

Changes in Household Energy Use as a Result of the California Energy Crisis

Loren Lutzenhiser, Portland State University, Portland, OR
Rick Kunkle, Washington State University, Olympia, WA
Sylvia Bender, California Energy Commission, Sacramento, CA
Susan Lutzenhiser, Portland State University, Portland, OR

ABSTRACT

From the fall of 2000 through late summer of 2001, the state of California experienced an energy supply crisis on a scale not seen in the United States since the late 1970s. The crisis and its aftermath presented a unique opportunity to gather information about conservation decision-making and the persistence of behavioral change. The research discussed in this paper focuses on how households responded to the California energy crisis. The experience in California suggests that residential consumers are better able to alter their patterns of energy use than had previously been thought. Four findings are of particular importance for understanding changes in household energy demand: (1) households' willingness and abilities to modify their energy consumption, (2) the relationship between behavior changes and hardware changes, (3) the incidence of conservation actions that have rarely been policy targets, and (4) the persistence of changes in energy consumption long after the immediate crisis had passed. Using the results of two phone surveys, one immediately following the crisis and one a year later, we explore these topics and their implications for programs and policies to influence household energy use.

Introduction

Conventional energy policy wisdom treats consumer demand for household energy as relatively inelastic. Behavior change related to energy use is seen as rare and often resisted, with post-conservation "snap-back" to be expected. The implications of this view have included a focus on *price policies* (as motivators) and *hardware programs* (to secure efficiency gains without requiring behavior change). For a variety of reasons, the energy situation in California in 2001 provides a unique research opportunity to critically examine this view.

In response to the 2001 crisis, Californians saved a significant amount of electricity and achieved significant reductions in peak demand. The California Energy Commission (CEC) estimated a demand reduction of over 6,000 MW by October 2001, as a result of a combination of program incentives and voluntary conservation (CEC 2002a). This response was unprecedented. To accomplish it, California consumers showed a greater willingness to reduce their electricity consumption than had been previously believed possible.

In this paper we draw upon research sponsored by the CEC to better understand this household response to the energy crisis. In particular we consider four topics that we believe are important: (1) households' willingness and abilities to modify their energy demands; (2) the relationship between behavior changes and hardware changes; (3) the incidence of conservation actions that have previously been considered "lifestyle threats;" and (4) the persistence of conservation behaviors following the crisis. These topics get at the nature of household response and questions regarding whether or not that response might continue. We also consider the program and policy implications of our research, and briefly describe plans for future research. We begin the paper with some background on the California energy crisis, the study, and its methods.

Background

Beginning in the summer of 2000, California experienced serious energy supply problems, sharp increases in wholesale (and retail) electricity and natural gas prices, and isolated blackouts. In response to the rapidly worsening electricity situation in California in late 2000, a variety of efforts were undertaken to enhance supply, encourage rapid voluntary reductions in demand, and provide incentives for actions that would result in load reductions. Large-scale conservation marketing campaigns accompanied by financial incentives were directed at residential consumers, who also experienced price increases, threats of rolling blackouts, and widespread media coverage of the political turmoil and uncertainty surrounding the energy supply system.

The CEC recognized that the crisis presented a unique opportunity to gather information about conservation decision-making that could ultimately lead to improved policy development, program design and demand forecasting. As a result, the CEC commissioned a detailed evaluation of California consumer response during the summer of 2001 and beyond. That research considered the actions of residential, business, government, and agricultural consumers. Just the residential sector research is reported here.

The data used in this analysis were acquired from California consumers and major utility companies. Two telephone surveys were conducted, one immediately following the crisis and one a year later. The first telephone survey of 1,666 randomly selected residential electricity consumers was conducted during the months of September and October of 2001. The survey sample was stratified by utility territory, with interviews of between 200 and 400 households conducted in each of the five major California utility service territories (Table 1). The smaller utilities were over-sampled in order to allow statistical comparisons with the larger utilities in subsequent analysis. The sampling frame was constructed from utility customer accounts and random phone number samples, assuring that all households in the five utility territories were equally likely to be selected.

Table 1. Completed Telephone Interviews in Each Utility Service Territory

	Wave 1	Wave 2
Southern California Edison Co.	396	192
Pacific Gas & Electric Co.	399	192
San Diego Gas & Electric Co.	411	204
Los Angeles Department of Water and Power	244	106
Sacramento Municipal Utility District	216	98

The second survey was conducted from late October 2002 to early January 2003 of 1482 households participating in the first survey that agreed we could call them back. A total of 792 surveys were completed and 23 were partially completed for a total of 815.

A detailed literature review and construction of an extensive bank of previously tested survey questions provided a basis for developing the phone survey. Many questions were open-ended. For example, we asked respondents whether they had “made any changes in energy use” and, if so, “what those changes were,” rather than eliciting responses from lists of possible conservation actions (and thereby reducing the risks of a “priming” effect that would result in over-reporting of behaviors). We gathered data on a variety of other topics in the same manner, including open-ended questions about

conservation/efficiency actions planned for the future, knowledge of conservation programs, and views of state policies needed to continue the conservation response. The resulting responses from the interviewees' own points of view and in their own words were then categorized and coded for analysis in combination with the pre-coded responses to close-ended questions.

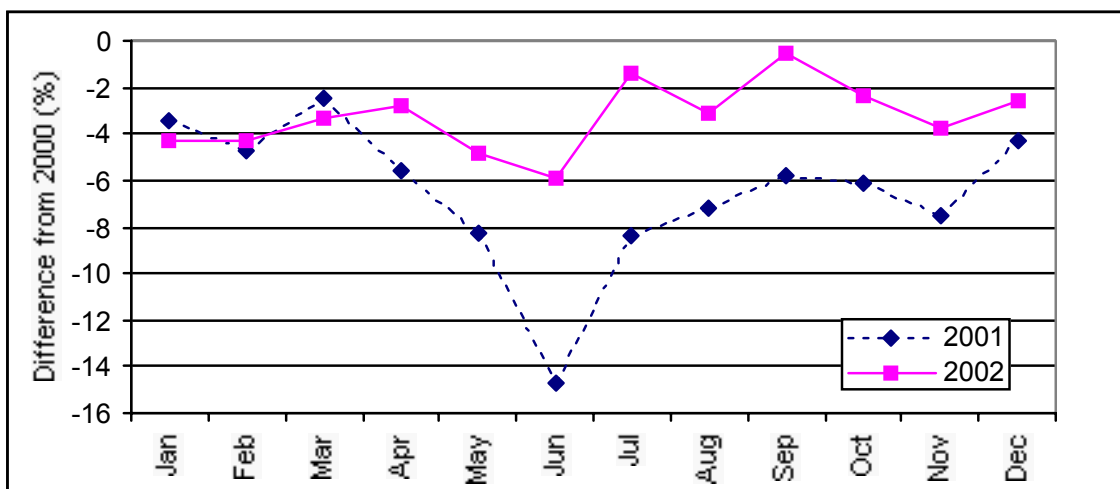
We also collected data on household energy use before, during and after the 2000-2001 crisis episode, along with weather data from key weather stations in the various utility territories. More detailed analysis of these data is underway and is not reported here.

Key Findings

Significant Changes in Demand

During the summer of 2001 changes in energy use that resulted from Californians' concerns and reactions to the energy crisis were striking. In 2001 Californians reduced electricity usage by almost seven percent and peak monthly summer demand by eight to fourteen percent compared to 2000. Figure 1 shows the reduction in monthly energy use for 2001 and 2002 relative to 2000. This is based on recent energy use data from the California Independent System Operator and corrects for the effect of weather and changes in the economy (CEC 2003). In 2002 the reduction is approximately half as much as 2001.

Figure 1. Difference in Monthly Energy Use Relative to 2000 in California



A detailed analysis of household billing data collected as part of this project was conducted to determine if there were significant differences in energy-use behavior during and after the 2001 energy crisis compared to the period before the crisis (Woods 2002). A model was developed that related average household electricity use to weather variables (heating and cooling degree days)—taking the effects of weather, *at the level of the individual household* and in both pre- and post-crisis periods, into account. The results reveal a significant difference in the energy-use behavior in the period during and after the crisis relative to previous behavior.

An analysis conducted by Lawrence Berkeley Laboratory (Goldman, Eto & Barbose 2002) also confirms that the reductions were not caused by either the weather or the downturn in the state's economy, but were due to the efforts of California consumers to reduce electricity consumption. In the following sections we explore the nature of this response and its persistence.

Household Conservation Response in 2001

In our initial survey a majority of the sample reported concerns about the energy situation and expressed a willingness to act to reduce their own consumption. Almost half of the survey respondents said they had been thinking a lot about the effects of the energy situation on their families, while less than 20 percent had been thinking little or not at all about the effects. Almost 80 percent said they had made changes in the way they use energy in the past year. This heightened concern and public awareness about energy was identified by a number of other surveys reporting similar conservation rates (PPIC 2001; Field Poll 2001a, 2001b; E Source 2002).

Consumers gave a wide range of reasons why they changed their energy use, ranging from what we might call *self interest* (keep my energy bill down) to *civic responsibility* (doing my part, avoiding blackouts) and *altruistic motives* (protecting the environment, using energy resources wisely). Many respondents reported holding more than one of these views. Qualifying for a utility rebate was the least common motivation, and available utility rebates were not relevant to most of the actions consumers took. The majority of those that did not take any conservation actions indicated this was because they felt that their energy use was already low.

In the research reported here, respondents who indicated that their energy-using practices had changed in any way as a result of the summer 2001 energy situation were asked to describe those changes in their own words. As noted earlier, rather than providing closed-ended choices, which risk over-reporting of socially desirable actions, we opted for an open-ended format. The resulting responses were coded by multiple analysts (with disagreements among them negotiated) and were ultimately categorized into nearly 100 different types of conservation behaviors. For the purposes of this paper, the results are presented using a collapsed coding scheme with 11 categories (Table 2). The abbreviated variable names in the table (e.g., “Lights,” “Equip Off,” etc.) are used throughout the remainder of our discussion.

More than 70 percent of the households participating in the survey reported taking one or more conservation actions. This is similar to the results of a survey conducted by E Source (2002). Figure 2 shows the percent of conserving households pursuing one or more conservation actions in each category of conservation behavior¹. Using less lighting was the most common response. Thirty-two percent reported using less air conditioning. Other actions that were reported by around 20 percent or more of the households include turning off equipment, using compact fluorescent or low energy bulbs, shifting energy use to off-peak hours, washing or drying clothes or dishes less often, and using the TV or equipment less. Relatively small proportions reported making major energy efficiency investments in their homes or investing in energy efficient appliances, although taken together these hardware installations were not trivial.

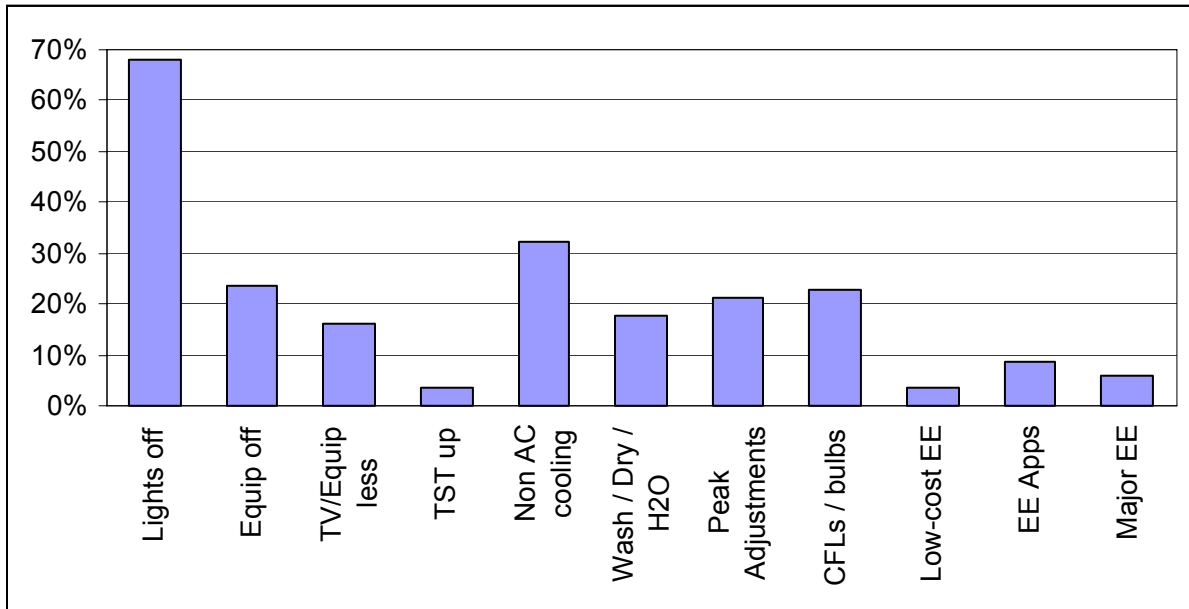
Table 2. Reported Conservation Behaviors

Variable name	Description
Lights	Turn off lights or using fewer lights
Equip Off	Turn off equipment when not in use (including less pool & hot tub use)
Use TV/ Equip Less	Turn off television or watching less television
TST Up	Raised air conditioner thermostat (in many cases to 78 degrees or above)
Non AC	Using the air conditioner less often or not at all
Wash/Dry	Wash or dry clothes or dishes less frequently, using a clothesline instead of

¹ The survey data have been weighted to match the demographic characteristics for each utility and thus reflect the conservation actions one might expect for all households in the five utility service areas.

	the dryer
Peak Adjustments	Used energy during off-peak hours
CFL/Low energy bulbs	Use compact fluorescent bulbs or other energy saving/low-watt bulb
Low-cost EE Improvements	Low cost investments (install fan, plant trees, add awnings, service air conditioner, purchase evaporative cooler, add timers or motion detectors).
EE Apps	Purchase energy-efficient appliances
Major EE Investments	Major investment (whole house fan, solar panels, added insulation, purchase new or energy-efficient air conditioner).

Figure 2. Percent of Conserving Households Reporting Various Conservation Behaviors in 2001



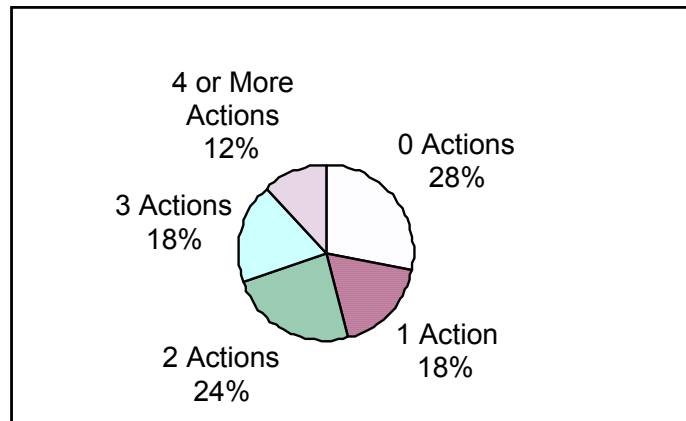
For each reported behavior, the survey respondents were also asked how likely they thought they would be to continue that action in the future, if the then-current (fall 2001) energy conditions were to continue. For all eleven categories of conservation behaviors, three quarters or more indicated they were very likely to continue the behavior. The behaviors most likely not to be continued were “washing and drying dishes or clothes less” and “using the TV or other equipment less,” although only ten percent and eight percent respectively of the people taking these actions gave this response. In addition, almost 60 percent of respondents said taking the conservation action had *no serious effect* on their quality of life, and 18 percent even said that they had experienced an *improvement* in quality of life. These responses suggested that most actions would be likely to continue, at least according to persons’ self estimates at the time. Actual persistence is explored further below using the results of the second survey conducted at the end of 2002.

Clusters of Conservation Actions in 2001 and “Hardware” vs. “Behavioral” Response

The majority of households that took conservation actions reported two or more *different* kinds of actions. Figure 3 shows that the largest share of households (24 percent) reported taking two different conservation actions, and that, in fact, a total of 54 percent reported doing two or more different things to conserve energy. Because more than one sort of action was usually taken by the majority of

conserving households, a logical question is whether some of these tend to be done with others. In particular, we were interested in any possible relationships between actions that involve hardware changes, and therefore financial investments (CFL/Low energy bulbs, low-cost EE improvements, EE Appliances and major EE investments), and those that are primarily behavioral (the first seven actions listed in Table 2).

Figure 3. Distribution of Households by Number of Actions Reported



Behavioral type actions (e.g., turning off lights, unplugging equipment, adopting more conserving thermostat settings, etc.) accounted for over 80 percent of all of the actions taken. This is not surprising, since there is a much greater opportunity for households to make these sorts of changes on short notice. Among the less common actions involving hardware purchases and investments (the final four action categories in Table 2), the installation of CFL/low energy bulbs was the most common. This is hardly surprising, since purchasing and installing new light bulbs is by far the easiest hardware action for households to take. On the other hand, opportunities to make low cost energy efficiency investments, purchase EE appliances, or make major EE improvements to dwellings and systems are quite limited for many households (e.g., persons with low and/or fixed incomes, persons living in apartments, rental homes, etc.).

None of the conservation actions were found to be more likely to be taken alone than in combination with other measures. However, for those households taking only one action, some were more likely than others to be reported – major EE investments, non-AC, lights, and CFL/low energy bulbs. Major EE investments to housing and systems were the most likely action to be done alone (one-action households accounted for 20 percent of the occurrences of these investments). However, major investments were still more likely to be done in combination with other conservation actions.

Several actions were more likely to occur in households reporting three or more different kinds of conservation efforts. These included purchase of EE appliances, low cost EE improvements, using TV/equipment less, washing/drying less, and turning equipment off. Almost 90 percent of all high efficiency appliance purchases occurred in households taking three or more different sorts of conservation actions.

Although correlation analysis provides little evidence that certain types of actions tend to cluster with others, the data reveal that most actions were done in combination. This suggests serious intent among the conserver group, with the choice of *particular* conservation actions depending upon the conditions within the household, as well as the capacity of the household to act. Some measures can be widely adopted (using less lighting), while the potential for adoption may be much more limited for others (e.g., buying an energy-efficient refrigerator). In the former case, the behaviors involved are

easily prompted by advertising and easily accomplished and policed within the household. In the latter case, despite public service appeals and rebates, the ability to act depends upon whether the household owns the existing refrigerator, whether it is a candidate for replacement, whether the resources are available to buy a new one, and whether the consumer can identify an energy-efficient model.

Adoption of Unexpected Conservation Actions

It is important to note that, with the exception of “turning off lights,” the conservation behavior most frequently reported was “non-AC,” which involves either not using air conditioning *at all*, or using it more sparingly. The actual responses in this category included actions such as “draw window shades or curtains during the day,” “turn thermostat off when I’m away,” “don’t use the air conditioner,” “use the air conditioner less often,” “open windows at night,” “open windows in early morning,” and “close off part of home to use less cooling.”

Not only was non-AC use a very commonly reported conservation approach, but is one that may well deliver the greatest energy and peak demand benefits. However, it is an approach that was not seriously recommended by state energy agencies or utility companies in California, even during the height of the 2001 energy crisis.

This is because common wisdom in energy program and policy circles holds that residential cooling demand is largely determined by weather and human thermal needs, with AC systems used to offer desired levels of comfort and convenience. Any significant changes in cooling energy use would, in this view, entail “lifestyle” changes (i.e., lower levels of comfort) that would be strongly resisted by consumers. Residential cooling is, therefore, rarely an energy efficiency target, (with the exception of efforts to improve Federal AC efficiency standards, and rebate programs to encourage homeowners to purchase newer, more efficient units). During the summer of 2001 the most prevalent cooling conservation message was to set AC thermostats at 78 degrees and higher, rather than not to use AC at all. As noted in Figure 2, that behavior was reported in a much smaller fraction of the cases than were the more radical non-AC cooling responses.

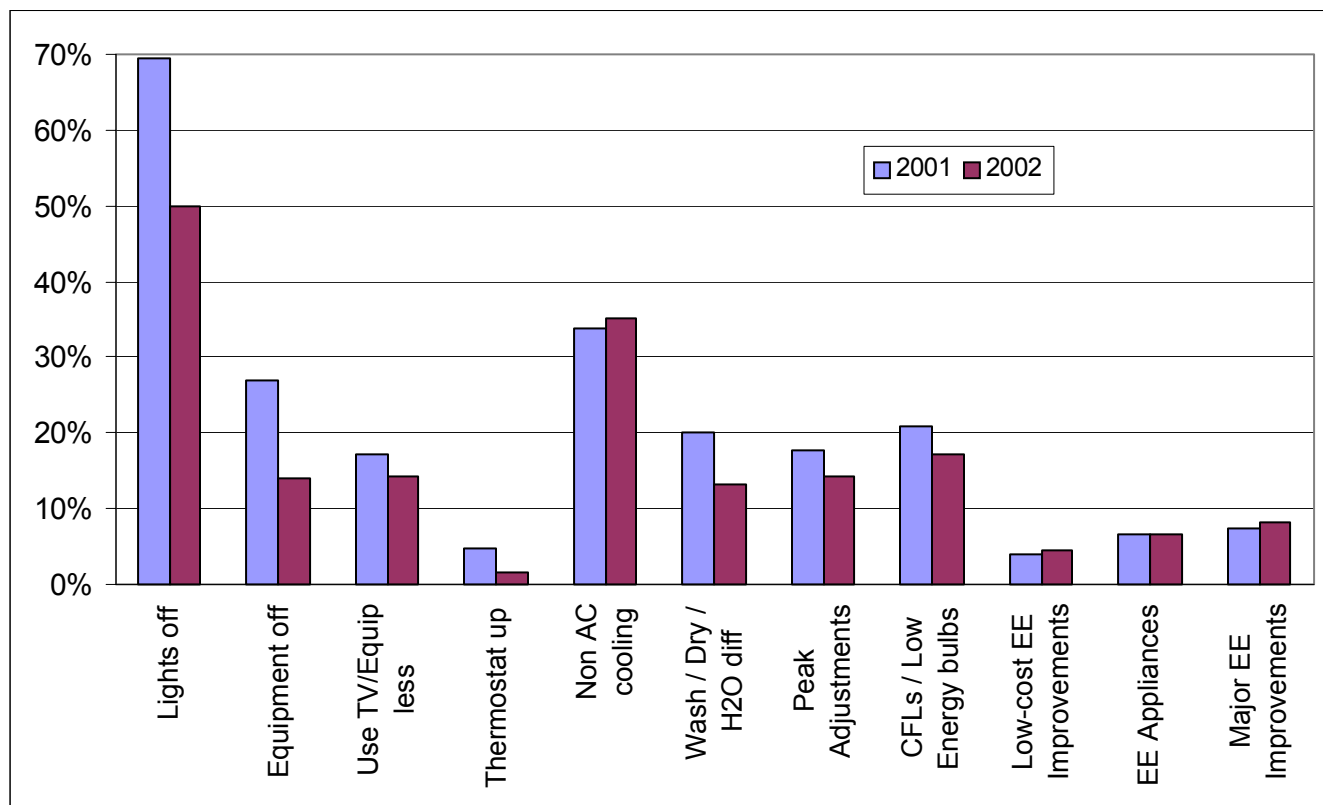
Persistence of Conservation Response in 2002

In our survey in the late fall of 2002 we asked participants questions about conservation actions that they still might be doing, as well as questions about their concerns and attitudes a year after the California energy crisis. We found that 88 percent of the households that had reported taking one or more conservation actions in the summer of 2001 were still pursuing at least one conservation action within the 11 categories of actions. Figure 4 compares the percentage of households that took one or more conservation actions in each category in 2001 and 2002 for those households that were conservers in 2001. There is a drop in the number of actions for all but one of the behavioral-type actions. Those actions declining the most a year after the crisis included raising the thermostat for cooling, which declined more than 70 percent, turning equipment off (declined 54 percent), and washing or drying clothes or dishes less often (declined 42 percent). However, the proportion of households pursuing non-AC cooling strategies in 2001 remained high in 2002 (92 percent). For hardware-type conservation actions there was a modest drop in CFL/low energy bulb purchases (declined 27 percent) and in energy efficient appliance purchases (declined 35 percent), while the reported number of major energy efficiency and low cost energy efficiency improvements were similar in 2001 and 2002.

It is important to note that actions reported by households as continuing in 2002 did not exactly correspond to the actions they reported in 2001. Even though the number of actions reported in 2002 was similar to 2001 for many measures, households sometimes reported a different mix of actions in the two years. For example, for lights (the most common action) 21 percent of the households reporting this

as a continuing action in 2002 did not report it in 2001. Thus, even though 64 percent as many households reported this measure in 2002 as in 2001, 51 percent of the households that reported it in 2001 also reported it in 2002. Since hardware type actions tend to be one-time events, most of the hardware actions reported in 2002 are new actions rather than continuing actions from 2001. Our future analysis will address these issues in more detail.

Figure 4. Percent of Conserving Households Reporting Various Conservation Actions in 2001 & 2002



We also specifically asked the households that reported conservation actions in 2001 if there were actions they were *no longer doing*. About 10 percent of the conserving households identified actions they were no longer taking. Some households reporting conservation measures in 2001 also reported taking new conservation actions in 2002. Twenty-three percent of these households, in fact, reported a total of 236 new conservation actions. Actions to reduce heating use (over 20 percent) and installation of CFLs/low energy bulbs (15 percent) were the most common new actions reported. Nineteen percent of the households responding to the 2002 survey had reported not taking *any* conservation actions in response to the 2001 crisis. The majority of these indicated the reason was their already-low energy use. In the 2002 survey, however, when these households were asked if they had taken any new actions to conserve energy, about a third indicated they had. Primary actions included buying CFLs/low energy bulbs, using less lighting, and installing energy efficient windows (including storm windows).

We asked households in both the 2001 and 2002 surveys “how much have you been thinking about energy problems in the state of California and how they affect you, your family, or friends.” As expected, the level of concern about energy declined, but the change was not dramatic (Table 3). While those saying they were thinking about energy a lot declined from 48 to 31 percent, there was only a very slight increase in the number saying that they were not thinking about energy at all. This suggests that

energy is still an issue for many Californians—a conclusion that is reinforced by responses to a series of attitudinal questions.

Table 3. Degree of Concern about the Energy Situation in 2001 and 2002

	A lot	Some / A Little	Not at All
2001	48%	47%	5%
2002	31%	61%	8%

Consumer attitudes about energy conservation were explored in greater depth in the 2002 survey than they could be in the 2001 survey, which focused more directly on conservation actions and motivations. We wondered if consumers might have become skeptical by 2002 about energy conservation (perhaps prefacing a post-conservation “snap-back”). To the contrary, the responses to the following series of questions (Table 4) seem to indicate that residential consumers in California continue to believe that energy issues are real and that energy conservation is important. In all cases, very large majorities (80 to 93 percent) offer pro-conservation responses that should have significant program and policy implications.

Table 4. Energy Attitudes

<i>I really don't care much about energy and see little reason to conserve.</i>		
Agree: 7.5%	Disagree: 92.4%	No Opinion: 0.1%
<i>Even if I cared about energy, there is not very much any individual can do to conserve that will have much effect in the long run.</i>		
Agree: 19.8%	Disagree: 79.6%	No Opinion: 0.6%
<i>We could all use a lot less energy than we do and if many people conserved, we could all make a big difference overall.</i>		
Agree: 87.7%	Disagree: 10.8%	No Opinion: 1.6%
<i>Regardless of whether it makes a difference, everyone has a moral obligation to do the best they can to conserve energy.</i>		
Agree: 87.7%	Disagree: 11.2%	No Opinion: 1.1%
<i>It makes sense every once in a while to ask citizens to reduce their energy use in order to do their part to avoid blackouts and keep costs down.</i>		
Agree: 92.7%	Disagree: 7.0%	No Opinion: 0.3%
<i>It is worth it to pay MORE for energy in order to NEVER be asked to conserve.</i>		
Agree: 11.5%	Disagree: 88.0%	No Opinion: 0.4%

However, when asked whether their conservation efforts involved real sacrifices (see Table 5), agreement was not nearly as strong. A little over half the households disagreed with this statement. Also, only half believe that increasing energy prices will cause everyone to become a conserver. This suggests both a measure of realism about constraints upon conservation action, as well as skepticism about the potential of price-based policies to produce widespread efficiency effects.

Table 5. Conservation and Sacrifice

<i>My conservation efforts over the last few years have involved real sacrifices.</i>		
Agree: 40.4%	Disagree: 58.6%	No Opinion: 1.0%
<i>As energy prices increase, everyone will become a conserver.</i>		
Agree: 52.2%	Disagree: 47.0%	No Opinion: 0.8%

The persistence of pro-conservation attitudes revealed by these questions seems to have been borne out in action and energy savings. As Figure 1 shows, the residential sector continued to consume less energy a year after the crisis, although savings levels seem to have rebounded. An approximately 50% conservation persistence rate has, in fact, been projected by the CEC in its “middle case” forecast of 2002-2012 electricity demand (CEC 2002b). And, our ongoing billing analysis shows that conservation actions by the surveyed households resulted in significant energy savings, controlling for the effects of other building, technology, weather, and socio-demographic factors that influence energy use.

Discussion and Program/Policy Implications

The findings reported here lead to several important conclusions about the willingness and ability of residential consumers to take conservation action, under both crisis and routine conditions. Our results call the conventional wisdom about electricity demand in the residential sector into question, and open some new avenues to program designers and policy makers.

Because the energy community has seen households as relatively fixed in their demands and an impossibly diffuse target for serious demand reduction, it is unlikely that anyone in California could have predicted the significant system-level reductions in energy use that resulted from the conservation actions of millions of residential consumer households in 2001. A significant advertising effort was mounted to encourage such a response, but at the time its potential was unknown.

Energy forecasting, program planning and policy development all see household sector demands as largely determined by needs, desires, and comfort requirements, which are fixed in building/technology configurations, social lifestyles and individual preferences. We conclude from the significant demand reductions observed, and accompanying evidence of low levels of complaint and “pain” on the part of consumers, that there may be both significant amounts of redundant or wasteful energy use, and therefore many possible conservation opportunities, to be found even in one of the most efficient states in the U.S.

Residential consumption is certainly more diffuse and highly varied than that of commercial, industrial or institutional sectors. And it is widely believed in energy policy circles that residential conservation response is, therefore, less predictable and more difficult to obtain (less policy-tractable)

than are reactions from other sectors. In 2001, however, California consumers showed a higher elasticity in their ability to reduce electricity consumption than would have previously been believed possible. A very high proportion of all households reported taking some conservation action. What's more, the majority of households reported taking several different sorts of action, exhibiting a willingness to respond to the energy crisis with some creativity and flexibility. This suggests that consumers can, under the right circumstances, react in a serious and concerted fashion. Even relatively small marginal energy saving effects, across the entire household sector, can combine to produce significant system-level effects.

Conventional wisdom also assumes that the most effective conservation actions are hardware-based—improvements to appliances, household technologies and building envelopes that provide long-lasting, measurable effects. The efforts by state agencies and California utilities in 2001 to encourage more rapid uptake of efficiency technologies offered messages that built upon long-standing public education efforts targeted at residential consumers. Hardware solutions were, in fact, heavily promoted in California both during and after the 2001 crisis period. The demand reductions observed, however, were largely due to changes in behavior, rather than the purchase of more efficient appliances and household technologies. This was because the hardware response is severely constrained by household capacity and conditions. In addition, the immediacy of the need for a conservation response dictated that it would necessarily be a behavioral one (even when combined with hardware purchases).

The largest portion of conservation actions taken also involved behavior changes that can be widely adopted by many households. While some actions (e.g., turning off a few lights) may have had limited impact, others (e.g., reducing air conditioning use), likely had significant effects. Making energy efficiency improvements to homes or buying more energy efficient appliances or products accounted for less than 20 percent of all actions taken. Opportunities to take these types of actions are limited and can be very time dependent (e.g. when a household is buying a new appliance or remodeling). So when developing energy policies and programs to reduce energy use, it is important to recognize that efforts should be made to influence and motivate households to take both hardware actions and behavior changes where each is appropriate.

Common wisdom in the energy system has put certain conservation targets “off limits” on the grounds that they require unacceptable “lifestyle” change that will be strongly resisted by consumers. As a result, requests for aggressive conservation (e.g., non-AC use) are seen to hold significant peril for policy-makers and program-designers, even under “crisis” conditions. Images of President Carter calling for sacrifice are invoked, and followed by the common political wisdom that his calls for “extreme” conservation contributed to his reelection loss in 1980.

In California in 2001, however, the changes in behavior observed were often beyond those requested and were more significant than had been imagined by state officials— and these often included changes with “lifestyle” implications. Official calls for action and advertising messages requested “care” in energy use and a modest conservation response (e.g., “don’t leave the house with the computer on,” “turn off a light”). There were no messages asking residential consumers to curtail their air conditioning use or to do more with cooling than to increase AC thermostat setting levels or to appreciate the possible benefits of fans. Residential consumers who took conservation seriously (at least 1/3 of conserver households) seem to have drawn upon their common sense experience, realizing that air conditioning was the largest energy use under their control, and by choosing not to use AC, they could have large effects on their energy demands. The striking finding that few of these consumers experienced significant discomfort and negative lifestyle impacts, suggests that *comfort* itself is likely to be more elastic than imagined (Hungerford 2003). While this may be mostly true of households with particular housing and landscaping characteristics (something that our continuing analysis is considering), it is still an important and surprising finding with a variety of implications for conservation

program design (e.g., regarding retrofits, non-AC cooling technologies, rethinking building design and new construction efficiency incentives).

Despite the relative “permanence” of hardware efficiency improvements, energy program evaluators have often noted “take-back” or “snap-back” effects following energy efficiency product adoption, where new forms of consumption erode program gains. Common wisdom has it that behavioral changes would be at least as likely to have “snap-back” effects, being quickly abandoned after a crisis had passed. However, our research has found a surprising persistence of self-reported conservation actions long after the energy crisis had passed and news coverage of energy issues faded.

In the 2001 survey, a large majority of the households indicated they planned to continue the conservation actions they were taking. The results of the 2002 survey suggest that they are continuing to do many of these actions, although the mix of actions taken by each household changed in many cases. We expected conservation actions involving new appliances or other energy efficiency improvements (hardware changes) to have persisted. But the majority of respondents also reported that they were still taking a number of behavioral actions. In particular, reduced use of air conditioning remained a common practice. This suggests that behavioral conservation may be longer lasting than is commonly believed.

We find this persistence of conservation behavior to be quite reasonable, given persons’ positive conservation experiences and their ethical commitments. Subsequent energy price increases (but applied quite unevenly across the state and within the residential rate class) are also likely to have had a reinforcing effect. Concerns about energy have declined since the energy crisis in 2001, but a significant number of households are still paying attention to energy, and a large majority expressed favorable attitudes about the value and need for energy conservation. Rather than causing people to become skeptical about energy conservation, the experience of 2001 may well have reinforced its importance.

Of course, we don’t know how seriously people are pursuing the actions they report. We learned that many households say that they still take energy seriously. If so, that would tend to reinforce behavior. But there is much more we need to learn about the persistence of particular actions and how they can be intentionally reinforced. We are interested in the motivation of households to continue particular actions, the influence of programs on that persistence, and the link between self-reported behavior and household energy use. Our ongoing research addresses at least some of these questions.

Ongoing Research

The research reported in this paper is part of an ongoing effort to learn from the experiences of the 2001 energy crisis. As noted, we have collected information using two surveys at different points in time, as well as household electricity billing data from a sample of households. This provides a rich data set to explore household energy behavior and household energy use. Research in progress includes:

- Modeling of household groups and conservation response, including clusters and groupings of conservation actions,
- Comparing 2001 and 2002 survey results to evaluate the likely persistence of particular conservation actions, as well as considering the nature of the actions taken and their effects on consumption,
- Examining possible blackout, price and media effects, as well as possible geographic clustering and neighborhood effects,
- Comparative analyses of conservation actions and effects across utilities

In this paper, we have presented some initial research results that suggest that a large majority of households took action to reduce their energy use in response to the 2001 energy crisis and that a large portion of these actions are continuing. Our ongoing research will elaborate these findings and explore their significance. We believe this research will improve our understanding of household energy behavior and identify opportunities for encouraging widespread changes in energy use.

References

- CEC (California Energy Commission). 2002a. *The Summer 2001 Conservation Report*. Sacramento, CA: California Energy Commission.
- CEC (California Energy Commission). 2002b. *2002-2012 Electricity Outlook*. Sacramento, CA: California Energy Commission.
- CEC (California Energy Commission). 2003. *Revised Energy Conservation Impact Assessment*. Sacramento, CA: California Energy Commission.
- E Source. 2002. *California Energy Efficiency in 2001: Customer Actions and Perceptions*. Boulder, CO: E Source.
- Field Poll. 2001a. "While Californians Believe Electricity Problems Are Serious, They See Them More as an Attempt to Increase Rates Than Due to a Real Shortage." San Francisco: The Field Institute. Poll Release #1992 (1/18/01)
<http://field.com/fieldpollonline/subscribers/Release1992.pdf>
- Field Poll. 2001b. "Residents' Reaction to California's Energy Crisis." San Francisco: The Field Institute. Poll Release #2000 (5/22/01)
<http://field.com/fieldpollonline/subscribers/Release2000.pdf>
- Goldman, C., J. Eto and G. Barbose. 2002. *California Customer Load Reductions During the Electricity Crisis: Did They Help to Keep the Lights On?*. LBNL 49733, Berkeley, CA: Lawrence Berkeley National Laboratory.
- Hungerford, D. 2003. Personal communication regarding results of work in progress on comfort and cooling in California residences.
- PPIC. 2001. PPIC California State-wide Survey: Californians and Their Government. San Francisco: Public Policy Institute of California. Jan. 2001.
http://www.ppic.org/content/pubs/S_101MBS.pdf
- Woods, J. 2002. *Exploring Changes in Household Consumption as a Result of the 2001 California Energy Crisis and Related Energy Conservation Policies and Programs, With Measured Controls for Weather Effects*. Washington State University: Research Report to the California Energy Commission.

