how many</u> mentoring-type meeting or working-sessions have you had with them *(not counting the 2-day in-the-field training*)? _____

13. [For feedback to CBPCA:] Can you think of any ways that their continuing support or mentoring efforts could be improved? If so, how?

14. How much would you estimate it's cost you so far to get set up to do HP diagnostics? (Including equipment and training of you and any other staff, etc.) _____

15. Do you have your own complete set of testing equipment? _____

16. If not, do you plan to buy it soon? _____

17. If not, how are you conducting HP tests now? _____

18. About how may Comprehensive Home Performance Diagnoses have you conducted in the past 4 weeks (in a month's time)? _____

19. And of those, about how many have resulted in a work authorization? _____

20. Can you recall about how many homes <u>in total</u> that you've done Comprehensive Home Performance Diagnoses on? _____

21. Would you say the number has been growing or has staying about the same? ____

22. If growing, how much growth (a lot, a little, double, triple or a percentage…) _____

23. There are a few computer programs on the market for estimating energy savings based on the type of information you gather during a homes diagnosis. In fact last year, contractors were encouraged to use a software package called TREAT to for this purpose. Since the CBPCA no longer recommend TREAT as a way to estimate energy savings for the homeowner, how do you do that now? _____

24. Do you use any, or all of the CBPCA's 14-page DATASHEET when doing the home diagnosis? [Any / All / Not At All]

25. If not at all, how do you record the data you collect during the Home Inspection?

26. AND how do you record your test results during an installation (e.g., testing the duct seal level)? _____

27. Do you routinely give the CBPCA a copy of all of the test results you collect?

28. If you don't, why not? _____ Did they tell you that it is important to future program funding for them to be able to show program results?

Implementing the HP Approach & Changes in Business Practices

In our interviews with some of the CBPCA trained contractors last year we found that they had different ways of applying the training. Some were interested in doing Home Performance diagnoses but didn't do work that include both shell and HVAC improvements. Others combined HP testing with both HVAC and Shell related retrofits.

29. How does (or how will) the testing and diagnosis fit into *your* existing business?

30. If a diagnosis recommends a broad scope of work (like insulation, major appliances, windows, air handling) how do you handle that – already have all those skills and licenses, hire subs or new employees, set up a new unit, or what?

31. Do you offer any NEW products or services now because of this HP approach? _____

32. If you ARE offering different products or services, what are they? - _____

33. In homes where you have ended up mostly providing the same products and services that you did before starting the HP approach (e.g., a new AC installation) - are there **any** specific things you now do differently because of the training? _____

34. If you ARE offering different products or services (since starting HP testing), what are they?
(Prompts might include duct sealing and insulation, refrigerant charge and airflow checking, duct cleaning, air balancing, combustion appliance safety testing, infiltration testing with a blower door, etc.) _____.

If I called up and asked you for a Home Performance diagnosis, tell me how the testing process would go (we'll talk about what happens after the test next). That is….

Ask each :

35. What sort of questions would you ask me on the phone first? _____

36. How many people would come out? ____

37. How long will it take? ____

38. Would you provide recommendations and costs on the spot, or what? ____

39. What tests would you conduct on my house? _____

[Ttry to find out if the same set of tests is done on every house, or if that varies]

Shift focus to "Reporting to Customer" and "Sales process":

So after the testing procedures are finished, then …

Ask each:

40. Do you calculate energy savings estimates for recommended retrofits? _____

41. Is there something about a PG&E bill release form? _____

42. Do I get a list of everything that needs to be done, a written report or what? _____

43. What about cost estimates? _____

44. If I cannot afford to do them all, how can I decide which are the most important to do? __

45. Will you have utility rebate information for me? _____

46. Do you have financing or loan information? _____

I have just 2 follow-up questions regarding rebates and financing…

47. As a contractor, do you usually use utility rebates? _____

48. How often do you find financing or loan information to be useful in making a sale? _____

THE WORK PHASE:

49. Just to make sure that I understand – do customers get more than one sets of retrofit options – "packages of options" that have different costs and different energy savings? Or what? ____

50. Let's say that I decide to get some work done that you recommend, what makes a CBPCA trained Home Performance contractor the best contractor for the job rather than me going out for bids from non-Home Performance-type contractors? _____

51. In what percentage of your diagnosis cases would you say that you get the bid versus how many go to other contractors? _____%

52. In what percentage of cases would you estimate that you recommend retrofits to the SHELL of the house (insulation, or new windows, air sealing, etc)? e.g., 10%…. 50% … 100%: _____%

53. Suppose I *just want a new AC*. Why should I hire a Home Performance contractor over any other HVAC contractor?

_____

54. Would you conduct a Comprehensive Home Performance test on my house in that case?

In thinking about your interactions with homeowners who are interested in HP testing, . . .

READ*: It's important to the CBPCA to understand why different customers ask for diagnostic testing, why some go ahead and pay for extensive retrofits, and why others don't do the work or only do part of what's recommended. Our interviews with customers last year showed that some were primarily concerned about saving money on their utility bills, while others were mostly interested in health and clean air, and others wanted better comfort, some just wanted some old equipment replaced—and lots of people had a combination of motives.*

55. In your experience, what are the different reasons that customers have for contacting you for a home diagnosis? _____

56. If there are differences between customers who go ahead with recommended retrofits and those who don't, what sort of differences have you discovered?

57. How about those who do partial jobs? What reasons do they give you? _____ If it's financial, could better financing support help?

Materials and Supplies:

58. *Have you had any problems getting the materials, technologies or services you need from suppliers or subs to do quality retrofits?*
*Explain*_____

59. *Do you think there's anything that the program or CBPCA could do to assist you to get what you need (including testing tools)?* _____

60. *What do your suppliers and subs think about the HP approach? (Do they know about it, a good idea, an oddity, a trend)?* _____

61. *Have you had to find any NEW suppliers or subs in order to do effective retrofits?*

62. *If "yes," . . .what kind of suppliers or subs? _____ And are they hard to find? _____*

63. *Do you talk about any of your successes/problems with other contractors who participated in the training? (If "yes," what is the most common thing to come up in conversation?)* _____

Views of marketing materials, strategies and messages

READ: We'll finish up with just a few questions about the Program's marketing and possible improvements.

64. Is Home Performance testing and retrofitting something that you explicitly advertise? If so, what kinds of things do you emphasize? (i.e., how do you sell it?)

65. Besides advertising in the ways you've always done it, are you doing any other kinds of marketing of the HP Retrofit part of your business? Explain…

66. *Do you use the Energy Star logo or affiliation in your own marketing or customer outreach?*

READ: The CBPCA has produced several types of marketing materials including a CD, brochures, etc.

67. *Has the CBPCA provided you with these marketing materials? ___Yes/No____*

68.

69. *IF YES — do you use them to solicit new customers?* _____

70. *During a Whole House diagnosis, do you routinely give customers any materials that describe the process (other than a written report of diagnosis results)?* _____

71. *Do you have any thoughts about the CBPCAs marketing materials and how effective they are at generating interest in HP testing?*

72. Are there ways that the Association could better help you in YOUR own marketing of HP services to customers?

73. *Do you see other industry people moving in this direction in your area? e.g., have any other contractors asked you for information?*

74. If "no," why is that, do you suppose?

Improving the Program

75. Now that you've gone through training and had some experience doing diagnoses, have you found any parts of the HP training package that <u>don't</u> work for you? …. Explain

76. *Can you think of any ways that the <u>program training</u> could be improved? (e.g., Was it long enough? Would a different class schedule work better? How effective were the trainers? Was it well organized?)*

77. *Given your actual experience <u>implementing</u> HP retrofits, can you suggest improvements in testing procedures, the Datasheet or software for gathering and calculating test information, reporting, etc.?*

78. *Do you think the HP Retrofit business is likely to survive in the future without support from the Association (the CBPCA)?*

79. *Do you see coordination with any other organizations, associations, businesses, or agencies as being crucial to the longevity of the HP type work?*

80. *Do you have any other thoughts or comments about anything else we haven't talked about?*

READ: If we have any more questions about your experience and the program over the next year, I hope it's OK to get in touch again _____yes / no

THANK FOR YOUR HELP….

APPENDIX C Customer Survey Instrument

The survey has 3 short sections on:
1- Home evaluations - tests that measure performance and energy efficiency
2- Home improvements, major appliance purchases, remodeling
3- Household characteristics

First, what was your primary reason for contacting [contractor name]?

☐ To conduct routine maintenance on your cooling or heating system.
☐ To get a bid for major repair or replacement work.
☐ To conduct a comprehensive Home Performance inspection.
Other. Explain: _____

Screening Question for Section One:

Did your contractor conduct a House Inspection to measure your home's performance and energy efficiency? (Typically this would include a blower door and duct blaster tests, the measuring of ceiling and wall insulation, the performance of your air conditioner and furnace, and related safety checks)

☐ Yes ▸▸▸▸ please start with Section One
☐ Not Sure ▸▸▸▸ please complete Section One as applicable, then go to Section Two
☐ No ▸▸▸▸ Skip to Section Two (page 3)

Section One (9 questions regarding the Home Performance testing process):

1. **Did you receive a written report with the results of the home performance tests conducted on your home?**
   ☐ Yes
   ☐ No ▸▸▸▸ **Skip to Question 3**

2. **The following are statements that others have made about the information provided in written home performance reports. Please indicate if you disagree or agree with each statement.**
   (Check the one option that most closely reflects your opinion.)

The written report…	**Disagree**	**No Opinion**	**Agree**
was too technical.	☐	☐	☐
provided useful information about my home.	☐	☐	☐
didn't have enough detail.	☐	☐	☐
was well written and prepared.	☐	☐	☐
was provided to me in a timely manner.	☐	☐	☐
identified rebates I might be eligible for if certain home improvements were completed.	☐	☐	☐
listed home improvement options (retrofits) and their potential energy savings.	☐	☐	☐

identified health and safety concerns.	☐	☐	☐

3. **After the tests were conducted … Did you <u>discuss</u> the results of the home performance tests and explore options for home improvements with your contractor?** (Either met in person or discussed the results and retrofit options over the phone.)

   ☐ Yes
   ☐ No ▸▸▸▸ **Skip to Question 5**

4. **Below are some statements others have made about their discussion of test results and optional home improvements. Please tell us if you agree or disagree with each statement.** *(Check one answer for each)*

While discussing test results…	**Disagree**	**No Opinion**	**Agree**
issues were clearly explained.	☐	☐	☐
contractor seemed biased toward certain options.	☐	☐	☐
contractor answered all of my questions.	☐	☐	☐
he seemed like an expert in energy efficiency.	☐	☐	☐
got back to me in a timely manner.	☐	☐	☐
we talked about energy efficiency improvements.	☐	☐	☐
we talked about improving comfort.	☐	☐	☐
we talked about health or safety issues.	☐	☐	☐
cost of each retrofit option was explained.	☐	☐	☐

5. **Cost of the Home Performance Evaluation -** *(Check one answer)*

   ☐ I paid a fee for my home inspection, and **the cost was $**_____ **(***fill in amount)*
   ☐ The charge for the Inspection was rolled into the cost of the work performed.
   ☐ I was not charged.

6. **Did you know that your Whole House inspector was affiliated with (and trained by) the California Home Performance with ENERGY STAR® program?**

   ☐ Yes
   ☐ No

7. ***Where* did you *<u>hear</u>* about the home testing and contracting service?** *(Check all that apply)*

   ☐ Telephone book yellow pages
   ☐ Newspaper, television or radio
   ☐ From a friend or colleague
   ☐ From the Internet
   ☐ From a Home Performance with ENERGY STAR® consultant or contractor
   ☐ Home show
   ☐ Yard sign
   ☐ Other (please describe): _____

8. Overall, how satisfied were you with…
(For each statement, circle one level of satisfaction or "NA" if not applicable)

	Very Dissatisfied				***Very Satisfied***	
the home testing process?	1	2	3	4	5	NA
the contractor's sales process?	1	2	3	4	5	NA
the cost of the inspection?	1	2	3	4	5	NA

9. Have you recommended this home performance <u>evaluation service</u> to friends, neighbors, or colleagues?

☐ Yes
☐ No

~ End of Section One ~

Section Two (9 questions regarding home improvements):

Screening Question for Section Two:

Did a contractor <u>install equipment</u> or provide some <u>other home improvement services</u> (such as installing a new air-conditioner, furnace or completing a home retrofit project)?

☐ Yes ▸▸▸▸ **Please complete Section Two starting on the <u>back</u> of this page**

☐ No ▸▸▸▸

IF NO: Do you plan to do some or all of the recommended projects later on?

☐ Yes ☐ Maybe ☐ No

If "Maybe" or "No" explain why: _____

IF YES or MAYBE: Do you think will you have [contractor name] do the work?

☐ Yes ☐ Maybe ☐ No

If "Maybe" or "No" explain why: _____

Skip to Section Three (page 7)

Section Two:

1. What home improvement projects did you decide to have completed by [contractor name].
(Check applicable boxes on both sides of the list. Leave blank if they were not recommended.)

FIRST: Check boxes for each item recommended by your contractor:		**SECOND: Check if you:** Completed this project	Plan to Do Later	Don't Plan on doing
⇓		⇓	⇓	⇓
☐	Replace existing furnace	☐	☐	☐
☐	Replace existing air conditioner	☐	☐	☐
☐	Install new furnace (1st time installation)	☐	☐	☐
☐	Install *new* air conditioner (1st time installation)	☐	☐	☐
☐	Air conditioner maintenance / tune-up	☐	☐	☐
☐	Install new thermostat	☐	☐	☐
☐	Seal existing ducts	☐	☐	☐
☐	Replace existing ducts	☐	☐	☐
☐	Install *new* ducts (may be in addition to old ones)	☐	☐	☐
☐	Window replacement	☐	☐	☐
☐	Air sealing (fix infiltration, leaks, weatherize)	☐	☐	☐
☐	Insulation – Ceiling	☐	☐	☐
☐	Insulation – Wall	☐	☐	☐
☐	Kitchen Remodel	☐	☐	☐
☐	Bathroom Remodel	☐	☐	☐
☐	Siding replacement	☐	☐	☐
☐	Roof (replacement or repair)	☐	☐	☐
☐	Home addition	☐	☐	☐
☐	Other List: _____	☐	☐	☐
☐	Anther List: _____	☐	☐	☐

2. *If you checked that you plan to do some or all of the recommended projects later on, will you have [contractor name] do the work?*

☐ Yes ☐ Maybe ☐ No

If "Maybe" or "No" explain why: _____

3. *How important* were each of the following reasons in your <u>decision</u> to complete your home improvement project? *(Check one level for each applicable reason)*

	Not Important	Somewhat Important	Very Important
A) Contractor was affiliated with the Energy Star® Program:	☐	☐	☐
B) Improve home's appearance:	☐	☐	☐
C) Increase or preserve home's value	☐	☐	☐
D) Improve indoor air quality:	☐	☐	☐
E) To be more efficient (to save energy and resources):	☐	☐	☐
F) Replacement of older equipment:	☐	☐	☐
G) Improve home's comfort:	☐	☐	☐
H) Address health issues:	☐	☐	☐
I) Product rebate was available:	☐	☐	☐
J) Reduce utility bills:	☐	☐	☐
K) The retrofit(s) were indicated by the contractor:	☐	☐	☐
L) Add additional space:	☐	☐	☐
M) The work was recommended by a Home Performance test:	☐	☐	☐
N) Other (list): _____	☐	☐	☐

4. If you checked more than one reason (above) as VERY IMPORTANT, among those, which would you say was your …

(List the letter associated with your reasons from your choices above)

____ highest priority among *Very Important* reasons

____ second, or next highest priority among *Very Important* reasons

____ third, or next highest priority among *Very Important* reasons

<u>Or</u> would you say that…

☐ I can't rank them because my **Very Important** reasons all had equal priority.

☐ Not applicable (only listed one or didn't list any as Very Important reasons above)

5. **Was specialized equipment used <u>during the work phase</u> or <u>after it was completed</u> – (for example, a duct blaster to test the air ducts, a blower door to measure infiltration, or an infrared camera to evaluate wall insulation)?**
(Check all that apply)

   ☐ Testing equipment was used <u>during</u> the work phase

   ☐ Testing was conducted <u>after</u> the work was completed

   ☐ None of these types of tests were performed by the contractor

   ☐ Don't Know

6. **Below are some statements others have made about contractors who perform home improvements. Please tell us how much you agree or disagree with these statements.**
(Check one answer for each)

The contractor I hired …	**Disagree**	**No Opinion**	**Agree**
responded to me in a timely manner.	☐	☐	☐
seemed like an expert in energy efficiency.	☐	☐	☐
made my home more efficient (resource-wise).	☐	☐	☐
made improvements that reduced my utility bills.	☐	☐	☐
made my home noticeably more comfortable.	☐	☐	☐
made my home more healthy to live in.	☐	☐	☐
explained the cost of each retrofit option.	☐	☐	☐
explained the options in terms I understood.	☐	☐	☐
seemed biased toward certain retrofit options.	☐	☐	☐

7. **Overall, how satisfied were you with your contractor in regards to…**
(For each statement, circle one level of satisfaction, or "NA" if not applicable)

	Very Dissatisfied				***Very Satisfied***	
the scheduling and on-time work?	1	2	3	4	5	NA
the behavior of the workers?	1	2	3	4	5	NA
the quality of the work performed?	1	2	3	4	5	NA
results from work completed?	1	2	3	4	5	NA

8. **Would you recommend <u>this contractor</u> to others?**
(Check one answer and explain why if you'd like to)

   ☐ Yes. Why? _____

   ☐ No. Why not? _____

9. If you have <u>not</u> had a Home Performance evaluation, would you like more information?

☐ I'd like a brochure on the Home Performance program and the inspection process mailed to me.

☐ I'd like my local Home Performance with ENERGY STAR® trained contractor to contact me by phone. Phone number _(_____)-_____-_____

~ End of Section Two ~

Section Three: *Everyone is asked to complete this section.*

1. About what year was your home built? _____ (year)

2. Approximate size of your home (square footage of living space only)

☐ Up to 1000 sqft
☐ 1001 – 1250 sqft
☐ 1251- 1500 sqft
☐ 1501 – 2000 sqft
☐ 2001 – 2500 sqft
☐ 2501 – 3000 sqft
☐ More than 3000 sqft

3. How long have you lived in this home? *(Check one answer)*

☐ Less than 1 year
☐ 1-2 years
☐ 3-4 years
☐ 5-10 years
☐ more than 10 year

4. Please indicate <u>the number of people</u> living in your home, in each age category:

____ 17 and under
____ 18-34 years
____ 35-49 years
____ 50-64 years
____ over 65 years

5. Please indicate your highest level of education:
(Check the box associated with the highest level of education you attained.)

___ grade school
___ some high school
___ high school graduate
___ some technical school
___ technical school graduate
___ some college
___ two-yr college grad
___ four-yr college grad
___ Grad/Prof degree

6. If there is another adult living in your home, please indicate their highest level of education:

___ grade school
___ some high school
___ high school graduate
___ some technical school
___ technical school graduate
___ some college
___ two-yr college grad
___ four-yr college grad
___ Grad/Prof degree

The last 4 questions are optional but will help us more effectively evaluate who the program is reaching:

7. Did cost or financing options limit which home improvement options you chose to complete? ***(****Check all that apply.)*

- ☐ *Cost was a factor*
- ☐ *Financing was a factor*
- ☐ *Cost or financing did not affect our choices*
- ☐ *Opt to skip this one*

8. Please indicate your average annual household income:
(Check one of these categories.)

- ☐ *under $15,000*
- ☐ *$15K - $24,999*
- ☐ *$25K - $49,999*
- ☐ *$50K - $74,999*
- ☐ *$75K - $99,999*
- ☐ *$100K - 124,999*
- ☐ *$125,000 or more*
- ☐ *Opting to skip this one*

9. Are you of Latino or Hispanic descent?

- ☐ *Yes*
- ☐ *No*
- ☐ *Not Sure*
- ☐ *Opting to skip this one*

10. Are you white, or black or Asian, or do you consider yourself some other race*?*

- ☐ *Asian*
- ☐ *Black*
- ☐ *White*
- ☐ *Other*
- ☐ Opting to skip this one

~ End of Section Three ~

The program evaluators, [name inserted], would like to thank you for participating in this important evaluation process.

To show our appreciation,
we're going send you a **coupon** for a
free pint of Ben and Jerry's ice cream or frozen yogurt.

If you'd like to know more about the Home Performance program you can go to the California Home Improvement with Energy Star® program website at
http://www.calhomeperformance.org/index.html

Or call toll-free
1-888-352-2722

Thank you for your valuable time and feedback.

APPENDIX D Details of Out-Year Job Production and Energy Savings Estimates: Contractors in the Bay Area and the Central Valley

Appendix Table D – 1

Estimated Annual Job Production Rates and Average Annual Energy Savings by Job Type 2006-2011:

CBPCA Trained Contractors in the Central Valley

										Av kWh Savings Est Per Job			Av Therm Savings Est Per Job		
Contractor ID	Area	Status	Business Type	# of Jobs Rprt to CBPCA in 2005	Est Jobs/mo	Est. Jobs/ Yr	% HVAC	% WH (no HVAC)	% WH/ w HVAC	HVAC	WH no HVAC	WH/ w HVAC	HVAC	WH no HVAC	WH/ w HVAC
V1	Fresno	Active	HVAC +	162	20	240	100	0	0	3100			217		
V2	Fresno	Active	HVAC	45	6	72	100	0	0	3100			217		
V3	Fresno	Active	HVAC +	18	6	72	100	0	0	3100			217		
V4	Fresno	Active	HVAC		6	72	100	0	0	3100			217		
V5	Fresno	Active	HVAC	1	2	24	100	0	0	3100			217		
V6	Sac	Active	HVAC		6	72	100	0	0	3100			217		
V7	Sac	New	HVAC		0	0									
V8	Sac	New	Remod/Bldr		0	0									
V9	Sac	New	HVAC +		0	0									

Appendix Table D – 2

Estimated Annual Job Production Rates and Average Annual Energy Savings by Job Type 2006-2011:

CBPCA Trained Contractors in the Bay Area

										Av kWh Savings Est Per Job			Av Therm Savings Est Per Job		
Contractor ID	Area	Status	Business Type	# of Jobs Rprt to CBPCA in 2005	Est Jobs/mo	Est. Jobs/ Yr	% HVAC	% WH (no HVAC)	% WH/ w HVAC	HVAC	WH no HVAC	WH/ w HVAC	HVAC	WH no HVAC	WH/ w HVAC
B_1	N Bay	Active	Remdl/Bldr	14	6	72	0	60	40		1756	2504		208	261
B_2	SF	Active	Remdl/Bldr	34	10	120	0	60	40		1756	2504		208	261
B_3	N Bay	Active	Remdl/Bldr	3	2	24	0	60	40		1756	2504		208	261
B_4	S Bay	Active	Remdl/Bldr	12	4	48	0	10	90		1756	2504		208	261
B_5	S Bay	Active	Remdl/Bldr	2	2	24	0	60	40		1756	2504		208	261
B_6	S Bay	Active	HVAC		6	72	100	0	0	2000			200		
B_7	N Bay	New	Remdl/Bldr		0	0									
B_8	E Bay	New	Remdl/Bldr		0	0									
B_9	S Bay	New	Remdl/Bldr		0	0									
B10	E Bay	New	HVAC	1	0	0									
B11	SF	New	HVAC		0	0									
B12	E Bay	New	HVAC +		0	0									
B13	SF	New	Remdl/Bldr		0	0									