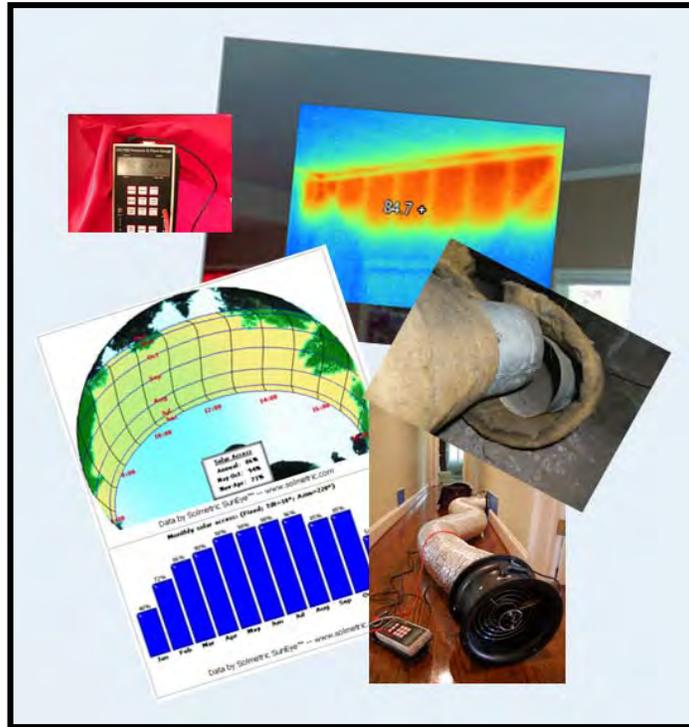


# CHICO ENERGY PIONEER INNOVATIVE PILOT PROGRAM

## FINAL REPORT



### PROJECT TEAM:

**Linda Herman**  
City of Chico

**Scott G. McNall**, Provost and Professor Emeritus  
CSU, Chico

**Annie Rafferty**  
Butte-Glenn Community College

**Jon Stallman**  
Energy X-Change

August, 2013  
DRAFT VER.1

# TABLE OF CONTENTS

<b>MAJOR FINDINGS</b>	1
<b>PROGRAM OVERVIEW</b>	3
Introduction	3
Project Goals	3
Project Area and Demographics	4
Building Performance Institute (BPI) Training	7
Homeowner Education/Workshops	9
Home audits/Assessment Reports	10
Direct Installation of Retrofits	12
<b>SURVEY RESPONSE SUMMARY</b>	17
<b>APPENDICES</b>	
Appendix “A” – Relationships Between Energy Use and Household Size	
Appendix “B” – BPI Training Course Outline	
Appendix “C” - Energy Goals and Issues Identified by Participants Prior to the BPI Audit”	
Appendix “D” – Overview of Actions, Attitudes, and Evaluations”	

## MAJOR FINDINGS

1. Residential energy use is the result of the complex interplay between social and cultural variables and how a home performs as a system. The variables that determine the amount of energy use are interrelated and no single independent variable serves as the explanation for the energy use in any given home.
2. Variation between residential consumers in the same neighborhood, living in the same type of home, is the norm.
3. Savings can be achieved by modifying homes built prior to establishment of Title 24 (pre 1991 homes)
4. People live in their homes in very different ways depending on family composition, their incomes and education, and their ideas about what it means to be an “average” American or a responsible citizen.
5. Comfort is an important goal but it is secondary to saving energy and money.
6. Environmental goals are also secondary to the goals of saving energy and money.
7. All homeowners in our sample had taken several behavioral actions to reduce their energy consumption and most had made some modification to their home to reduce energy consumption.
8. Homeowners believe they are doing the right things to save energy. However, homeowners do not know what determines their energy use, i.e., their behavior or how their home functions.
9. Problems with a home’s envelope, insulation, and/or HVAC systems were discovered in every home (with four exceptions) in our study. The top 5 issues found were:
  - Air infiltration through the building shell and a high air exchange rate.
  - Lack of or poor installation of insulation in the attic.
  - Duct leakage at seams, joints, and sheet metal leaking outside the home.
  - Over sized cooling systems and low airflow into the home.
  - Combustion safety issues emitting excessive carbon monoxide inside the home.
10. Even a core group of homeowners, who self-identified as committed environmentalists and who had done everything possible to modify their homes to make them energy efficient, learned there were still significant modifications in their home’s envelope that would yield additional savings.
11. Some homeowners had taken actions they thought would reduce their energy use but those actions had the opposite effect

12. Modifying the home's envelope, rather than modifying behavior, will yield the quickest and deepest energy savings.
13. People need information about the performance of their entire home to modify the envelope, and they need plug-load information to help them modify their behavior.
14. In general, homeowners are not using energy accounts or on-line resources to determine how to lower their energy use.
15. The greatest barriers to homeowner engagement are time, who to trust, and the resources to act.
16. People want to know the cost effectiveness of specific modifications to their homes.
17. People need and want information from trusted sources, from those not trying to sell them something.
18. Financing needs to be made available to middle-class families who do not have the resources necessary to invest money up front to make energy efficient improvements.
19. People better receive and understand information when it is presented using all of the learning modes - kinesthetic, auditory, and visual.
20. Although this project successfully influenced some of those in the participating building trades, (i.e., general contractors and inspectors) in regard to the relationship between a home's performance and a homeowner's energy needs, some of the other sub-trades, such as HVAC and insulation installers, would benefit from this information and education as well.
21. The duration of the project had both advantages and disadvantages. The primary disadvantages include the impacts on homeowners who needed information, answers, and the installation of the retrofits right away due to financial, health, or safety concerns. However, for some, the delay allowed time for them to evaluate the needs of their home, prepare themselves to make a decision on what to do next, gather funds, and plan for the installation of the improvements within their busy lives.

### **Conclusions and Observations:**

Our findings support the idea that prescriptive audits, however they are funded, will be needed to help homeowners achieve significant energy savings. Personalized reports and an opportunity to engage individual homeowners in discussions about how their home performs and how they are using energy may be time consuming but they seem essential.

In addition, a project of this size and magnitude takes a lot of coordination and more staff and time needed than was imagined by the Project Team. Although, overall the response to this program was very positive, it is clear that better communication with the participants regarding the status of the project and the reasons for the delays was needed.

# **PROGRAM OVERVIEW**

## **I. INTRODUCTION:**

As part of its Climate Action Plan (CAP) and greenhouse gas emissions (GHG) reduction strategy, the City of Chico identified existing housing stock as a significant area of opportunity to achieve GHG reductions. In 1990, the City of Chico adopted a residential energy conservation ordinance (RECO), which requires that certain energy efficiency measures, such as attic insulation and other weatherization measures, be installed at point-of-resale for homes built prior to 1991. While updating the RECO in 2008, City staff discovered that implementation of this well intentioned ordinance had not been fully realized because of a lack of awareness of the requirements among both the real estate industry and homeowners.

In addition, there were only a few local individuals who were trained to be Home Energy Rating System (HERS) raters, and the closest Building Professional Institute (BPI) certified auditors were located 100 miles away in Sacramento. Recognizing the direct relationship between a home's performance with overall household energy use, the City determined that additional whole house assessment and energy efficiency training opportunities were needed to provide qualified and trained individuals to serve homeowners and businesses in the North State area.

To address this problem, the City partnered with California State University, Chico, Butte-Glenn Community College and Energy X-Change ("Project Team") to submit an application to the Pacific Gas & Electric Company (PG&E) Innovator Pilot Program to develop and implement the Chico Energy Pioneer Program ("Project"). Through a competitive process, the City was awarded \$399,530 to implement the Project. The Project sought to engage and motivate homeowners to modify their homes by informing them of the benefits of energy improvements and by coming into compliance with the RECO prior to selling. The program sought to include 100 households without regard for the level of income for two reasons: most programs serve only low-income households and many moderate-income households need to make modifications to their homes to achieve energy savings but do not have the means to do so.

## **II. PROJECT GOALS:**

The Chico Energy Pioneers Innovator Pilot Program had two primary goals:

- A. To identify those factors, such as energy education, home energy retrofits, and/or behavioral changes, that yield the most cost effective approach to reducing residential energy consumption, and to determine which factors serve as the greatest catalysts for change.
- B. To determine the extent to which energy behaviors can be changed by providing consumers with detailed, frequent, ongoing information about their personal energy usage, and tailored suggestions on how to reduce energy consumption.

To achieve these goals, the project was separated into two components as follows:

## **PART A: Community Energy Education/Residential Energy Assessments**

- Components:
- 1) Green Work Force Development/Training
  - 2) Energy Efficiency Education Workshops
  - 3) Residential Whole House Energy Assessments and Report
  - 4) Direct Installation of No-cost Energy Efficient (RECO) Retrofits

## **PART B: Energy Management and Behavior Change Study**

Objective: Provide Energy consultations to participants to determine how personal and specific energy information might affect consumer's energy use behavior. Consultations were provided as follows:

- 1) Initial Consultation to obtain baseline demographic and energy information
- 2) Post Building Professional Institute (BPI) Audit/Retrofit Consultation
- 3) Continued follow-up questionnaires with participants via mail, e-mail, phone calls, etc.

## **III. PROJECT AREA AND DEMOGRAPHICS:**

Participants were recruited from two targeted neighborhoods, which were chosen due to the age of the homes (built prior to 1991) and whether SmartMeters™ had been installed in the area for at least a year. Participant were voluntarily recruited by canvassing the neighborhoods with door hangers, holding four (4) informational workshops at neighborhood schools, through direct mail, and word-of-mouth. Participants had to be willing to participate for the duration of pilot program, and share energy use data and experiences.

Initially 96 homeowners volunteered from these targeted neighborhoods and a few were from outside of the project area who had heard about the program from others and/or the media. The demographics of the participating residents and homes are:

1. The years the houses were built ranged from 1912 to 2005, with the majority of the homes built between 1950 and 1970.
2. Average household size is 2 people.
3. Average square footage of the homes was 1,679 sq. ft.
4. Average home price was \$200,000, compared to \$327,000 for the City
5. Participants were more energy conscious and had taken more actions to reduce energy consumption than a comparable national sample.
6. Compared to other Chico residents, participants were slightly older.
7. A core number of participants are well educated, and active in community sustainability initiatives.

8. Most indicated they wanted to take additional steps to save energy and to improve the comfort of their home.

The following table also provides the aggregate average annual and monthly energy use and costs for the sample group:

<b>AGGREGATE ENERGY USE AND COST DATA</b>		
	<b>Annual Average</b>	<b>Monthly Average</b>
<b>ELECTRIC</b>		
Kilowatts Used	6,419	535
Base Load Cost	\$683	\$57
Heating Load Cost	\$187	\$16
Cooling Load Cost	\$217	\$18
<b>GAS</b>		
Therms Used	532	44
Base Load Cost	\$148	\$12
Heating Load Cost	\$304	\$25
Cooling Load Cost	\$108	\$9
<b>TOTAL UTILITY COSTS</b>		
Total Annual Cost	\$1,662	\$139
Base Load Cost	\$831	\$69
Heating Load Cost	\$491	\$41
Cooling Load Cost	\$325	\$27

A more detailed analysis regarding the relationship between energy use and the demographics of the participating households (i.e., size of home, square footage etc.) prepared by Professor Emeritus Scott G. McNall of the CSU, Chico Team is attached in Appendix “A”.

In conclusion, identifying a typical homeowner in this Project is not an easy task, because every one of our participants lived in their homes in different ways. They had different goals in terms of energy use, as some had a priority of comfort as opposed to saving energy. Others had taken significant actions to reduce energy consumption before participation in the project, and others had done little. Not because it wasn’t relevant to them, but because they did not know what to do, did not have the time or money to act, and if they did want to act, they did not know who to trust.

Having offered that caution, we can provide three cases that exemplify the experiences of most participants.

**Family A.** Family A had purchased an older home in one of the two target areas and had engaged in a major remodeling project. After it was completed, they found that their energy bills doubled. This was in spite of the fact that they had done many things to save energy, including: putting in low-flow shower heads, low-flow toilets, installing a new HVAC system and whole-house fan, added extra insulation and improved weather stripping, put their computers and television on power strips, and installed a new on-demand hot-water heater. They also turned their air conditioning up to 79° in the summer and all the way down to 60° in the winter. Their reason for enrolling in the project, “We needed to save money and could not understand why our bills were so high.” Inspection of the home revealed that the HVAC system was not properly installed, one wall was hot, the “can” lights they installed had caused leaks in the home’s envelope, their pool pump was drawing power during peak hours, and their home-entertainment system was heating up the house. They are working to address all of the issues that were identified in a systematic manner, when their finances allow.

**Family B.** Family B had lived in their small (1100 square foot) home for ten years. The home was built in 1956 and constructed at the same time as other homes in the target area. The family had at different times installed a new HVAC system, bought energy-efficient appliances, changed out incandescent bulbs for CFLs, improved weather stripping and put their computers and television on a power strip. They also engaged in a number of other actions to limit their energy use by turning up their air conditioning in the summer and their heating down in the winter. They carried re-usable beverage containers, used cloth bags instead of plastic or paper for grocery shopping, and tried to reduce their water consumption. They participated because they were committed to saving energy but did not know what else they could do. After receiving their home assessment they said, “I had no idea the state my house was truly in, and did not realize the importance of the things I needed to focus on, and the things I could not see, like the need to ventilate the gas.” In sum, “This was a project that took into account the age of our home and helped us decide how to create a more efficient home. Thank you!” They also gave us the same piece of advice virtually every other participant gave us: “Follow up; let us know what is happening. It was a long process and better communication would be helpful.”

**Family C.** Family C was a single-headed household who told us they were participating in the project to save money and noted that they had already taken steps to reduce their energy consumption. They had lived in their home built in the 1970s for over a decade and had replaced appliances with energy-efficient ones when needed, as well as adding additional insulation in the attic. They had not changed out the incandescent bulbs for CFL’s because they had heard there was a \$12,000 fine for breaking a CFL. They engaged in a number of energy-efficient behaviors such as turning off electronics when they were not used, washing in cold water, recycling, and reducing the number of things they bought. They did not find the initial energy audit helpful, noting “I am already energy conscious and done a lot to reduce my consumption. I can’t afford to do more.” They learned there was

*damage to the duct system, which was corrected by the project. However, they wanted to know specifically how much energy was used by a particular appliance and they wanted to know how much it cost them to run their air conditioner or heater. The homeowner described the project as a “huge disappointment” and felt that the project had “no value” because they wanted information on the cost-effectiveness of doing one thing as opposed to another.*

#### **IV. Building Performance Institute (BPI) Training:**

BPI Building Analyst and Envelope training, was successfully facilitated by the Butte College Team member with 30 initial participants. Through an in-field mentor process, the trainees also received extensive hands-on experience in performing the BPI audits, in collecting proper data, and in communicating information to the homeowners.

**A. Training Course:** The training and the commitment required for this certification included:

- 56 hours BPI classroom training
- 16 hours of BPI field demonstration
- 40 hours of Butte College technical training
- 24 hours for a refresher course requested by students
- 30- 60 hours of on-site mentoring
- Commitment by each student to perform assessments on at least 5 houses

A copy of the training course outline is attached as Appendix "B". This training program made these students (now certified energy assessors) more competitive in the renewable energy/energy efficiency job market and has assisted them with new job placements and/or expanding job skills.

**B. Participant Selection:** Information sessions and applications were submitted to pre-screen and select candidates for the training. Traditional e-mail notifications to Clean Energy mailing lists, posting to the Butte College Training Place website and participation at the “Contractors Speed Dating” Valley Contractors Association event yielded 31 original participants.

**C. Training Participant Profiles:**

- 4 Realtors
- 2 Building Inspectors
- 3 College students expanding certifications
- 7 Dislocated workers looking to build contracting skills
- 12 Contractors (2 years – 30 years of experience)
- 3 Trade contractors (i.e., HVAC/Insulation sellers)

**D. BPI Test Results:**

After the training began, some of the original participants dropped out of the program. Twenty nine (29) made it to the first written Building Analyst exam, and six either dropped out or decided not to take the Building Envelope Exam. The exam results were as follows:

**Building Analyst Written Exam**

- 26 of 29 participants passed 90% pass rate
- Total Class Average Score 88

**Building Envelope Written Exam**

- 22 of 23 participants passed 95% pass rate
- Total Class Average Score 84

**Building Analyst and Envelope Field Tests**

- 19 of 26 (3 dropped out) passed 73% pass rate
- Resulting in 19 local certified BPI energy assessors

*Chico's written exam scores were the best class performance in California at the time.*

**E. Green Workforce Development**

As stated above, the original intent was to have those trained under our Project help perform the initial and post-BPI assessments for our participating homeowners. Initially, the energy auditors/trainees performed between 5 and 10 audits each with higher performing students requesting more houses. However due to the training they received, many of the certified auditors had increased workloads at their existing companies, or received jobs in the renewable energy and energy efficiency market place as follows:

- One student, who had the most experience was hired by “Build It Green” to perform audits on the auditors and retrofit projects in the PG&E whole home program. (Should this be capitalized?)
- One of the mechanical engineering professionals received a commercial auditing job for a refrigeration systems company.
- A mechanical engineer received his commercial auditing credentials and is actively engaged in the Sacramento area.
- Three (3) students were recruited to head up the energy efficiency division of an existing company directly appealing to the whole home program in the Chico area.
- One student has received employment from one of our strongest local solar PV integrators and is infusing energy efficiency into their business model.
- Twelve (12) of the general contractors expanded their existing business to include home energy assessment for both new construction as well as remodeling projects.
- Six (6) auditors have applied to become Energy Upgrade California contractors.

## **Conclusions and Observations:**

- The lack of hands-on experience by some students resulted in incomplete data collection, which required retesting of some of the homes.
- Prior level of education (particularly in math, science, and computers) and knowledge of the construction practices appears to be the most important aspect of the audit process. This results in a greater understanding of the whole house performance by the auditor.
- Trainees surveyed expressed the need to modify the training to increase the number of laboratory activities and hours practicing the use of equipment and auditing techniques. More group activities; smaller class sizes, and pre-assessment for class placement based on the level of learner are recommended.
- In addition, post certification mentorship in performing audits is crucial. Many of the trainees felt that the more audits they performed, the better they were able to assess homes and communicate the findings to the homeowners, which directly affect a homeowner's commitment to change.
- Although it was a positive thing that most of the auditors received employment or increased business as a result of the training they received, not having them available to perform the audits for our participants delayed implementation of the program by several months.

## **V. HOMEOWNER EDUCATION/WORKSHOPS**

After the participants were chosen for the program, all participants were required to attend one of five (5) workshops developed by the Butte College Team to explain what would happen at each stage of the program. As participants in the program, homeowners were informed to expect the following:

- A.** BPI teams would be trained by Butte College and would come to participant's homes to conduct an energy audit that could take 5-6 hours.
- B.** A team of students from California State University, Chico would come to people's homes to help them get started using their SmartMeters™, collect information about prior actions homeowners had taken to reduce their energy consumption, identify additional actions they could take, and determine if there were specific energy questions a homeowner wanted addressed. (For more information, see "Energy Goals and Issues Identified by Participants Prior to the BPI Audit" attached as Appendix "C")
- C.** A detailed home energy report would be provided to each participant indicating which actions could and should be taken to improve their home's energy efficiency.
- D.** A qualified contractor would perform the retrofits necessary to bring their homes into compliance with RECO standards.

- E. Students from California State University, Chico would again contact homeowners to determine which information caused them to take action.
- F. The workshops also provided an opportunity to introduce the Energy Pioneer Team and auditors, to obtain the necessary Non-Disclosure Agreements and liability release/waiver forms, and to answer any questions the homeowners had.

### **Conclusions and Observations:**

The workshops provided an opportunity for the Energy Pioneers Team to better understand the needs of homeowners. *The workshops were one of the first steps in a long process of building trust.* The establishment of relationships of trust was a keystone of the project. People needed to trust that the information they were receiving about their home's performance was unbiased. During the first interviews, the Energy Pioneers Team was told that one reason for a homeowner not acting to improve the energy efficiency of their homes was: *They did not know who to trust.*

## **VI. HOME AUDITS/ASSESSMENT REPORTS**

One of the important and most time consuming components of this project was the development and preparation of the personalized whole house assessment reports given to each homeowner. The purpose of the report was to submit the results of the complicated audit calculations and assessment of their home's performance and its relationship to their energy use in an easy to understand format. Our experience identified that homeowners wanted and needed unbiased information to help them prioritize what should be done to their homes to improve their home's energy efficiency. The report also provided a prioritized list of measures identified from the audit that could either be completed through our Project or conducted by the homeowner as funding and time allowed.

The BPI training does not provide training in energy analysis, data analysis, diagnostic approaches, and most importantly report generation fundamentals. Project Manager Jon Stallman (Energy X-Change) had to develop the home assessment reports from scratch and also prepared most of the reports himself due to the reduction in the number of auditors/trainees available.

In addition, it was determined that just providing the report was not sufficient to motivate and encourage the participant to make substantial changes. They needed one-on-one meetings with the auditor to help explain the report details. Because Project Manager Jon Stallman was the primary person conducting the audits, preparing the reports and meeting with all of the homeowners, this process took a considerable amount of time, which caused frustrations for both the participants and the Project Team.

Although timing was an issue, the majority of the participants believed that the whole house assessment and the meeting about the report was the most helpful in understanding what they needed to do to improve their home's energy efficiency or comfort level. In addition, the presentation of the report and information prompted many participants to take action on their

own, either by changing their behavior and/or making improvements that would have been completed under our program. Contacting the homeowners to schedule the home assessment report consultations also took more staff time than anticipated.

### **Observations and Conclusions:**

1. The BPI audits and report created a database and information that allowed homeowners to go beyond the basic weatherization models and engage in deeper home performance issues that improved comfort, health, safety, and energy use in their homes.
2. Those who took action prior to receipt of their home energy audits and the retrofits are a unique group; they had the knowledge and means to act. Among those who acted were two professors from California State University, Chico and two homeowners who are well educated and understood the cost-effectiveness of their actions.
3. The evidence suggests that participants are counting on modifications to the envelope of their home and to technological changes, not behavioral changes, to save on their energy bills. Another possible interpretation is that this is a unique sample composed of homeowners who were motivated to reduce their energy use and had already done everything they thought they could; thus, modifications to the home's envelope was all that remained to be done.
4. However, even though many thought they were doing all they could to save energy, they found from the BPI audits and reports that many of the behavioral actions they had taken and/or modifications they had made to their homes, were not as effective as they assumed. Many were surprised to find their homes leaked, or their ducts were damaged, or their HVAC systems were incorrectly sized for their homes, or that they were poorly insulated. Some of the counterproductive efforts, both behavioral and structural, were:
  - Using space heaters throughout the house instead of their HVAC systems.
  - Closing off vents into some rooms to "save" energy.
  - Using window air conditioners, either in place of or to "boost" their system's cooling capacity.
  - Remodeling efforts, such as installing can lights, which resulted in air leaks and voids.
  - Improperly installing and insulating whole-house fans.
  - Painting over the exterior vents for their homes.

## **VII. DIRECT INSTALLATION OF RETROFITS**

### **A. Retrofits to Be Installed:**

As stated in the program goals, an intent of this program was to determine the cost effectiveness of the installation of the energy efficient measures required by the City's

RECO, which include:

- Insulating attic space with 30" or greater headroom to a minimum thermal resistance rating of R-30 (*Current standards require R-38, but it was determined that under a resale scenario the incremental cost between R-30 and R-38 were higher than the return in energy savings*).
- Sealing, or caulking all major cracks, joints, and other openings in building exteriors to limit air infiltration.
- Weather stripping of windows and doors and other areas, including door sweeps.
- Insulating at a minimum thermal resistance rating of R-3 all exposed cold and hot water lines connected to and within five-feet of existing water heaters.
- Installing insulation blankets with a minimum rating of R-6.
- Duct sealing or repair (*due to costs, RECO does not require this measure, but was included in the scope of work for this project*).
- Programmable thermostats (*it was decided that carbon monoxide monitors would be substituted for thermostats under the Pioneer Project*)

After conducting the whole house audits and preparing the home assessment reports, it was determined that the items called for under the RECO were not necessarily the most effective measures that should be implemented nor were they in the proper construction sequence. Many times other issues, such as combustion safety issues or leaking ducts, took precedence on what should be installed or repaired. It did not make sense to install insulation without first repairing the ducts and air sealing the attic. Many of the homeowners understood this and, due to the limited funds available, requested these improvements be installed by our Program in-lieu of insulation, and some used their own funds to finish the job.

In summary, it is important to emphasize that every home in the sample had one or more problems with the home's envelope, insulation, duct work and/or HVAC systems, which, if corrected, would yield energy savings. The following table indicates the percentage of issues affecting the health, safety, and energy use in the sample homes, with the top five being:

1. Air infiltration through the building shell and a high air exchange rate.
2. Lack of or poor installation of insulation in the attic.
3. Duct leakage at seams, joints, and sheet metal leaking outside the home.
4. Over-sized cooling systems and low airflow into the home.
5. Combustion safety issues emitting excessive carbon monoxide inside the home

Percent of Homeowners with the category issue	Top Issues in Chico Homes Affecting Health, Safety, Comfort, and Energy
100%	Houses with <u>low HVAC Airflow</u> into rooms (typically caused by ducting design, kinks, bends, return register size, and over sized compressors relative to blower capacity- often related to lack of design calculations and poor installation practices)
99%	Houses with City of Chico Residential Energy Conservation Ordinance (RECO) measures to address ( <u>basic weatherization measures</u> - insulation, crack sealing, door seals and sweeps, leaking ducts, hot water heater insulation, water conservation measures)
98%	Houses with <u>over sized cooling systems</u> for the volume of the home (one of the single biggest energy consumers in a home and leading cause of excessive energy consumption) Note: With air sealing and insulation HVAC systems can be sized smaller with a net effect of using less energy in long term operation costs.
91%	Houses that <u>require air sealing for best efficiency</u> sealing to 70% of the building airflow standard (leading cause of comfort issues leading to increased electrical and gas consumption through HVAC operation) Note: Should be done before insulation.
88%	HVAC <u>duct systems with leakage</u> above California state standards for new construction of 6%, average of 24% leakage
87%	Houses with <u>attic issues causing energy loss and comfort issues</u> (poor/little/or no insulation, large holes to the inner walls, wall air leakage, attic ventilation)
84%	Houses <u>requiring ceiling insulation</u> up to R-30 (new construction code is R-38) Note: Only add after air sealing and duct repair
81%	Houses with <u>too much building shell air leakage</u> increasing energy consumption and causing comfort problems (infiltration/exfiltration), average of 2.5 times greater than airflow standard regardless of age of home. Note: Should be sealed before adding insulation.
80%	Houses with <u>poor HVAC duct insulation</u> (falling off, not present, or non-functional)
51%	HVAC <u>duct systems with leakage</u> above California state standards for existing systems of 15%, average of 24% leakage
38%	<u>Combustion Safety Problems</u> (excessive carbon monoxide exposure from mechanical system usage within the home causing hot water heater back drafting CO)
9%	Houses with <u>ventilation problems that cause mold</u> and fresh breathing air issues (under-ventilated per building airflow standards)
36%	Houses that <u>use more electricity</u> than the state average of 7000 Kilowatts/year or 583 kw/month, Chico average: 6150 kw/yr or 512 kw/month
6.2	Average whole building performance assessment score for homes in Chico, high of 9.2 and low of 4.4

**B. Contractor Selection:**

Through a competitive Request for Proposal (RFP) process, three local contractors, one of whom was one of our trained auditors, were chosen to install the RECO retrofits or other measures prescribed by the whole house assessments. Several (6-7) of the homeowners dropped out of the program, because they were too busy, moved, the process took too long, and so forth. The final participating homeowners (91) were then randomly distributed among the three contractors, unless a homeowner requested a specific contractor.

To monitor costs and to level the playing field for all of the participants, the City used the prices of the RECO and other energy efficient measures provided in the three proposals to come up with an average unit or hourly cost for each measure. All three contractors agreed to honor these prices. For convenience, the homeowner was informed that they had the option to use one of the City contractors for work that was outside the scope of the Energy Pioneer Program and to be funded by them, but that they were not obligated to do so.

**C. Direct Installation Summary:**

Scheduling of the retrofits took several steps. The process required the contractor to review each assessment report and the field notes from the meetings with Jon Stallman, meet with the homeowners to determine the initial scope of work, obtain City approval of the scope of work and the amount to be funded by the Program, then meet again with the homeowner to confirm the final scope. In several cases, the contractors had to make multiple trips to the homes before final decisions were made. As a result, scheduling these appointments and the actual installations were challenging and took more time than was anticipated.

In addition, the contractors experienced a much larger scope of workload from homeowners than expected, with nearly a third engaging in significant construction projects going beyond simple weatherization. All of which had to be timed with the approved RECO measures and the proper construction sequence.

At project end, 91 homeowners received direct installation of energy efficient measures from this Project. The results of the installations are summarized below:

1. Estimated amount of insulation installed:	88,200 sq. ft.
2. % of homeowners who received duct repairs:	56%
3. % of homeowners who received air sealing measures:	63%
4. Number who needed CO2 Monitors:	24
5. % who received insulated can light covers or LED fixtures	33%
6. Average amount of funding for retrofits received per home:	\$1,342

7. Estimated amount of additional work requested/paid by homeowners: \$200,000

Participants were extremely positive about their interactions with the contractors. Some of the comments include:

75% responded that the contractors explained the work well that needed to be done

77% responded that the work was completed in a timely manner.

80% responded that the work was done in a professional manner.

94% did not feel pressured to do more work.

#### **D. Coordination with Other PG&E Programs:**

Energy Upgrade California (EUC) - One of prime goals was to coordinate the Energy Pioneer program with other PG&E programs. Particularly, the City wanted participants to be able to access funds for additional energy efficient measures that our Project could not fund from the Energy Upgrade California (EUC) program. So all of the City contractors were required to have a BPI auditor on staff and be an approved EUC contractor to help facilitate the complicated application process. Eleven or 12 % of our homeowners participated in the EUC program, resulting in the installation of deeper energy efficiency measures such as:

- New energy efficient HVAC systems.
- Vacuum out and complete air sealing of attic.
- New ducting systems.
- New energy efficient hot water heaters.
- More energy efficient whole house fans.

LIHEAP and Other PG&E Programs - One of the City's contractors is a subcontractor contracted to also perform the construction portion of the Low Income Home Energy Assistance Program (LIHEAP) and other PG&E's low-income weatherization programs. Some of the homeowners were eligible for attic insulation under these programs, which allowed the Energy Pioneer program funds to be used for other energy efficiency measures in their home. In addition, some received hot water heaters or windows that were not part of the scope of the Energy Pioneer program, which further complimented the two programs.

#### **Observations and Conclusions:**

Our contractor's experience is that the time and cost to conduct the additional testing, energy savings analysis (Energy Pro), and application to qualify under the EUC program reduces the amount of benefit for the homeowner. An example is that the initial cost of preparing the EUC application and conducting the testing to get approval into the program averages about \$2,000. The EUC rebate is based on energy savings achieved for a maximum rebate of \$4,000 (i.e. improvements that achieve 10%-40% energy savings equate to a \$1,000-\$4,000 rebate), If the homeowner wants to recover the initial application costs, then they would need to engage in projects achieving a minimum of 20% energy savings

just to break even. Therefore, the homeowner only starts to receive a monetary benefit when measures that achieve 25% energy savings or above are installed (i.e. a \$2,500 + rebate). For our program, the contractors were reducing and subsidizing their EUC testing and application costs to increase the return to the homeowner.

# SURVEY RESPONSE SUMMARY

All participants were contacted by letter, phone, and e-mail (if they had one) by the CSU, Chico Team asking them how they wished to complete the final step in the program---to be interviewed in person, to complete an interview over the phone, or to complete the questionnaire by themselves (on-line or hard copy). Twenty-two participants were interviewed in person by a two-person team of students from California State University, Chico (CSUC). Others completed the questionnaire on-line or completed the hard copy we sent to them with a postage-paid return envelope. For those who did not respond initially, they were called, sent e-mail reminders, and the Team used a default strategy of sending a hard copy of the questionnaire with a postage-paid return envelope to those who had not responded. As of May 22, 2013 there were 62 completed questionnaires for a *response rate of 70% (62/89)*.<sup>1</sup>

The complete survey responses and analysis can be found in Appendix D, but below are what the Project Team thinks are the most important and key indicators on whether the Chico Energy Pioneer Program had an impact.

## **1. About the home house assessment report and meeting with the Project Manager:**

### a. What was the most interesting thing you learned?

- 45%** How poor our home's envelope was (leakage).
- 33%** Problems which were hidden from us and of which we were unaware.
- 8%** Our home's energy score.
- 8%** How comprehensive the report was.
- 6%** Other: how poor our HVAC was; the infrared images.

### b. What was the most helpful thing you learned?

- 34%** Specific suggestions about how to improve our home's efficiency.
- 16.5%** Received new information about our home.
- 16.5%** Our energy score.
- 11%** How much our home was leaking.
- 11%** Problems with our insulation (not enough, wind-blown, etc.)
- 5%** Everything was helpful.
- 4%** Infrared images.
- 2%** What I could do myself

### c. What was the most troublesome or frightening thing you learned?

- 26%** Leakage of our home's envelope.
- 18%** Carbon-dioxide exposure.
- 13%** Problems with insulation.
- 13%** Cost of needed work, beyond RECO.
- 13%** Problems with ducts.

17% Other: animal feces, blocked vents, vermiculite and asbestos discovered.

2. Did the report motivate you to act and if so, what did you do, and when did you do it? (N=57 responded to this question.)

a. **75% action taken. What?**

- i. 21% indicated they changed some behavior. The actions varied from line-drying clothes, changing lights bulbs, to using energy at non-peak hours when possible.
- ii. 79% indicated they had modified or will modify their home's structure.

b. **25% no action taken. Why?** The reasons were diverse: home needed no improvements; no money to take action; "it took too long to get the results of our home assessment;" or it was too soon to tell if would take action, i.e., they wanted to wait and see if they could finance upgrades.

c. **31% had taken action before the retrofits were completed.** These included insulating, sealing, purchase of new HVAC system, installing whole-house fan, changing pool pumps, replacing water heaters, and so forth.

d. **21% indicated they would take actions after the retrofits and in addition to the retrofits.** These include major remodeling projects to achieve energy savings, vacuuming out attic insulation and resealing, repairing and replacing duct systems, and so forth.

Observations: The number of respondents who acted on their own to improve the health/safety and efficiency of their homes is encouraging. *It means that armed with knowledge provided by a trusted source about how their homes function, many will act to improve the energy efficiency of their homes.* The number of those willing to take action is probably underestimated because a majority of those participants who did not respond to our requests to complete this last step, are also considering programs such as EUC and/or making improvements without the assistance of the EUC program. The reported behavioral changes people have made will yield some energy savings, but we are not able to measure their impact.

3. **Will you take actions in the future?**

**20%** No. Why? Too costly; not needed; selling the house.

**80%** Yes. Eight respondents indicated they will look into or are planning on solar systems; 9 will purchase new HVAC systems; 7 intend to remodel their homes to make them more efficient; 5 plan on modifying their landscaping; 1 will switch to natural gas.

Observation: *People who have the means to do so are acting on the basis of the information they received about their home's performance.*

**4. Which aspects of the program were most important to you?** (Rankings were on a 1-5 scale with 1 being the most important and 5 the least?)

**94%** gave the oral presentation by Jon Stallman a ranking of 1-2.

**91%** gave the overall energy assessment of the home a ranking of 1-2.

**65%** gave information on the health and safety of their home a ranking of 1-2.

**64%** gave participation in the BPI audit a ranking of 1-2.

**49%** gave the discussion with the contractor a ranking of 1-2.

**36%** gave the retrofits they received a ranking of 1-2.

Observations: There are several remarkable findings here, including the fact that *people valued less the retrofits they received than the information they received about their home's performance. It is also clear that one of the things they valued highly was the opportunity to talk about what their energy reports actually meant. Such findings should shape future policy because it suggests that information alone will not be sufficient to get people to take the kind of actions necessary to maximize the energy efficiency of their homes.*

**5. In terms of the retrofits, did you receive what you wanted?** (N =50 responses).

**64%** Yes.

**36%** No.

Observations: Those who reported not getting what they wanted said they would have preferred one or more of the following: whole-house fans; weather stripping; windows; doors; duct work, and so forth. For those who had homes meeting or exceeding existing RECO standards they wanted something that could not be provided under the agreed scope of work, e.g., an insulated door. Second, some people want aesthetic improvements they thought would yield significant energy savings, but do not make sense in terms of cost-effectiveness. *Many participants, at the outset of the project, expressed a desire for new windows.* This is not surprising as window companies advertise widely that replacement of windows will “pay for themselves” because of lower energy bills.

**6. Did you receive the kind of information you anticipated from participation in the project?** (N=59).

**88%** Yes.

**12%** No.

Observation: Those who said they did not receive the kind of information they anticipated or needed *wanted information about rebate programs, about how to finance retrofits, and what the cost effectiveness of specific actions would be.*

7. **If you were to pay for the home energy assessment you received, how much would you have been willing to pay? (N=61.)** The following categories were provided.

3% \$2,000  
0  
6.5% \$1500-1999.  
10% \$1000-1499.  
30% \$499-999.  
44% Less than \$499.  
6.5% \$0

Observations: Only two (2) respondents indicated they would be willing to pay \$2000 and they had both previously contacted a contractor to find out what the actual cost was for a home energy assessment. The four (4) who said they would pay \$0 were also those who said the project had no value to them. Several (8) of those who checked the category \$499-999 circled \$499 as what they would be willing to pay and noted they did so because it was all they could afford. The same is true with those checking \$499 or less; several noted they could not afford even that amount. When people noted in response to question 22, that they were grateful, some indicated it was because they simply could not have afforded either the audit or the retrofits. *The public policy consequences are significant. Even people with the means to pay for a home energy assessment do not want to pay the market value.* Therefore, contractors often “bury” the cost of these assessments in bids given for HVAC systems and other improvements to the home so they do not lose money. *The value of home assessments is clear but our data suggests that prescriptive audits, paid for with energy savings, may need to be mandated.*

<sup>1</sup> As of May 22, not all of the participants had decided what they wanted to do, e.g., go beyond what RECO provided, had not yet received their scheduled retrofit, or had not yet met with a contractor to discuss what would be done. It is unlikely that the overall pattern of responses would change with additional questionnaires. One caveat is, though, in order. Some of those who had not responded by May 22, were waiting to see if they would qualify for the EUC program, and/or they were trying to decide what they wanted to do beyond RECO and how they would pay for changes to their home’s envelope.

## APPENDICES

---

## APPENDIX “A”

### *Relationship between energy use, size of home, number of occupants and square footage.<sup>i</sup>*

It might seem reasonable to assume there would be a direct relationship between the size of a home a person is heating and cooling, as well as a direct relationship between the number of occupants in a home and the amount of energy used. There is a combined but weak relationship between the number of people in a home and the square footage of the home. But, *neither square footage nor number of occupants is sufficient to explain the wide variation in energy use among members of the Chico Energy Pioneers Project.*

#### **Energy use by square footage:**

People heating and cooling homes of the same square footage, and built in the same year, exhibit very different patterns of energy use. For example, to take but a few of those homes in the 900-1000 square foot range in the same neighborhood, we have the following results. One person’s high electricity and gas bills are, respectively, \$47 and \$54; while for others their highest electric and gas bills are: \$55 and \$95; \$54 and \$74; \$89 and \$118; \$126 and \$48; \$194 and \$105.

For those with larger homes (approximately 1400 square feet) electric and gas bills are also variable. Examples of electric and gas usage are: \$32 and \$41; \$46 and \$110; \$83 and \$88; \$209 and \$66; \$224 and \$124.

Anomalies are found throughout, when we consider just size of home. For example, one home of 1680 square feet had one of the highest monthly bills: a 2000 square foot home had a bill of \$694 for one month; a 3000 square foot had one of \$546; and a home of 2300 square feet had one of \$443 with similar bills for other months throughout the year.

- Explanation: The explanations for these differential rates of energy use are due to two primary factors: *human behavior and the building envelope*. One user with high rates of energy (who also had a solar system) had a medical condition that required the home be maintained at a constant temperature. The home also had significant leakage. Another home with high rates of energy use had been remodeled in such a fashion that the envelope was breached leading to significant energy loss. One high energy user’s home was efficient but the behavior of the homeowner caused them to waste energy because they never turned off computers or their media center. Other homeowners ran water features and pool pumps more than necessary, driving up their bills.

#### **Energy use by number of occupants:**

*Size of household is not sufficient to explain energy use.* The number of occupants in participant’s homes ranged from 1-6. Some of the homes with the greatest number of people (6) had some of the lowest energy bills. As an example, three households with six members had respective energy bills (the high electric and high gas bills) of \$44 and \$85; \$89 and \$87; and

## APPENDIX “A”

\$223 and \$110. Single-member households, as well as those with 2-4 members, had equally diverse ranges of energy use.

- Explanation. The differences in energy use by size of household are driven by behavior, by the home’s performance and *by ethnicity*. The largest households in our study were Hispanic low-income families who are doing their very best to lower their bills. They do so by turning off heating and cooling when they are not at home; and by turning down the heating and increasing the temperature at which the house is cooled, when they are. *Those who live in homes that are poorly sealed and/or homes with poorly functioning HVAC systems have two choices: they can pay more for energy or they can reduce their energy consumption. A number of our participants have chosen to reduce energy consumption.* Another option elaborated in another section of this report is to modify the envelope of their home. A central finding of the study is that *most people do not know what to do to modify their home’s envelope to make it more energy efficient.*

### **Leakage of air, lack of insulation, leaking ducts, and poorly functioning or improperly sized HVAC systems.**

Virtually all homes built prior to the implementation of **Title 24**, California Building Standards Code, had one or more problems identified by the BPI auditors: ducts were bent or broken; the HVAC system was not properly sized for the home (which meant it could be running all the time during the summer or winter); there was insufficient insulation; there were cracks and voids leading to air leakage; equipment such as whole-house fans had been improperly installed; there was insufficient venting or plugged vents; and so forth. *However, we found that two homes, of the same size and vintage, with two different levels of leakage, could have almost exactly the same energy bills.* One home, for example, could have twice the air leakage as another home but both would have the same energy bill, *because one homeowner chose to live cold in the winter and warm in the summer as that was the only way s/he knew how to manage their energy bill.* There was a tendency for those who fell into this category (i.e., reduced their energy bill by turning off their heating and cooling) to be among our older participants (65+) who were on fixed incomes and/or had grown up without central heating and cooling systems. *Their behavioral patterns of low-energy consumption had begun during the 1940s and 1950s.*

### ***What determines energy use?***

The simple answer is “a lot of things.” As noted above, close to 100% of those homes in the two target areas had one or more problems with the way in which the physical home performed. However, *no single variable* (e.g., ducts, envelope leakage, number of occupants, and size of home) *is sufficient to explain energy use in a particular home*, because energy use is determined by the behavior of its occupants in relationship to how their home functions.<sup>ii</sup>

## APPENDIX “A”

### *Variability in energy use.*

Loren Lutzenhiser of Portland State University and Sylvia Bender of the California Energy Commission conducted one of the most complete studies of variations in household energy use, seeking to identify which independent variables accounted for the differences.<sup>iii</sup> As they note, “household energy use is. . .highly structured by household composition/dynamics, status-appropriate dwellings and appliances, [and] lifestyle-based behavior patterns.” Energy use nationally is also influenced by climate zone and by seasonal variations. A multiple-regression analysis found that 36% of the variance in energy use was determined by social variables. That is, *people’s ethnicities, incomes, their lifestyles, the number of people who lived in the home, and their level of education could explain 35% of the variance* in energy use. Hispanic energy users use less than Anglo energy users, a finding that parallels our own and is driven primarily by level of income. Nine-percent could be explained by building type (single-family dwelling, condo, townhouse, square footage), 17% by climate zone, and 39% was the result of the joint effects of all three---people, environment, and buildings.<sup>iv</sup> *Residential energy use is thus characterized by high variability*, because even in the same neighborhood people choose to live in their homes differently. Residential energy use is determined by decisions about where to live, how much to spend on housing and what type that will be, how to use technology, composition of household, and behavior.<sup>v</sup>

### *Rational irrationality.*

All study participants indicated they were doing one or more things to save energy, e.g., changing out incandescent bulbs for CFLs or LEDs, turning down the heat in the winter to 68<sup>o</sup> or up to 76<sup>o</sup> in the summer, washing in cold water instead of hot, and so forth. *Participants have gotten the message that they need to reduce their energy consumption and the prime motivator for them is economic. They think they are doing the right things.*

*However, not everything people are doing makes good sense when it comes to saving energy. They are acting but not in ways that lead to less use of energy. Several participants indicated they had closed off ducts in rooms they seldom used in the hope this would save on energy, which it does not. Others had turned off their HVAC system during the winter using, instead, portable space heaters, some of which ran continually. Others turned off their central air conditioning and used window units to cool a bedroom or bedrooms.*

*The good news is that PG&E consumers are trying to save energy. They are purchasing energy efficiency appliances when old ones fail; they are washing in cold water; they have changed out incandescent bulbs; and they have turned down their thermostats. But most consumers have little or no idea about how their home is functioning and need clear guidance and help to take steps that could save energy.*

### **OBSERVATIONS AND CONCLUSIONS:**

## APPENDIX “A”

In one of the best known studies of residential energy consumption, the consulting firm McKinsey and Company argued that on average 35% of all residential energy was “wasted,” because HVAC systems were improperly installed, or because ducts were leaking, or because homes were not properly insulated.<sup>vi</sup> They identified a set of prioritized actions that would have the greatest potential for energy savings in single-family homes. In descending order they are: sealing ducts, insulating basements (not a factor among our participants), upgrading heating equipment, installing programmable thermostats, adding attic insulation, sealing home air leaks, maintaining HVAC systems, upgrading windows, insulating slab foundation, insulating wall cavities and upgrading cooling equipment. *Our findings support these conclusions. Broken ducts, poorly functioning (or improperly sized) HVAC equipment, and lack of insulation were found to be trouble spots in the homes of participants built prior to 1981. Most of the work performed in people’s homes addressed these problems.*

The McKinsey report also identified some of the barriers home owners currently experience in acting to make their homes more energy efficient. The reasons they identified (time, money, and the homeowner did not know who to trust) were the same reasons given by our participants at the beginning of the study, with one addition: *Many simply did not know what to do.*

Another barrier to action identified by McKinsey was the availability of BPI trained contractors. “Most contractors do not train in holistic building science; rather they specialize in a single construction procedure, e.g., HVAC or windows.<sup>vii</sup> This plays itself out in several ways, one of which is that *people have had work done on their homes that failed to make them as efficient as possible, and/or even made them less efficient.* Many participants who lived in their homes for an extended period have had new HVAC systems installed, some of which were improperly sized and/or without proper attention being given to the duct system at the time of installation. In addition, some participants *remodeled their homes by themselves or with the help of licensed contractors, with the result that the homes became less energy efficient.*

*Opportunities for engaging homeowners in discussions about how to improve their home’s energy efficiency are limited. One important point of contact could be when the homeowner is considering a remodeling project. At that point, a BPI trained contractor could help the homeowner by identifying those actions that would improve the aesthetics of their home, as well as improve its comfort and efficiency. (Comfort and efficiency were goals identified by all our participants.)*

*Participant behavior is a wild card. Karen Ehrhardt-Martinez and John A. Laitner have laid out a strong argument that changing energy behavior is both necessary and possible.<sup>viii</sup> But, as Ehrhardt-Martinez and Laitner point out, even though people want to change they simply do not know what to do.*

*Today, only a tiny fraction of households know how much energy they consume, or how best to reduce their energy consumption. As such, American households may best be*

## APPENDIX “A”

*characterized as dis-empowered. At the same time, the evidence suggests that people want to reduce their energy consumption, whether for reasons of thrift, economy, or the environment. In fact, 78% of American’s report they should be spending thousands of dollars to increase the energy efficiency of their homes. And some people are trying to do their part as evidenced by the results of a recent survey in which a large proportion of Americans (85%) reported having taken some action to reduce their household’s energy in the past year.*

This parallels our findings: *People are trying to change their behavior, but are uncertain what to do.*

Mark Zimring and his colleagues from the Lawrence Berkeley National Laboratory have also noted that there are significant opportunities for residential consumers to improve the energy efficiency of their homes. Many of the things are simple and low cost---sealing leaks, reducing plug loads, adding insulation---while others are more expensive, e.g., replacing inefficient HVAC systems.<sup>ix</sup> We wish to emphasize that knowing what is drawing power in your home (*plug-load data*) is a key piece of information needed by homeowners, and was information requested by our participants during interviews, and when they received their energy reports.

Zimring goes on to note that when homeowners replace appliances or remodel their living spaces they should be encouraged to consider energy savings. *None of our participants needed to be reminded to purchase energy-saving appliances but, prior to this project, only a handful understood what they needed to do to improve the energy-efficiency of their homes.*

Even when people do understand what needs to be done, they are unable to act. Several of our participants, after receiving their detailed home assessments, noted that they could not afford to do more than was provided by the project, i.e., bringing homes up to the City of Chico’s RECO ordinance. Those who did act to go above and beyond what was required by City ordinance were people who had both the knowledge and means to act. One homeowner said, “I can save \$100,000 over 10 years! Of course I’ll participate in Energy Upgrade California (EUC).” On the other hand, another homeowner said, “What can I do? I know I’m wasting money but I can’t afford to do anything about my home?” Another noted that he and his family could not participate in EUC because he could not wait for the rebate he would receive, even though he knew that over the long run he would save money by improving his home’s energy efficiency.

What our findings point to is the following:

- Plug load information needs to be provided if people are to change their behavior.
- Savings can be achieved by modifying homes built prior to **Title 24.**
- Prescriptive audits will be essential to help homeowners understand how their home functions and how to save energy.

## APPENDIX “A”

- Each home requires a separate analysis as to what needs to be done, because of variations in the ways in which people live in their homes.
- Financing needs to be made available to middle-class families who do not have the resources necessary to invest money up front to make improvements.

---

<sup>i</sup> The data was provided by PG&E in October, 2012 and covered one year’s worth of energy data (gas and electric) for homes in the Pilot Project. This analysis focuses on homes within the two target areas, not those outside of it. Those participants on PG&E’s CARE program are excluded from analysis.

<sup>ii</sup> See the summary sheet for the actions taken in participant’s home.

<sup>iii</sup> Loren Lutzenhiser and Sylvia Bender. 2008. “The ‘Average American’ Unmasked: Social Structure Differences in Household Energy Use and Carbon Emissions.” Washington, D.C. American Council for an Energy-Efficient Economy.

<sup>iv</sup> Ibid., p.7-200.

<sup>v</sup> Ibid., p.7-203.

<sup>vi</sup> McKinsey Global Energy and Materials. 2009. *Unlocking Energy Efficiency in the U.S. Economy*. P.34.

<sup>vii</sup> Ibid., p.36.

<sup>viii</sup> Karen Ehrhardt-Martinez and John A. “Skip” Laitner, eds. 2010. *People-Centered Initiatives for Increasing Energy Savings*. Washington, D.C.: American Council for an Energy-Efficient Economy, pp.317-331. The quotation is from p.317.

<sup>ix</sup> Mark Zimring, et al., 2011. “Delivering Energy Efficiency to Middle Income Single Family Households.” Berkeley: Lawrence Berkeley National Laboratory, p.8.



## Building Performance Institute (BPI) Training Call to Register: 895-9015

**PROGRAM DESCRIPTION:** BPI Training will focus on the fundamentals of whole home performance and hands-on home assessment. Following classroom training participants will complete field testing and prepare home assessment reports of residential home performance of 100 homes located in Chico. This is a full contact, hands-on learning environment. Participants should be in good health, have adequate personal construction attire, and be prepared for an action packed workshop. Participants will be expected to be complete all four levels of training and audit 5 homes as part of the training and laboratory experience.

### LEVEL I

---

#### LOCATION: Butte College Main Campus – AHPS, 217

##### Day 1 – Monday, May 16, 2011

Time: 8:00am-5:00pm

- Introduction to Home Performance
- Home Performance Case Studies
- Pre-Home Analysis Tasks
- Utility Bill Dis-aggregation
- Occupant Interview
- Home Site Inspection
- Environmental Considerations
- Water Management
- Technical Math

##### Day 2 – Tuesday, MAY 17, 2011

Time: 8:00am-5:00pm

- Envelope Tightness
- Air Infiltration Driving Forces
- Blower Door Tests
- Building Pressure Diagnostics
- Building Ventilation
- Ventilation Strategy
- IAQ
- Water Vapor Transmission and Control
- Building Insulation
- Insulation Performance
- Air Barriers
- Measuring Thermal Performance of Assemblies
- Insulation and Air Barrier Alignment

##### Day 3 – Wednesday, MAY 18, 2011

Time: 8:00am-5:00pm

- Calculating Heat Loss
- Attic Ventilation
- Crawlspace Ventilation
- Infrared Thermography
- Door Thermal Performance
- Window Thermal Performance
- Heating Systems
- Calculating Delivered Costs or Various Energy Sources
- CBPCA Temperature Stratification Test
- Delivering Comfort
- Air Conditioner Performance Factors
- Duct Leakage Testing and Sealing
- Ducts: Repair or Replace



**Butte College: The Training Place**

**LEVEL II**

---

**Day 3 – Monday, June 6, 2011**

**Time: 8:00am-5:00pm**

**LOCATION: Butte College Chico Center – 107**

**Analyze Data from the Field House:**

- Analyze Utility Bill Data
- Consider Appropriate Improvements
- Evaluate Each Potential Improvement
- Select the Improvements That Will Best Meet the Customers Needs
- Develop Report; Test Findings, Proposed Scope-of-Work, Estimate Costs
- Discuss Customer Presentation and Sales Techniques

**FIELD HOUSE – Tuesday, June 7 and Wednesday, June 8, 2011**

**Time: 8:00am-5:00pm**

- Lighting Efficiency
- Appliance Efficiency
- Water Heater Improvements
- Worst-Case Combustion Tests: BPI Approach
- Perform complete field testing of actual home
- Perform more in-depth testing of the field house based on the results of the previous days testing.

**Level III – BPI Review & Computer Test (Classroom)**

---

**Shell Measure Day and BPI Shell Test Material Review**

**Day 7 – Monday, June 27, 2011 Time: 8:00am-5:00pm**

Location: Chico Center, Room 107

- Outline the shell measures recommended for the field house in more detail.
- Discuss installation procedures for these and other typical shell measures.
- Discuss BPI Shell Specialist Material

**HVAC Measures and BPI Heating Test Material Review**

**Day 8 – Tuesday, June 28, 2011**

**Time: 8:00am-5:00pm**

**Location: Chico Center, Room 107**

- Outline the HVAC measures recommended for the field house in more detail.
- Discuss installation details for these and other typical measures.
- Discuss the BPI Heating Specialist Material

**Certified Building Analyst Review**

**Day 9 – Wednesday, June 29, 2011**

- Time: 8:00am-12:00noon
- Location: Butte College Main Campus – LB, 106

**Testing: Online Examination**

- Time: 1:00pm – 5:00pm
- Location: Butte College Main Campus – LB, 106



**Butte College: The Training Place**

**Level IV – BPI Field Practice and Training**

---

**Dates: Monday, Tuesday, Wednesday, Aug 1, 2, 3, 2011**

Time: 8:00am-5:00pm

Location: Test House

- Review BPI technical standards and processes to prepare students for taking [BPI field exam\(s\)](#).
- Gain confidence through hands on practice with diagnostic tools (blower door, manometer, combustion analyzer, etc.) while being closely observed by the mentor and assistant to ensure proper techniques
- Special emphasis is placed on combustion safety diagnostics and action levels throughout the course.

**BPI Field Testing (1 Day per Student)**

**Dates: Thursday, Friday, Monday, Tuesday, or Wednesday, Aug 4, 5, 8, 9, or 10, 2011**

Time: 8:00am-12:00pm OR 12:30pm-4:30pm

Location: Residential Home Chico, CA

- One field exam (two hours) = one testing slot.
- A BPI proctor, usually the trainer, will administer the exam and fill in the proctor evaluation form. Once completed, the proctor sends the report to BPI for scoring and the student is notified directly by BPI in three to six weeks.

**For More Information, Call 530-895-9015**

---

**PG&E’s Innovators’ Pilot Program Partners**

This Program is sponsored by the City of Chico and funded by California utility customers and administered by PG&E’s under the auspices of the California Public Utilities Commission. Funding is administered through PG&E’s “Innovators’ Pilot Program” Partners involved in the program include students and faculty from California State University, Chico and Butte College as well as the City of Chico and PG&E.



“PG&E” refers to Pacific Gas and Electric Company, a subsidiary of PG&E Corporation. ©2010 Pacific Gas and Electric Company. All rights reserved.



## APPENDIX “C”

### *Energy Goals and Issues Identified by Participants Prior to the BPI Audit*

The behavioral team interviewed 95 participants during the summer and fall of 2011, before the BPI teams collected data on the performance of individual homes. There are three findings worthy of note as they relate to: 1) what participants had already done to improve the energy efficiency of their homes; 2) their willingness to set a specific goal for reducing their energy consumption before receiving an audit and home assessment report; 3) and specific information people wanted about their home’s energy performance.

- *All (95/95) participants indicated they had taken more than one action to improve the energy efficiency of their homes prior to involvement in the program.<sup>i</sup> The actions included:*
  - Basic weatherization.
  - Additional insulation.
  - Purchase of dual-paned energy efficient windows.
  - Purchase of energy-efficient appliances.
  - Upgrading of HVAC systems.
  
- *A subset of participants (12/95 or 12.6%) had taken significant actions to improve the energy efficiency of their home, including the installation of solar systems, new efficient HVAC systems, sealing and/or modification of their duct work, adding additional insulation, and sealing cracks and voids.*
  
- *A substantial number of homeowners ( 45/95 or 47%) had specific questions they wanted answered and/or issues to which they called the attention of the BPI auditors including:*
  - Windows, e.g., should they be replaced by dual-paned windows (N=6).
  - Whole house or attic fans (N=6).
  - Additional insulation (N=16).
  - Ducts, condition of (N=10).
  - Pool pumps (N=9).
  - Air leakage (N=5).
  - Solar hot water heater (N=2).
  - Health issues, e.g., mold (N=2).
  - Remodeling projects that could increase energy efficiency (N=4).
  
- *The majority of respondents (82/95 or 86%) did not want to set a specific goal for the reduction of their energy use. They wanted to wait for the BPI audit and until they had received their home energy assessment. (For those who set a specific goal (13/95 or 13.6%) it varied from 10-20%. This may be explained by the fact that: All participants had already taken action (some significant) to reduce their energy consumption and did not, as they said, know what else to do.*

## APPENDIX “C”

### Conclusion:

- **Chico Energy Pioneers were a group that had already taken action, sometimes significant, to reduce their energy consumption and were seeking additional information about what they could do to modify their homes and/or change their behavior.**

---

<sup>i</sup>As will be noted in the section which provides an analysis of participants’ behavior, all participants had done more than one thing to modify their energy use including installing CFLs, putting media centers and computers on power strips that could be turned off, washing in cold water, and turning the thermostat down in the winter to 68<sup>0</sup> or up to 76<sup>0</sup> in summer.

## APPENDIX “D”

### *Overview of Chico Energy Pioneers Project: Actions, Attitudes, and Evaluations*

The final number of participant households was 89. All respondents were contacted by letter, phone, and e-mail (if they had one) asking them how they wished to complete the final step in the program---to be interviewed in person, to complete an interview over the phone, or to complete the questionnaire by themselves (on-line or hard copy). Twenty-two participants were interviewed in person by a two-person team of students from California State University, Chico (CSUC). Others completed the questionnaire on-line or completed the hard copy we sent to them with a postage-paid return envelope. For those who did not respond initially, we called them, sent e-mail reminders, and used a default strategy of sending a hard copy of the questionnaire with a postage-paid return envelope to anybody who had not responded. As of May 22, there were 62 completed questionnaires for a *response rate of 70% (62/89)*.<sup>i</sup>

1. How did you hear about the program?

- **38%** a flyer on the door, letter from the City of Chico, neighborhood meeting.
- **30%** a friend or neighbor.
- **13%** a member of the City’s Sustainability Task Force or City staff member.
- **19%** Other: Newspaper, contractor, Chico Pioneer Team member, CSUC student, Community Action Agency.

Observation: Significant efforts were made to bring the project to the attention of homeowners in the two target areas but those efforts were not sufficient to meet our initial goal of 100 participants. Once the project had begun a network of friends and neighbors was effective in drawing participants into the effort. *Efforts to reduce residential energy consumption should identify and use friendship networks as part of any outreach effort.*

2. Why did you decide to participate? (Check all that apply. Total responses = 169.)

- **24%** to receive free retrofits.
- **27%** to find out how to lower my energy bill.
- **31%** to learn how to improve my home’s energy efficiency.
- **4%** to find out how my energy use compared to that of my neighbors.
- **11%** to learn how to change my/our behavior.
- **3%** Other: it was the right thing to do for the environment; sounded interesting; wanted to help scientific study.

Observation: At the beginning of the project (See the results for Questionnaire #1), respondents indicated that one of their primary reasons for participation was to protect the environment and/or because they wanted to create a sustainable future. But, by the end of the project, it was clear their *reasons were primarily economic*, i.e., receive free benefit, lower energy bill (a stated goal of everyone at the beginning of the project), and learn how to improve their home’s energy efficiency. *These are all goals of rational actors.* Fewer indicated they wanted to learn how to change their

## APPENDIX “D”

behavior (11%), and only 4% cared what their neighbors’ energy use was. *This finding varies from that of other national studies which have suggested that changes in behavior are key in reducing the energy consumption of residential customers and that one way to change behavior is let them know what others are doing---the social norms approach.* It may be that by the time our participants had gained knowledge of how their home was functioning they came to the conclusion, as one participant said, “We are not the problem; our home is!”

3. During the time of the project did you receive information from other organizations or businesses about how to reduce your energy consumption?
  - **38%** No.
  - **62%** Yes. If you did receive information, was it from PG&E?
    - **25%** Yes.

Observation: We asked this question because we knew that virtually every participant received over the course of the study numerous mailers from HVAC firms offering to reduce their energy consumption and mailers (and e-mails) from PG&E about how customers could reduce their energy consumption and rewards if a customer could lower their summer electricity bill or reduce their consumption of gas during the winter. That 38% of the sample did not recall receiving any information about how to reduce their energy bills is intriguing, as is the finding that *only 25% of the respondents recalled receiving any information from PG&E.* A few of the respondents (19 of 62) did act on the basis of the information they received, indicating they had asked PG&E for an inspection, got their bill lowered, put in solar tubes, and so forth. *Only one person indicated they had changed their behavior because of information they had received.* **Seventy percent** of the respondents indicated they took no action as a result of information they received from either PG&E or from HVAC firms. Most indicated they were waiting for their home assessment reports and/or the retrofits and did not feel a need to act. (Some also indicated they had neither the time nor the money to act.) *Time, financing, and not knowing what to do are themes that repeat themselves throughout the study.* Finally, we want to note that *flyers, mailings, and e-mails are not sufficient to change behavior and significantly reduce residential energy use.*

4. During the time of the project did you seek information outside of the project about how to reduce your energy bill?
  - **43%** Yes.
  - **57%** No.

Observation: If people sought to gain additional information they did so in a variety of ways: accessed on-line sites, talked to friends, called an HVAC firm (N=3), or used their PG&E account (N=13). Most (57%) did not seek outside information indicating they had

## APPENDIX “D”

neither the time nor money to do so and of those who did wait 43% they said it was because they wanted to wait for their home assessment.

5. Did your energy bill change since the project began?
- **31%** Yes.
  - **69%** No.

Observation: Of those who said, “Yes,” 14% indicated it was because they had changed their behavior. They put electronics on a power strip; used their washer and dryer during non-peak hours; changed light bulbs; changed pool pumps; or modified their home’s envelope (insulation, weather stripping) by themselves. For those who said, “No,” there were two main reasons: 1) it was too early to see the benefits of the retrofits; or, 2) there were still modifications that needed to be made to their homes.

6. What were your responses to the detailed home energy assessment report you received, as well as the oral report given to you by Jon Stallman?
- What was the most interesting thing you learned?
    - **45%** How poor our home’s envelope was (leakage).
    - **33%** Problems which were hidden from us and of which we were unaware.
    - **8%** Our home’s energy score.
    - **8%** How comprehensive the report was.
    - **6%** Other: how poor our HVAC was; the infrared images.
  - What was the most helpful thing you learned?
    - **34%** Specific suggestions about how to improve our home’s efficiency.
    - **16.5%** Received new information about our home.
    - **16.5%** Our energy score.
    - **11%** How much our home was leaking.
    - **11%** Problems with our insulation (not enough, wind-blown, etc.)
    - **5%** Everything was helpful.
    - **4%** Infrared images.
    - **2%** What I could do myself.
  - What was the most troublesome or frightening thing you learned?
    - **26%** Leakage of our home’s envelope.
    - **18%** Carbon-dioxide exposure.
    - **13%** Problems with insulation.
    - **13%** Cost of needed work, beyond RECO.
    - **13%** Problems with ducts.
    - **17%** Other: animal feces, blocked vents, vermiculite and asbestos discovered.

## APPENDIX “D”

Observation: Perhaps the most important finding is that in virtually every home problems were identified (envelope, ducts, insulation) of which homeowners were unaware, the correction of which would lead to energy savings. *This strengthens an argument for prescriptive audits.*

7. When you received your written report, which section gave you the clearest understanding of what needed to be done?

- **33%** The photographs.
- **31%** The score for our home.
- **22%** Graphs.
- **14%** Other: What we could do to improve our home; the oral report; discussion with Jon Stallman; healthy-home opportunities.

Observation: The home assessment reports were long (50+ pages) and detailed. What caught most people’s attention were photographs of problems that had been identified, a contextualized energy-efficiency score for their home, and the graphs which showed energy use, how different systems in their home performed, etc. *Without a comprehensive home energy assessment photographs would not be available but a contextualized score and well-developed graphs to help people understand their energy use could be effective.*

8. What was most helpful to you in terms of understanding what you needed to do to improve your home’s energy efficiency?

- **48%** The oral presentation of the report by Jon Stallman.
- **26%** The on-site audit by the BPI team.
- **20%** The written report.
- **6%** The presentation by the contractor scheduled to do the work.

Observation: The oral presentation provided an opportunity for homeowners to ask questions, and the on-site audit allowed them to see how well sealed their home was, whether or not insulation was missing in the walls, and so forth. Those participants who indicated the written report was most helpful (N=12) were well educated, e.g., Ph.D., MD, etc. *The findings suggest that an audit and a chance for the homeowner to discuss the data with a neutral party are essential.*

9. Did the report motivate you to act and if so, what did you do, and when did you do it? (N=57 responded to this question.)

- **75% action taken.** What?
  - 21% indicated they changed some behavior. The actions varied from line-drying clothes, changing lights bulbs, to using energy at non-peak hours when possible.

## APPENDIX “D”

- 79% indicated they had modified or will modify their home’s structure.
- **25% no action taken.** Why? The reasons were diverse: home needed no improvements; no money to take action; “it took too long to get the results of our home assessment;” or it was too soon to tell if would take action, i.e., they wanted to wait and see if they could finance upgrades.
- **31% had taken action before the retrofits were completed.** These included insulating, sealing, purchase of new HVAC system, installing whole-house fan, changing pool pumps, replacing water heaters, and so forth.
- **21% indicated they would take actions after the retrofits and in addition to the retrofits.** These include major remodeling projects to achieve energy savings, vacuuming out attic insulation and resealing, repairing and replacing duct systems, and so forth.

Observations: The number of respondents who acted on their own to improve the health/safety and efficiency of their homes is encouraging. *It means that armed with knowledge provided by a trusted source about how their homes function, many will act to improve the energy efficiency of their homes.* The number of those willing to take action is probably underestimated because a majority of those participants who did not respond to our requests to complete this last step, are also considering programs such as EUC and/or making improvements without the assistance of the EUC program. The reported behavioral changes people have made will yield some energy savings, but we are not able to measure their impact.

### 10. Will you take actions in the future?

- **20% No.** Why? Too costly; not needed; selling the house.
- **80% Yes.** Eight respondents indicated they will look into or are planning on solar systems; 9 will purchase new HVAC systems; 7 intend to remodel their homes to make them more efficient; 5 plan on modifying their landscaping; 1 will switch to natural gas.

Observation: *People who have the means to do so are acting on the basis of the information they received about their home’s performance.*

### 11. Please evaluate (on a scale of 1-5, with 1 being exceptional and 5 being completely unacceptable) your interaction with the contractor who performed the work. (N=44, as not all respondents had received their retrofits).

- How well was the work explained to you? (1-5).
  - **75%** gave the contractor a score of 1-2.
  - **16%** were neutral (3).
  - **9%** gave the contractor a score of 5, the lowest.
- Was the work completed in a timely manner? (1-5).
  - **77%** gave the contractor a score of 1-2.

## APPENDIX “D”

- **10%** were neutral (3).
- **13%** gave the contractor a score of 5.
- Was the work done in a professional manner? (1-5).
  - **80%** gave the contractor a score of 1-2.
  - **8%** were neutral.
  - **12%** gave the contractor a score of 4-5.

Observation: For those *respondents who had retrofits completed, they were extremely positive about their interactions with the contractors.* It should be noted that in several cases contractors made several trips to a person’s home to explain what would be done, what could be done for additional costs, and what it made most sense to do, given a homeowner’s financial situation.

12. Did you feel pressured by the contractor to do more work than you felt was necessary?

- **94%** No.
- **6%** Yes.

Observation: *Though contractors could have benefitted significantly from going beyond what was allowed under the RECO ordinance, they did not oversell participants.*

13. Did you look into other programs that provide assistance for making your home more energy efficient?

- **34%** Yes. This included PG&Es’ CARE program; EUC; and the Community Action Agency.
- **64%** No. The reasons for not seeking additional assistance were: selling home; it is already energy efficient; the program (Chico Energy Pioneers) met my needs; don’t see the economic value; and no time.

Observation: There were two, though small, distinct groups that sought additional information: those who had economic needs that drove their actions and those who had the means to consider such programs as EUC.

14. Which aspects of the program were most important to you? (Rankings were on a 1-5 scale with 1 being the most important and 5 the least?)<sup>ii</sup>

- **94%** gave the oral presentation by Jon Stallman a ranking of 1-2.
- **91%** gave the overall energy assessment of the home a ranking of 1-2.
- **65%** gave information on the health and safety of their home a ranking of 1-2.
- **64%** gave participation in the BPI audit a ranking of 1-2.
- **49%** gave the discussion with the contractor a ranking of 1-2.
- **36%** gave the retrofits they received a ranking of 1-2.

Observations: There are several remarkable findings here, including the fact that *people valued less the retrofits they received than the information they received about*

## APPENDIX “D”

*their home’s performance. It is also clear that one of the things they valued highly was the opportunity to talk about what their energy reports actually meant. Such findings should shape future policy because it suggests that information alone will not be sufficient to get people to take the kind of actions necessary to maximize the energy efficiency of their homes.*

15. In terms of the retrofits, did you receive what you wanted? (N =50 responses).

- **64%** Yes.
- **36%** No.

Observations: Those who reported not getting what they wanted said they would have preferred one or more of the following: whole-house fans; weather stripping; windows; doors; duct work; insulation, and so forth. For those who had homes meeting or exceeding existing RECO standards they wanted something that could not be provided under the agreed scope of work, e.g., an insulated door. Second, some people want aesthetic improvements they thought would yield significant energy savings, but do not make sense in terms of cost-effectiveness. *Many participants, at the outset of the project, expressed a desire for new windows.* This is not surprising as window companies advertise widely that replacement of windows will “pay for themselves” because of lower energy bills.

16. Did you receive the kind of information you anticipated from participation in the project? (N=59).

- **88%** Yes.
- **12%** No.

Observation: Those who said they did not receive the kind of information they anticipated or needed *wanted information about rebate programs, about how to finance retrofits, and what the cost effectiveness of specific actions would be.*

17. Did you discuss your home energy report with others, such as friends or family? (N=58).

- **43%** No.
- **57%** Yes.

Observation: Those who did discuss their report with others found that they, too, would like to participate in such a program. *To build on programs such as this, we need to draw on the positive experiences of those who participated and we need to consider how best to use existing organizational and friendship networks to publicize such efforts.*

18. Participants were asked which actions they thought would be most effective in reducing home energy consumption in the future. (N=58). Four choices were given and

## APPENDIX “D”

participants were asked to rank each category with a score of 1-5 with one being most important and 5 the least.

- **83%** indicated that building energy efficient homes was critical (1-2).
- **83%** indicated that retrofitting existing homes was critical (1-2).
- **68%** indicated that new energy-efficient technologies were key (1-2).
- **17%** indicated that behavior change was most important (1-2).

Observations: These responses do not lend themselves to an easy interpretation. Clearly participants believe that *building it right in the first place is important* and if a home is not energy efficient to start with, it needs to be modified so it is.

**Eighty-eight percent** of respondents indicated that all homeowners should get an energy audit. *Behavior change is not seen as a way to achieve significant energy savings.* It may be that people do value behavior change but all of our participants indicated they were already doing what they could to reduce their energy use. So, the only thing left for them to do is to modify their homes, or buy one that is energy efficient. Builders frequently say, “We can build any home people want; they just need to be willing to pay for it.” Assuming this is true, then “*Energy Star*” ratings need to be given to new homes, like the gas-mileage stickers on new cars, so that consumers can make better choices.

19. Which of the following terms best describes you? (Check all that apply.) (N=158 responses.)

- **31%** Somebody who wants to save money.
- **31%** Somebody who wants to reduce their energy consumption.
- **19%** An engaged community member.
- **16%** An engaged environmentalist.
- **3%** Other: Community sustainability activist, likeable.

Observation: People could check multiple categories, which meant that the same person could note they were both an engaged environmentalist and an engaged community member. And, in fact, 10 out of the 62 who completed the questionnaire are well known for their environmental work in the community. Even though the City of Chico and its inhabitants are known for their engagement with environmental and sustainability issues, it is unlikely that a random sample of Chico residents would report that between 16-19% of them are involved in environmental or sustainable activities. However, *it is notable that for most of our participants, their clear focus is on saving energy and hence money.*

20. How would you describe this project to a close friend? (Open-ended question. N=120 responses.)

- **29%** “It was a wonderful project!”
- **29%** “I learned so much!”
- **11%** “Everyone was great.” “Everybody helped.”<sup>iii</sup>

## APPENDIX “D”

- **13%** “It was holistic.” “It gave me an understanding of how my home worked.”
- **9%** “It was very disorganized. I never knew who was in charge.”
- **5%** “It took way too much time.”
- **5%** “It was worthless.” “It was a complete waste of time.”

Observations: *The results were very positive, although there were six (of 62 reporting) who expressed disappointment.<sup>iv</sup> Their reasons varied and included comments that they did not receive what they wanted (e.g., a whole-house fan), the information was not useful to them, and that what got done under the program guidelines (RECO ordinance) was not what they wanted or needed.*

21. What advice would you give to the team to make the project a more positive one? (Open ended question. N=66 responses.)

- **85%** Manage the timeline better; it took too long; communicate more frequently.
- **9%** Improve the organization of the entire project.
- **6% Other:** Solve contractor issues; provide information about financing and/or help to arrange.

Observation: *The length of time (over three years) was a problem and it caused some participants to drop out. A small number of respondents did say, however, that the length of time between when they received their home assessment and when they needed to act was a benefit. For those who were going to participate in the EUC or improve their home’s energy efficiency by financing all of the work themselves, they needed time to decide what to do and how to pay for the work. Though we do not know what the time gap should be, consideration should be given to structuring a time lag between when a homeowner receives their report, and when they need to make a decision. Homeowners should not feel pressured to make quick decisions about whether or not to spend significant amounts of money on improving their home’s energy efficiency.*

22. What else would you like to tell us in confidence? (N=40 open-ended responses.)

- **25%** “I’m grateful.” “I don’t know what I would have done without this chance.”
- **23%** “I loved being involved in the program.” “I learned so much.”
- **15%** “You need to improve management of everyone’s time.” “You need to improve the organization of the program.”
- **12%** “You need to improve communication.”
- **25% Other:** “Give us a better selection of contractors.” “Set up a webpage for the program.” “I felt our concerns were heard.”

Observations: *Again, the results are positive, although time-management and communication with participants was an issue.*

## APPENDIX “D”

23. If you were to pay for the home energy assessment you received, how much would you have been willing to pay? (N=61.) The following categories were provided.

- **3%** \$2,000
- **6.5%** \$1500-1999.
- **10%** \$1000-1499.
- **30%** \$499-999.
- **44%** Less than \$499.
- **6.5%** \$0

Observations: Only two (2) respondents indicated they would be willing to pay \$2000 and they had both previously contacted a contractor to find out what the actual cost was for a home energy assessment. The four (4) who said they would pay \$0 were also those who said the project had no value to them. Several (8) of those who checked the category \$499-999 circled \$499 as what they would be willing to pay and noted they did so because it was all they could afford. The same is true with those checking \$499 or less; several noted they could not afford even that amount. When people noted in response to question 22, that they were grateful, some indicated it was because they simply could not have afforded either the audit or the retrofits. *The public policy consequences are significant. Even people with the means to pay for a home energy assessment do not want to pay the market value.* Therefore, contractors often “bury” the cost of these assessments in bids given for HVAC systems and other improvements to the home so they do not lose money. *The value of home assessments is clear but our data suggests that prescriptive audits, paid for with energy savings, may need to be mandated.*

---

<sup>i</sup> As of May 22, not all of the participants had decided what they wanted to do, e.g., go beyond what RECO provided, had not yet received their scheduled retrofit, or had not yet met with a contractor to discuss what would be done. It is unlikely that the overall pattern of responses would change with additional questionnaires. One caveat is, though, in order. Some of those who had not responded by May 22, were waiting to see if they would qualify for the EUC program, and/or they were trying to decide what they wanted to do beyond RECO and how they would pay for changes to their home’s envelope.

<sup>ii</sup> Respondents did not, as expected, rank the categories as a whole, giving each category a separate number from 1-5. Rather than gave a 1-5 ranking for each category.

<sup>iii</sup> Jon Stallman was often singled out by participants for his high level of engagement, his knowledge, and his willingness to go “above and beyond” to help participants.

<sup>iv</sup> Those people who were interviewed in person were all exceptionally positive, praising all aspects of the program. The six who indicated they felt the project had no value, completed their questionnaires on-line or returned the mailed questionnaire.