

Education and Training Programs: An Evaluation of the Energy Benefits

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Abstract

The purpose of this evaluation is to assess the indirect impacts of the California Statewide Energy Efficiency Education and Training Program and its primary program effort, nine Energy Centers. Historically, the performance metrics of the California IOU Education and Training Programs focused on the number of participants and similar frequency of use measures. A program was considered successful if it was well-attended regardless of whether it led to changes in behaviors and attitudes.

This evaluation takes a different approach by assessing the impact of the Centers on program participants' attitudes, awareness and knowledge of energy saving behaviors. In addition, the evaluation estimates net energy savings resulting from actions taken due to participation in the courses.

We conducted surveys with a sample of 2,864 people who took courses at the Centers between January 2006 and June 2007. The results provide a profile of course participants and the impact the courses had on their attitudes and behavior. The study indicates that there is a substantial positive impact of these centers in energy savings that is not being captured by impact evaluations of the incentive programs. Course participants gained knowledge and changed their way of thinking about energy efficiency opportunities they could take advantage of at their home or work. Many took energy saving action or changed their work practices as a result of taking the course. In addition, a large majority shared what they learned with others, potentially extending the influence of the courses beyond the individual participants.

Introduction

The Purpose of the Evaluation

The purpose of this evaluation is to assess the indirect impacts of the California Statewide Energy Efficiency Education and Training Program. The primary program effort is the nine Energy Centers operating within the Investor Owned Utility (IOU) service territories, which are the focus of our evaluation. The Energy Centers offer a large number of courses and activities, and the evaluation includes surveys with participants.¹ The surveys were designed to measure the impact of the courses on participants' attitudes, awareness and knowledge of energy saving behaviors. In addition, the surveys contain impact modules that assess net energy savings resulting from actions taken due to participation in the courses. The results from these surveys are the focus of this paper.

Our evaluation is broken into two waves due to the large number and variety of activities offered by the Energy Centers and lack of a priori knowledge of the impact of these activities. This approach allows changes in design to be made based on the results of the first wave. The results presented in this

¹ The Centers offer a wide range of training programs including courses, demonstrations and consultations. Our larger evaluation includes all of these. However, this paper focuses primarily on our evaluation of Center courses along with a few additional activities that could be evaluated with a participant survey. For ease of presentation, we will use the term "courses" for all activities evaluated in this paper.

paper are drawn from Wave 1, which covers courses taken from January 2006 through June 2007. Wave 2 will cover courses taken from July 2007 through December 2008.

Scope

In this paper, we focus on courses offered at the nine energy training centers operated by the California IOUs (see Table 1). This evaluation is unique in its scope and breadth; it examines the entire curriculum of energy centers and attempts to quantify the impacts on cognitive and behavioral change among participants.

Table 1: Energy Center and Location

Energy Center	Location
Pacific Gas and Electric	
Energy Training Center (ETC)	Stockton
Pacific Energy Center (PEC)	San Francisco
Food Service Training Center (FSTC)	San Ramon
Southern California Edison	
Agricultural Technology Application Center (AgTAC)	Tulare
Customer Technology Application Center (CTAC)	Irwindale
Technology and Test Centers (TTC)	Irwindale
Southern California Gas	
SCG Energy Resource Center (SCG ERC)	Downey
San Diego Gas and Electric	
SDG&E Energy Resource Center (SDG&E ERC)	San Diego
California Center for Sustainable Energy (CCSE)	San Diego

Researchable Issues

This evaluation was designed to answer twelve researchable issues. The following seven researchable issues will be explored in this paper for all nine Energy Centers combined:²

1. What is the reach of the Centers?
2. What types of behavioral changes are occurring as a result of the activities of the Centers?
3. What is the change in awareness of energy saving opportunities as a result of the Centers?
4. How likely are the Centers to induce behavioral change?
5. What percentage of the people targeted and exposed to the Centers changed?
6. Among what groups are the changes occurring?
7. What indirect behaviors were taken by those people who received education or training from the Centers?

² The level at which results are presented differs for Wave 1 and Wave 2. The focus of Wave 1 is on the course and personal characteristics associated with behavior change. The results for all Energy Centers are combined for this analysis. In Wave 2, the sampling design allows the results to be presented at the Center level.

Approach Taken

The evaluation makes use of two surveys and a course content review. The first survey was conducted with instructors of the 458 unique energy center courses in order to gain information on course characteristics. We then attempted a review of the course content for these 458 courses and received and reviewed materials for 344. The second survey was conducted with participants from a sample of 189 of the unique courses. Participants were asked about changes in their knowledge of course material, attitudes towards energy savings and any energy saving actions they may have taken as a result of what they learned. Based on these results, we can examine the course and participant characteristics that are associated with these changes and actions. We can also estimate total energy savings for each energy center. Key to this approach is a battery of participant survey questions that allows us to determine the level of influence the course had on changes in knowledge, attitudes and behaviors. With this focus, the evaluation will provide much needed information about the impact that education and training programs beyond the number of program offerings and participants.

Background

Historically, the performance metrics of the California IOU Education and Training Programs focused on the number of participants and similar frequency of use measures. A program was considered successful if it was well-attended regardless of whether it led to changes in behaviors and attitudes.

Using this metric, the nine Centers were collectively quite active during the Wave 1 evaluation period. Across all nine Centers, a total of 1,389 courses were offered between January 1, 2006 and June 30, 2007. We were unable to include some of these courses in our evaluation because participant data was either not tracked or not provided. As a result, our evaluation includes a total of 1,285 courses with 54,237 participants (see Table 2). In addition, centers often conduct multiple sessions of the same course during a year. Therefore, the total number of evaluable courses with unique content is 458.

The level of activity varies greatly by Center. It is worth noting that the Centers offer other services besides courses, including consultations, tool lending libraries, and outreach. The Centers also do not have a uniform definition of what constitutes a course or activity. Some centers include sessions with a handful of participants, while other centers include trade show events with hundreds of participants. This explains to some degree why the number of attendees differs among the centers.

Table 2: Energy Centers Class and Participant Information

	Total Number of Evaluable Classes	Unique Number of Classes³	Number of Participants
ETC	417	91	7,951
PEC	216	94	8,811
CTAC	186	56	8,133
SCG ERC	182	72	17,980
FSTC	66	12	1,083
AgTAC	95	56	2,356
SDG&E ERC	61	39	5,960
TTC	28	7	675
CCSE	34	31	1,288
Total	1,285	458	54,237

³ Many Centers offer the same course multiple times during the evaluation period. This number reflects the number of unique classes offered by each Energy Center.

Methodology

A sample of 200 unique courses was included in the Wave 1 survey. Out of the 344 unique courses for which we had both an instructor survey and material for a content review, 63 courses were selected by Center directors for inclusion in the sample; the remaining 137 were randomly selected in proportion to the number of unique courses offered by the Center. The participants of 189 courses were the focus of the participant survey effort. The remaining 11 are the focus of in-depth analysis due to the nature of the activity. The 189 courses had a total of 14,287 participants.

As part of the course content review, all courses, including those that were not included in the participant sample, were assigned one of fifteen end uses. Table 3 shows the fifteen end uses, number of courses offered in each, and number of total participants.

Table 3: Wave 1 Sample by End Uses

End Use	Total Population of Evaluable Courses		Wave 1 Sample	
	Courses	Participants	Courses	Participants
Lighting	150	5,332	22	1,315
Green Building/Building Envelope	98	5,586	23	866
HVAC	379	18,346	38	3,673
Renewables	75	3,041	8	1,346
Commercial Cooking/ Food Service/ Refrigeration	99	3,126	22	1,183
Boilers/Furnaces/Water Heating	60	3,062	13	1,351
Controls/Energy Management Systems	34	1,173	6	370
Motors/Pumps	46	1,838	10	617
Pools	15	159	2	113
General/Other	145	6,077	13	690
Commissioning	40	1,310	9	431
Title 24	89	2,765	12	970
Rebates/Incentive Programs	36	1,516	5	759
Compressed Air	17	647	4	384
Water Management	2	219	2	219
Total	1,285	54,237	189	14,287

Careful review of the participant database showed that many participants took more than one course during the Wave 1 time period giving us 11,310 unique individuals who took courses. Table 4 shows the distribution of the number of classes taken by each unique individual. Participants took between 1 and 38 courses during Wave 1.

Table 4: Wave 1 Sample by Number of Courses Taken

Number of Courses	Number	Percentage
1	6,711	59%
2	2,322	21%
3	927	8%
4	503	4%
5 – 9	678	6%
10+	169	1%
Total	11,310	100%

A participant profile was created for each participant who took a sample course. The profile included the number of all courses taken in each end use area. These data showed that participants not only took multiple courses, but in some cases they took courses across a variety of end uses. A large majority of participants (83%) took courses that focused on a single end use. However, a sizable percentage of participants (12%) took courses in two end use areas whereas 5% took courses in 3 or more areas (see Table 5).

Table 5: Wave 1 Sample Participants by Number of Course End Uses Taken

Number of End Uses	Number	Percentage
1	9,335	83%
2	1,374	12%
3	360	3%
4	145	1%
5+	96	1%
Total	11,310	100%

The original survey approach had been to ask participants to evaluate a single course. But with participants taking multiple courses within an end use, we felt that participants would not be able to attribute their actions to a single course. Therefore, people who took multiple courses within an end use were asked to evaluate all of the courses they took in that area. For example, if a participant took three lighting courses, he would be asked to answer the questions based on the combined effects of all three courses.

In order to minimize respondent burden, it was also necessary to limit the number of survey requests a single participant would receive. If a participant took courses across multiple end use areas, we limited the number of survey requests to three. Of the 2,657 participants who completed surveys, 93% completed one survey, 6% completed two surveys, and 1% completed three surveys. Overall, this resulted in 2,864 completed surveys.

The participant survey contained a series of questions that classified respondents by their occupation or reason for taking the courses. Residential participants are those who intended to apply the course information in their homes or who did not have a specific purpose in mind. Residential participants made up 17% of the respondents. Those who intended to apply what they learned on the job were further broken into two categories: (1) commercial participants were those who would apply the information in facilities their company owned or rented and made up 29% of the respondents, and (2) market actors were defined as those who would apply the information in their client’s facilities and made up just over half the participants (54%).

Table 6: Type of Participant

Participant Type	Number	Percentage
Residential	472	17%
Commercial	843	29%
Market Actor	1549	54%
Total	2,864	100%

The survey questions were tailored by respondent type in order to ask about appropriate changes in knowledge and behaviors. All respondents were asked a set of “core” survey questions that were designed to measure general changes in knowledge and behaviors. Residential and commercial respondents who took action based on what they learned in the course were directed to impact modules that asked about the details of the actions taken that could be used to calculate the resulting energy

savings. Because market actors may have taken actions multiple times across many clients, they were not asked to provide comparable information. Instead, they were asked some general questions about the frequency with which they took the actions and to provide a rough estimate of resulting energy savings.

Results

Change in Knowledge and Attitudes about Energy Efficiency

Compared to resource acquisition programs that encourage participants to take action by providing a financial incentive to those who install more energy efficient equipment, the influence of the Energy Centers’ education and training programs is indirect. Course participants must first increase their knowledge and awareness of the course concepts and energy efficient actions they could take.

Results from the participant survey show that the courses were successful at increasing participant’s knowledge of course concepts. Nearly all survey participants (94%) said the course provided them with new information. Of those who did not think they learned anything new, 58% felt their participation moved them closer to implementing efforts to save energy they were already considering.

Participants were asked to rate the impact of the course on their knowledge of how to achieve course concepts using a 7-point scale in which 1 represented “no more knowledgeable” and 7 “significantly more knowledgeable”. Nearly all participants reported that their knowledge increased with two out of five (41%) rating their knowledge increase as a 6 or 7 on the 7-point scale. The survey included several additional questions designed to measure knowledge gains in the application of energy efficient behaviors (see Table 7). These questions were tailored to the type of respondent and showed similar results. When combined into an overall knowledge scale, gains in knowledge could be described as moderately high (mean=5.3). On average, residential, commercial and market actor respondents all experienced similar knowledge gain.

Table 7: Impact of Course on Knowledge

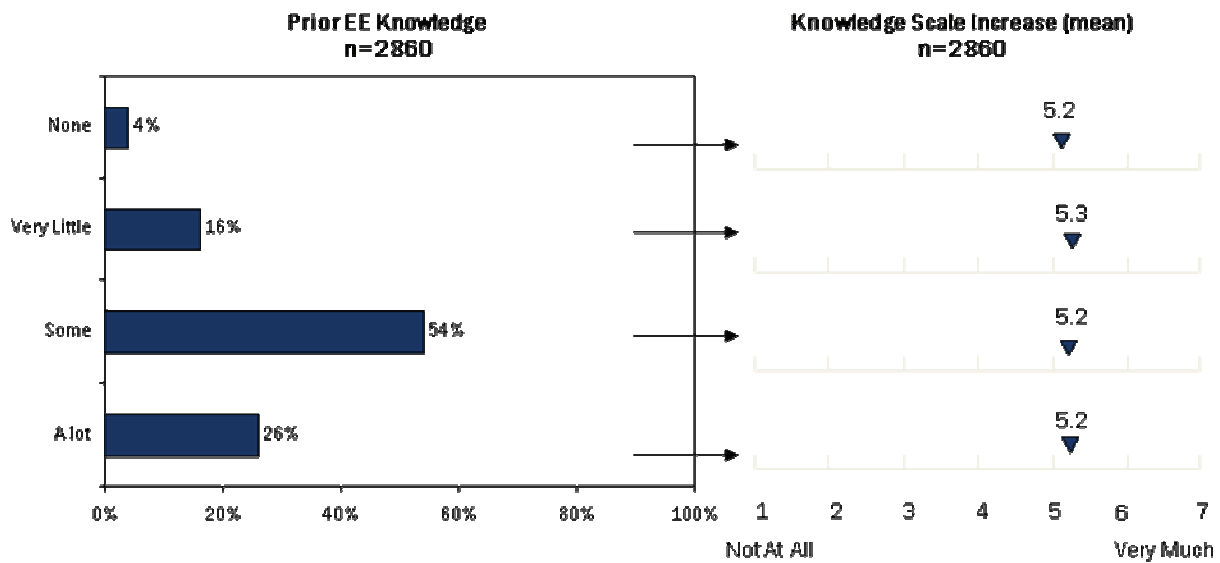
	Bottom Two	Middle Three	Top Two	Mean
Degree to which knowledge of course concepts increased	5%	53%	42%	5.1
Better able to implement EE solutions	5%	47%	48%	5.3
More aware of utility sponsored EE programs	8%	44%	48%	5.2
More familiar with tools/techniques to enhance client services*	3%	46%	50%	5.3
Have more confidence when EE recommendations to clients that savings will actually occur*	5%	43%	52%	5.4
Better understand how to improve EE at my facility**	3%	46%	52%	5.3
Have more confidence that EE steps will result in expected savings**	4%	45%	51%	5.4
Overall Knowledge Scale	4%	55%	41%	5.3

*Asked only of market actors.

**Asked only of commercial respondents.

Course participants were also asked how much knowledge of the course concepts they had prior to taking the courses. The courses were effective at increasing knowledge among all participants regardless of their prior knowledge of the subject area. The average rating on the knowledge gain scale was no different for the 26% who had a lot of prior knowledge than it was for the 20% who had very little or no prior knowledge. The same is true of the middle categories of prior knowledge (see Figure 1).

Figure 1: Influence of Prior Knowledge on Knowledge Gain of Course Concepts



Cognitive Change

We have seen that course participants learn from the courses, which is a necessary first condition for the courses to encourage energy saving behavior change. Another key step is changing participant's thinking about energy efficiency more generally.

Course participants were asked a series of questions designed to measure the impact the courses had on their thinking about energy efficiency opportunities using a 7-point scale in which 1 represented "not at all" and 7 "very much". The wording of the questions differed slightly across participant types, but the concept being measured was similar for all. Residential respondents were asked about energy efficiency opportunities in their homes while commercial respondents were asked about their facilities. Market actors were asked about opportunities to introduce energy efficiency to their clients.

The courses changed most participants' way of thinking about energy efficiency opportunities (see Table 8). As a result of taking the courses, participants say they think differently about energy efficiency opportunities, want to make energy efficiency changes, and are more aware of opportunities. Participants also felt that the course was a good way to explain the importance of taking advantage of energy efficiency opportunities. The average rating for the four items ranged from 4.9 to 5.4 with a combined mean of 5.1 on a 7-point scale. Residential, commercial and market actor participants showed similar levels of cognitive change.

Table 8: Impact of Course on Cognitive Change

	Little Change (1 or 2)	Some Change (3, 4, or 5)	Large Change (6 or 7)	Mean Score
Degree to which course caused participant to think differently about EE opportunities	9%	53%	37%	4.9
Degree to which course caused participant to want to make EE changes	9%	48%	43%	5.0
Degree to which course increased participant's awareness of EE opportunities	8%	49%	44%	5.1
Degree to which course was a good way of explaining the importance of taking advantage of EE opportunities	6%	41%	53%	5.4
Overall Cognitive Change Scale	6%	54%	40%	5.1

Behavior Change

Each respondent type was asked a number of questions designed to assess changes in behavior as a result of taking the course(s). A majority of all participant types applied the course concepts (see Table 9). Among residential respondents, three out of five (60%) took actions to save energy in their homes whereas four out of five commercial respondents (80%) took energy saving actions at their facility. Just over three out of four market actors (78%) changed or enhanced the services they provide to clients using the course concepts.

Residential and commercial respondents were asked whether their efforts took place at a home or facility served by an IOU. If not, the interview was terminated as any savings that resulted would not impact an IOU. Additionally, residential and commercial respondents who took action were asked whether they had received any other technical or financial assistance through a utility resource program. Half of the residential respondents (50%) and approximately one-third of commercial respondents (35%) who took action in IOU territories had received additional assistance. This left 27% of residential and 45% of commercial respondents who took action that could be attributed to the Energy Center courses that was not already being counted by another program. These respondents were asked a number of detailed questions, the results of which are currently being used to calculate energy savings.

Table 9: Energy Saving Actions Taken as a Result of Attending Courses

	Residential (n=472)	Commercial (n=843)	Market Actors (n=1,428)
Applied Course Concepts	60%	80%	78%
Applied Course Concepts in Locations Served by IOU	55%	68%	--
Applied Course Concepts in Locations Served by IOU and Did Not Receive Assistance from Another Program	27%	45%	--

Because market actors could apply the course concepts numerous times, the survey did not ask whether their actions were in an IOU territory or whether their clients received additional assistance through a resource program. Given the variety of actions and situations in which market actors could have applied the course information, we determined it would not be possible to ask them questions that would allow us to calculate energy savings as we did with commercial and residential respondents. Instead, we asked market actors a series of general questions about the types of changes they made and the frequency with which they made them. Across all questions, a majority of market actors said that

they had taken that action. On average, market actors changed 2.4 out of 7 practices. As Table 12 illustrates, in most cases, a large majority of market actors changed their behavior.

Table 10: Types of Changes Made by Market Actors

Among those making changes (n=1,120)	Yes
Specify EE measures of which previously unaware	75%
Specify EE measures more frequently	78%
Apply building or system design principals or elements of which previously unfamiliar	69%
Utilize diagnostic tools or practices of which previously unfamiliar	56%
Utilize building or system design tools or practices of which previously unfamiliar	57%
Change manner in which install or maintain EE equipment	53%
Change methods used to size and specify new equipment	64%

The survey asked market actors whether the changes they had made had become standard practice and resulted in measurable energy savings for their clients (see Table 11). Of all market actors, two out of three had made changes to their standard practices (67%) and just over half had made changes that resulted in measurable energy savings (53%).

Table 11: Change in Market Actor Behavior

	Market Actors (n=1451*)
Applied course concepts by changing or enhancing services	77%
Became standard practice	67%
Measurable energy savings	53%
<i>Significant</i>	20%
<i>Moderate</i>	30%
<i>Insignificant</i>	4%

*A total of 1521 market actors were surveyed. However, the 70 who took the courses that directed them to other financial incentive programs were not asked about a change in their practices due to course content. Instead, they were asked if they took part in an incentive program, of which 39% (27) did participate.

Residential and commercial participants were asked whether they had taken several indirect actions that could lead to energy saving behavior in the future either by themselves or by others (see

Table 12). The courses made an impression. A substantial majority of both shared course information with someone else while a sizable number were motive to search for additional information related to the course concepts. An equally large number of commercial participants took an advocacy role after taking the course by helping convince others in their organization that energy saving actions were needed and that they would actually save energy.

Table 12: Indirect Behaviors among Residential and Commercial Respondents

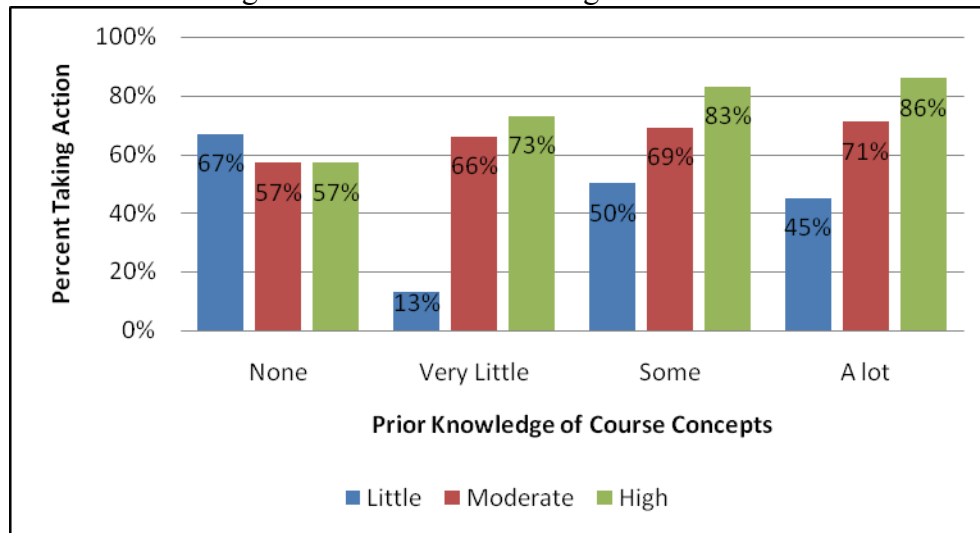
	Residential (n=472)	Commercial (n=841)
Shared course information with friend/family/colleague	82%	93%
Searched for additional information related to course concepts	69%	71%
Helped convince others in organization that energy saving actions are needed	--	85%
Helped convince others in organization that certain types of actions help save energy	--	73%

Influence of Course on Behavior Change

We have hypothesized that in order for education and training programs to result in energy saving behavior change, course participants must first learn about actions they could take and change their attitudes about energy saving opportunities. The influence of the courses runs through these two areas. So far, the survey results indicate that the courses were successful in both regards. The results also show that many participants report that they took action as a result of the course. However, we still need to determine whether there is a link between course learning and attitude change and taking energy saving action as we expect. Figure 2 provides one piece of this link.

Figure 2 shows the percentage of respondents who took action by the amount of knowledge they gained from taking the course(s). Knowledge gain is based on the knowledge scale presented earlier, reclassified into three categories: low, moderate and high. The figure also controls for the level of knowledge respondents had prior to taking the course. We saw earlier that prior knowledge was not related to learning, but existing knowledge might be related to taking action.

Figure 2: Influence of Knowledge Gain on Behavior Change



The results indicate that both course learning and prior knowledge are associated with taking energy saving action. However, how much participants learned in the course matters more than the amount of knowledge they brought to the course. Those who had “some” knowledge of course concepts prior to the course were as likely to take action as those who had “a lot” of prior knowledge. For both groups, the more they learned, the more likely they were to take energy saving action.

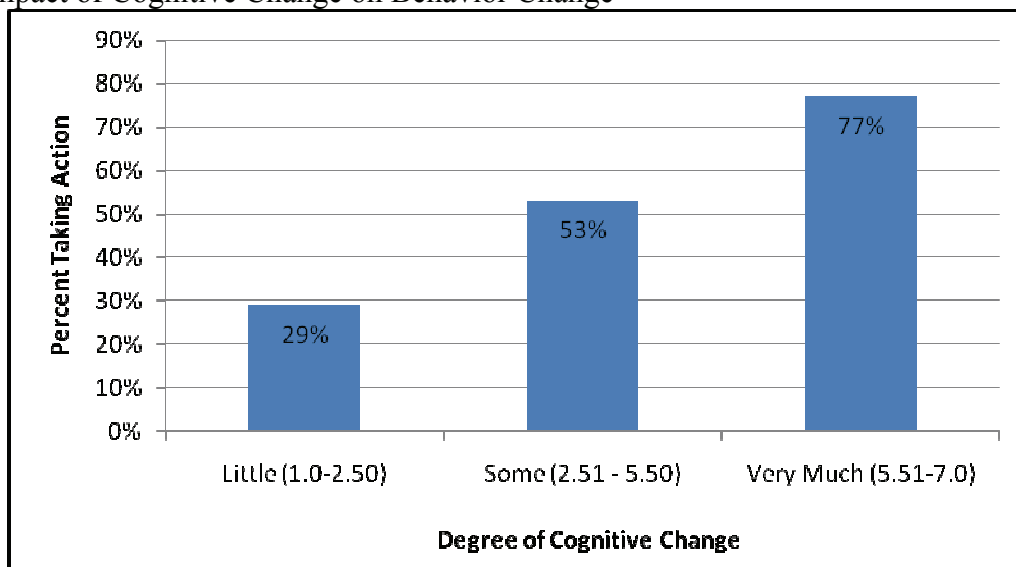
Even those who had “very little” prior knowledge of course concepts were influenced by how much they learned. Two out of three who gained a moderate amount of knowledge took energy saving actions (66%) while nearly three out of four who gained a high degree of knowledge took action. Those who came to the course with very little knowledge and gained little knowledge were unlikely act.

Finally, participants who had no knowledge of course concepts prior to taking the course were equally likely to act regardless of how much they learned in the course. With no prior knowledge, a little knowledge gain was as good as a lot.⁴

Figure 3 provides the second link between the courses and energy saving action. It shows the percentage of respondents who took energy saving action by the amount of cognitive change they experienced as a result of the course. Cognitive change is based on the 4-item scale presented earlier that measured the degree to which the course(s) changed participants’ thinking about energy saving opportunities. This scale has been reclassified into three categories: little, some and very much.

As Figure 3 shows, cognitive change is highly associated with taking energy saving actions. Approximately one in three participants who experienced little cognitive change took action (30%) compared to three of four who experienced a high degree of change (77%). Those who experienced a moderate amount were equally likely to take action as not (53%).

Figure 3: Impact of Cognitive Change on Behavior Change



Finally, respondents who took energy saving action were asked to assess the influence of the course information on their decision to take action using a 7-point scale in which 1 represented “not at all influential” and 7 “very influential”. On average, participants reported that the course had a moderately high degree of influence on their decision to take energy saving action (mean=5.3). Half of course participants who took action rated the course as having a very high degree of influence on their decision (a rating of a 6 or a 7).

⁴ Only 3 respondents came to the course with no prior knowledge and left with little knowledge gain. Therefore, the 67% who acted should be interpreted with caution.

Table 13: Influence of Course

	Average	Little Influence (1 or 2)	Moderate Influence (3, 4 or 5)	A lot of Influence (6 or 7)
Overall	5.3	5%	45%	50%
Residential (n=259)	5.5	5	39	56
Commercial (n=576)	5.3	4	49	47
Market Actors (n=1,106)	5.3	5	45	50

Note: The average for residential and commercial is based only on those participants who took action in IOU territory and did not receive assistance from another utility sponsored program.

Conclusions

This study represents the first ever attempt to quantify the energy saving results of California IOU's extensive investment in training and education provided through the nine training centers. The study indicates that there is a substantial positive impact of these centers in energy savings that is not being captured by the impact evaluations of the incentive programs. Forty-five percent of the commercial end-user attendees and 27% of the residential end-user attendees took energy saving actions in locations within the four IOU territories that was not already being counted in another impact evaluation. In addition, 77% of market actors changed or enhanced services based on course information, and over half had made changes that resulted in measurable energy savings. The courses also had the expected indirect benefits of increasing attendees' awareness of energy saving opportunities and utility programs.

As this study is the first attempt to capture energy savings on California IOU's Education and Training Energy Centers, it is bound to have encountered issues in its implementation. This study relies heavily on self-reported actions. More importantly, the study cannot fully attribute the energy saving actions to a single course or series of courses. There may be other non-program influences that contributed to the taking of actions. Conversely, this study has eliminated any actions that are also associated with the receipt of a utility incentive or other technical assistance, even though the training session may have played a part in the action being taken. However, even with these issues, the study definitively finds that these training programs should not be treated as minor contributors to the California energy saving portfolio.

Fortunately, this study also represents the first of two waves of study. Based on this wave's experience, we expect to refine the process to capture more detailed energy saving numbers, to develop case studies to explore those courses with the largest energy savings, and to explore what elements of the courses contribute to the likelihood that energy saving actions will be taken.