Consumer Conservation, Demand-Reduction and Fuel-Switching Behaviors among Agriculturists in California, Summer 2001

Robert A. McBride, University of California, Davis
Kathleen A. Bagby, University of Idaho
Loren Lutzenhiser, Washington State University
Ricardo Amon, California Energy Commission

ABSTRACT

Twenty agriculturists from diverse sectors of California's agricultural community were interviewed regarding their understandings of energy use and their behavioral responses to the state's energy crisis of 2000 and 2001. Specifically, their perspectives and reported actions are examined in respect to energy efficiency incentives, such as the California Energy Commission's peak load reduction program. Interview participants' experiences reflect responses to several key motivators of behavioral change, including: supply uncertainty, price increases, messages about energy efficiency, and program interventions.

Introduction and Scope

The purpose of this research is to improve our understanding of how agricultural consumers perceived and reacted to four key motivators of behavior change during 2001: informational messages and appeals, program interventions, price or rate changes, and the perceived uncertainty of electricity supply (including blackouts and threats of blackouts). In many ways, the summer of 2001 represents a "natural experiment" during which consumers were exposed to a variety of differing messages, price signals, incentives and experiences that might singly, or in combination, be expected to result in changes in attitudes, capabilities, habits, and ultimately energy use behavior. Specifically, this research explores how and why selected agricultural firms did (or did not) choose to employ peak load reduction technologies and behaviors, and in particular to participate (or not) in the California Energy Commission's (CEC) agricultural peak load reduction rebate/grant program. The study explores possible reasons for lower than expected participation rates in that program, and offers some insights into the decision-making of potential program participants as they attempted to respond to the energy conditions of 2001.

In April 2001, California enacted legislation in response to an imbalance in energy supply and demand in the state (CEC 2001). California Senate Bill 1X 5 (SB 1X 5), which included an agricultural component, called for significant reduction of electricity demand during peak consumption periods. Acting on SB 1X 5, the California Energy Commission, which administers demand-side energy efficiency (EE) programs, established the Agricultural Peak Load Reduction Program. The program provides grants and rebates to agricultural consumers as incentive to take conservation actions to reduce peak period use,[1] such as installing energy efficient equipment. There are four categories of eligible incentive

[1] The CEC program defines "peak period" usage as occurring "weekdays, excluding holidays from 12:00 p.m. to 6:00 p.m. during the months of June through September" (CEC 2001).

projects, summarized in Table 1. None of agriculturists we interviewed had experience with the latter two program categories, so this report focuses primarily on the first two—high efficiency equipment and pump testing, retrofit and/or repair.

Table 1. Agricultural Peak Load Reduction Program Categories

Program Focus	Incentive type	Requirements	Examples
1. High efficiency electrical equipment or other electricity conservation efforts	65% grant payments[2] for engineering, equipment purchase/installation, equipment testing, or software for control systems	Must reduce peak period electricity demand	Cool and cold-storage refrigeration equipment, irrigation system equipment/management
2. Pump efficiency testing and retrofit/repair	80% grant for certified testing; 65% for repair, retrofit, and replacement	Must reduce kilowatt-hour usage	Deep well pump and electric motor repairs or replacement with high efficiency models, restoring wells
3. Advanced metering and telemetry (sensors and remote control equipment)	65% grant payments for purchase and installation of advanced metering or telemetry equipment to monitor/manage usage	Must verify peak period load reduction, or participate in another voluntary demand reduction program	Time-of-use electric meters, sensors and telecom equipment to report readings
4. Retrofit of natural gas-powered equipment to alternative fuels	65% grant payments to replace/retrofit equipment to reduce demand for natural gas	Switch to legal fuels other than unmodified diesel, gasoline, or natural gas	Food and fiber dryers, boilers and furnaces, electric generation

Source: Adapted from CEC Agricultural Peak Load Reduction Program, Program Description (2001)

The data presented here are from in-depth, open-ended telephone interviews with key informants working in diverse sectors of agriculture in California. The research was conducted as part of a larger study of consumer response to the 2000-2001 California energy crisis (Lutzenhiser et al. 2002). The analysis reports some important variations in how California agriculturists understand energy use, what their behavioral responses have been, how they see and evaluate longer-term efficiency investment options, and what their exposure has been to the various motivators of behavior change (programs, prices, messages, blackouts, etc.). In particular, awareness of and responses to the CEC Peak Load Reduction Program are examined. Findings include a brief discussion of policy implications. The report concludes with general recommendations for future research.

Sample and Methods

Individual telephone interviews were conducted with 19 key informants working in diverse sectors of agriculture in California. Interview participants were selected through a purposive sampling method, chosen to represent the diverse range of agricultural businesses

[2] Grant payments can cover up to 65% of project costs, based on a calculation of N$/kW multiplied by the number of actual peak kiloWatts reduced.

that are eligible for participation in the CEC rebate program. Eligible applicants include agricultural producers and the following business types (CEC 2001):

- Water agencies and irrigation districts that serve agricultural users
- Confined animal feeding operations
- Greenhouses and nurseries
- Processors/handlers for agricultural commodities
- Cold storage or refrigerated warehouses for agricultural commodities
- Agricultural and commodity non-profit organizations serving agricultural customers

Informants represented a variety of firm sizes and types, as well as a range of awareness and participation in the CEC rebate program (see Table 2). Informants were identified through a CEC peak load reduction rebate program database, the Dun and Bradstreet Million Dollar Index, and personal contact. Subjects are located in the San Joaquin River, Tulare Basin, Sacramento River, and Salinas River watersheds. The interviews lasted approximately 30 minutes, and most were conducted in October and November of 2001. In addition, existing data from trade publications and an earlier program consultant's report were analyzed for content. This mix of subjects represents the major crops and agricultural specialties that consume electricity in California's agriculture industry, as well as representing a majority of the agricultural regions.

Table 2. In-Depth Interview Subjects and their Conservation Actions (n=20)

Type of operation by size	Conducted or planned pump test	Reduced or planned to reduce peak load	Evidenced knowledge of CEC programs
Small			
Nut orchard, 160-acre, 2 brothers			
Electric motor repair shop owner	N.A.	**X**	
Nut orchard, 40 acres	**X**	**X**	
Small dairy farmer, USBR water			
Foothill vineyard, retiree	**X**		**X**
Foothill hobby ranch, horses	**X**		
Consultant dairy VSD retrofits		**X**	
Medium			
Citrus and nut rancher, 500 acres	**X**	**X**	
Dryland ranch, cow-calf operation	**X**		
Large			
Water manager, large cotton grower	**X**		
Nursery greenhouse heating (gas)*	Unknown	Unknown	Unknown
Harvester & wholesaler, vegetable crops		**X**	
Frozen food process engineer	N. A.	**X**	
Water and power district manager	**X**	**X**	**X**
Public sector			
CEC PL reduction program manager	N. A.		**X**
Conservation District Manager			**X**
Other informants			
Utility district representative	N. A.		
Researcher, son of retired farmer	N. A.		
University post-harvest expert	N. A.		
University irrigation specialist	N. A.		

*data drawn from trade publication

In-depth interviews were employed to provide a more complete exploration of beliefs, attitudes and intentions leading to actions among some likely candidates for program participation. Open-ended questions allow the story to be told in the words of the respondent, unconstrained by the preconceived response categories of survey instruments. Respondents were asked the following general questions:

1. Please describe your organization/agricultural operation.
2. How has the current energy crisis affected your business?
3. What actions have you taken in response to the energy situation? (If action taken, proceed to questions 4-9. If no action taken, proceed to questions 10-13)
4. How did you find out about each alternative?
5. Who was involved in the choice of each action?
6. Why was each action selected?
7. How did you learn about the California Energy Commission Peak Load Program?
8. How important has the peak load program been in your overall energy actions?
9. Would you recommend participation in the program to others?
10. Have you heard of any programs to encourage energy consumption reduction?
11. Have you considered participating in any of them?
12. Why did you choose not to do so?

The interview script was adapted according to the knowledge and experience of the respondent. Different interview participants could speak to different components of the agricultural sector and energy-related decisions. Data were analyzed for both content and tacit meaning through an inductive method, identifying both the central tendencies and the *range* of interview responses (Glaser and Strauss 1967).

Our selection of participants does favor those willing and able to dedicate thirty minutes to an unpaid activity. Additionally, sampling from a database of e-mail users suggests overrepresentation of those with computer/internet access. However, each of the individuals who were contacted by means other than email (phone or in person) mentioned web sites among their sources of program information. Finally, with non-random sampling, respondents may not typify practitioners in the agricultural sectors they are chosen to represent. The respondent may experience greater-than-average impacts from the energy situation, may self-identify as an industry spokesperson, may be more articulate, may be doing a good deed for agriculture by sending a message to the Government, or may simply have more free time. In each of these cases, selection bias is toward likely program participants—the subject of this research.

Data provided here cannot be generalized beyond the individuals interviewed. [3] The purpose of this exploratory assessment was to highlight a range of perspectives, experiences, and actions related to the energy crisis of 2001 among agriculturists in the state—not to produce a representative sample of California agricultural energy users.

[3] In a sample this small, covering such a broad range of topics, reporting percentages of how many individuals made comments about any one topic holds little analytic meaning. Thus findings are presented in non-interval phrases, such as "a few," "most," or "many."

Findings

Key findings of the assessment are arranged around 3 topic areas: (1) behavioral responses to the energy situation of 2001; (2) understandings of energy use, motivations for change, and perspectives on investment in long-term efficiency measures; and (3) factors influencing communication of program purpose and benefits, and encouraging enlistment (delivery systems). Each of these is analyzed, where applicable, in relation to four key motivators of behavior change: program interventions, prices, education and media messages, and external events such as blackouts. Specific interview comments are labeled by size of firm as small (S), medium (M), large (L), or service/public sector (PS).

A wide variety of constraints (which are not considered in detail here) also influenced conservation actions, understandings and program participation. These larger contexts of decision-making both establish the real life conditions "on the ground" for agriculturists, and increase the risks involved in their conservation and efficiency actions. Here we have in mind such things as: the sorts of crops being grown, the timing of interventions (and in this case the crisis) within the cropping cycle, long lead times needed for crop planning and equipment replacement and maintenance, depressed and increasingly uncertain commodity prices in global markets, industry debt structure and availability of capital, and so forth. All of these factors combine to form a complex background for agricultural energy choices—and in the process condition and constrain the behaviors, understandings/motivations, and program effects discussed in this paper.

Behavioral Responses

Increases in energy prices had significant impacts on the farms and firms of most interview respondents. Nearly all took action to reduce their energy costs, including switching to alternative energy sources—primarily diesel—and moving activities to off-peak times.

Impacts of 2001 energy situation. Nearly all agriculturists interviewed felt the impacts of the 2001 energy situation. About half said their electric bill increased 30% to 50% and, for a couple of the large and medium sized operations, prices doubled. The dryland cow-calf rancher (M) commented: “It has doubled the bills. Even though it is not a big percentage of our deal, it was a sizeable increase. Our bills were around $800 to $1000 per month and now they are up to $1700.” Energy-intensive operations such as greenhouses and frozen foods appear to have been affected the most by increased prices. For example, the frozen food engineer (L) said the spike in the cost of power “Almost killed it,” [the business]. In early 2000, a nursery greenhouse operation featured in a trade publication was paying just over 20 cents a therm to supplier Texas-Ohio Energy. In September 2000, Texas-Ohio left California and the nursery came under a new contract with Enron. That month rates jumped to 63 cents a therm, and again in December to $1.47 a therm. “The cost will have to be passed on. We’ve never had anything like this. This isn’t absorbable,” the manager said. “We’re selling plants at the same price we were getting 20 years ago.” Energy price hikes were a significant concern for nearly all respondents interviewed.

Behavioral change. Some respondents took action to protect their products from being impacted by blackouts. The vegetable post-harvest manager (L) said, "We redesigned some of our power systems to accommodate generator power, should we need to get to that point. And we have actually put in place some generators in a couple of key critical areas." All but two private sector agriculturists interviewed had taken, or planned to take, action to replace existing or install new diesel capacity, either for a back-up power source, or (for several) as their primary energy source.

Since the spike in energy prices, respondents have tracked the relative prices of diesel fuel and electricity, considered in light of efficiency and the nature of their individual systems. Diesel-generated power is reported by several respondents to cost less than equivalent electric power, whether existing or new. Much agricultural equipment, whether on field or in a processing or storage plant, has an electric motor with a diesel backup. Several years of low diesel prices have strengthened the economic incentive for respondents to buy new diesel generators. In addition, recent program interventions have offered incentives for replacing old diesel backup generators with new ones that are cleaner and more efficient. Several of the respondents had replaced diesel generators through assistance provided under an earlier program, the Moyer program (AB1571).

In the past, the old diesels were used primarily during power failures. However, many respondents are now using the newly installed diesel generators to provide peak power regularly, allowing agricultural firms to cut energy costs. Some report going entirely "off the grid", and others report using diesel to supply electricity for hours "blacked out" according to the (interruptible) agricultural electric rate tariff they chose. For example, the frozen food facility (L) used a diesel engine during the 2001 peak periods that had not been in regular operation for over a decade. The water and power district manager (L) indicated that the district had diversified its power supply to guard against the higher gas prices and random costs of energy production. He indicated that "we have also kept away from being interconnected into the grid in California." The small horse rancher (S) is also using alternative energy sources. He installed a solar power system using the ongoing CEC alternative energy rebate program (separate from the program under study). Higher energy costs and the conversion to diesel appear to have had significant impacts on the proprietor of the electric contracting and electric motor repair shop that serves agricultural clients (S). He commented that business had been greater than normal over the fall and winter of 2000-01, but has slowed significantly since February 2001.

Many respondents appear to be serious about avoiding as much peak-time electricity usage as they can, by whatever means are available They have changed their operating schedules to take advantage of lower energy costs during off-peak hours. About half of the respondents from private enterprises said they had shifted at least some activities to off-peak. For example, the vegetable post-harvest manager (L) related,

> We have changed work schedules so that we have less of a power draw during peak times of the day. Our employees basically moved their work schedules around by 12 hours in our plants. All the plants start at 7 p.m. Our primary operations work on off-peak. We did that all season long. When we transplanted, we changed some harvesting hours to earlier in the morning to accommodate some of the farm pumping.

The frozen food facility (L) took similar action and shifted work schedules.

The energy saving benefits of improving irrigation systems and equipment can be significant. As the Resource Conservation District manager (PS) describes,

> The Resource Conservation District sends its team out to help farmers plan more efficient irrigation systems. The program works very well among smaller organizations, but has a two-year backlog of clients signed up. We do a lot of testing of irrigation systems and recommend practices that improve irrigation, which in turn reduces energy consumption. In our area, everything is pumped from groundwater resources, so we test pumps for efficiency. There is quite a substantial amount of energy reduction [available] by improving the pumping systems.

Surprisingly, only one respondent, the 40-acre nut farmer (S), reported taking actions in 2000 and 2001 to monitor or improve the efficiency of their irrigation systems. He relates,

> Well, what I did personally, was that I tried to manage. I have put sensors in my orchard. I have tried to read my profile of what moisture is available to my crop. It is pretty much a guess, but it is an educated guess. We are using watermark sensors.

About half of the private-sector respondents were in the process of having their electric pumps tested for efficiency. Since deep-well pumps are in continuous use over long periods during the growing season, they need to be replaced every 10 to 12 years. In any given year, an operation may be repairing or replacing pumps. In a lean year for an individual or organization – considering yield, costs, and commodity price – they may tend to choose to repair equipment, while in a prosperous year they may replace it. Programs that offer assistance with pump retrofitting and replacement are likely to have significant participation, as they are compatible with agriculturists' needs (see Rogers 1983 work on agricultural diffusion of innovation). Among the categories of the CEC peak load reduction program in Table 1, pump testing, repair and retrofitting has had the greatest participation. The program resembles a popular ongoing program of free pump testing that Pacific Gas and Electric (PG&E) discontinued a few years ago. Familiarity, compatibility with needs, and a 'fast-track' application procedure for pump tests may be contributors to higher participation over the other program categories.

In sum, interview respondents indicated that they have been impacted by the spike in energy prices. All respondents that pump groundwater with electric motors are either converting to diesel or ensuring efficiency in their electric pumps (or both), if they hadn't already done so over the past five years. Several report now using diesel power as a peak power supply. While the new diesel engines are cleaner than the old, increased diesel use in general has negative implications for air quality. One person, the horse rancher (S), converted to a cleaner source, solar power. Two of the larger firms have taken actions to move activities to off-peak hours.

Understandings of Energy Use and Motivations for Change

Interview respondents described a variety of factors that motivated and shaped their behavioral responses to the 2001 energy conditions. Of key importance were product yields, energy prices, environmental concerns, and program incentives.

Maintaining or improving product quality and yields. All private sector respondents explained their motivations for action in terms of protecting and improving product quality, increasing yields, and increasing water supply. For example, the Resource Conservation District manager (PS) commented that most of their clients improve their irrigation systems to get better yields. Deficit irrigation was adopted on the citrus farm (M) to improve the value of the product. Soil moisture sensors and a new irrigation-scheduling regimen were adopted by a nut farmer (S) to extend the acreage he could irrigate with his existing wells. In addition, he planned to repair and improve his pumping equipment on existing wells so that water yield would increase and extend his irrigated acreage. The post-harvest vegetable manager (L) described his decision-making in terms of protecting product margins in the event of a power loss: "What is the biggest loss that we could incur? What takes the most time to get back to normal? …Loss of [profit] margin on the product more than anything else."

Energy prices and energy costs. Most respondents highlighted increased electricity prices as the threat to maintaining or improving product quality or quantity that motivated changing their energy use practices during 2000 and 2001. For some, price is a motivator to look for ways to cut back on use and other expenditures. For example, the dryland cow-calf rancher's (M) energy bills doubled. He commented, "We have been fairly frugal with our use anyway, so it is not like we are wasting a lot and have so much to cut back." He indicated that he had thought about how to reduce energy usage through lifestyle changes, but he did not mention peak demand-reduction as a means toward savings. His comments suggest that he understands energy use and savings in terms of *overall consumption*, rather than changing the *source* or *timing* of energy consumption.

For a number of the agriculturists interviewed, the case for conversion to diesel as an alternative fuel has shifted. Diesel generators have been used for years in this sector as a way to provide power where electricity is not available and as a back up for power outages to protect their commodity. In addition, from 1999 through 2000, diesels were subsidized through California's Moyer program to cover the need for backup power, in case of extended blackouts. As electricity prices rose and diesel fuel prices stayed relatively stable, an added motivation for buying diesels became lowering long-term costs. For interview respondents, the prices of alternative sources of energy, including utility service, are compared against the long-term cost of diesel fuel. Power from diesel fuel is reported by several to be less expensive than equivalent grid-supplied electric power. In addition, old diesel engines need to be replaced due to emissions requirements and wear. The respondent from the 160-acre nut partnership (S) explains his motivations for diesel upgrades:

> Fuel economy, and the other engines were getting on towards the end of their life. The realization that air rules are going to get more stringent, it looked like a good opportunity to upgrade. We knew we had engines that were probably in excess of 20,000 hours in 15 years, so it was time to do something. This [program] came along at an opportune time.

Several respondents are now using diesel-generated power in their regular day-to-day operations. While cost is the primary motivator, a few respondents related that the implications of diesel use are more complex than simple economic savings. For example, the dairyman (S) expressed concern about the impacts on air quality:

> What I am more worried about—and it just fries me—is that I had to convert these deep-water electrical systems to diesel systems. This goes clear back to the 1980s when a lot of people were doing it. I maintained from day one that it is ridiculous to have these power lines running right over our pumps and I can put in a diesel engine and it's cheaper. It costs about 50% and dirties up the atmosphere. Somebody's got their head where they shouldn't have it, letting those rates for ag wells be so high that we sit here and we burn diesel and we pour smoke into the valley. It is a sick political situation and I hope somebody hears that somewhere.

Another respondent, the cotton water manager (L), added additional irrigation wells to maintain the water supply to irrigate crops already in the ground. He anticipated that their water supply would be reduced due to the lower than normal surface water deliveries typical of a dry year. After analyzing costs of using the electric utility and diesel as an alternative, he opted for diesel even though his "first choice was using electricity." He expressed misgivings about the public and private sectors representing the use of diesel electricity generation for peak load reduction as a means of "conservation:"

> I feel that changing from an electric motor to either generators or diesel power is a game. You are not saving any energy, you are changing the form of energy. I am a strong believer that we can build efficient power plants. But what we have done is build little inefficient power plants all over the place in exchange for building centralized more efficient power plants. And then the political people or the people in the industry say, "Look at all the energy we have conserved" when we haven't conserved, we have just gone to a different form or source.

Energy savings were also important considerations for those who chose alternatives other than diesel. For example, the horse rancher (S) explained his reasoning for installing solar power through the CEC rebate program: "Basically looking at what our net costs would be and figuring that we could pay for it in about 10 years based on how much power we could generate." This respondent is also examining long-term *non-economic* impacts. A quote from his web site indicates that an important consideration in his decision-making was energy conservation:[4]

> The estimated life of the system is more than 25 years. We hope that what we are doing will (1) pay for itself in a reasonable period of time, (2) be some small help to alleviate California's power problems and our country's dependence on oil, and (3) encourage others to do the same.

Price and energy savings are also considerations for the consultant to small dairies (S). The primary selling point for his customers to add variable speed and vacuum control to milking systems is energy savings. In addition, the carefully regulated vacuum system has benefits for herd health. The frozen foods engineer/manager (L) said his business took several actions, including shifting labor and energy-intensive activities to off-peak times, in order to stay in business through the energy price spike.

Program intervention. A third motivator of behavioral change, program intervention, was a consideration for some agriculturists interviewed. In most of the stories related, it seems that

[4] The URL of the horse rancher's web site is not provided here in order to protect respondent confidentiality.

a program opportunity was an event that "tipped the scale" toward a particular course of action. For example, the 500 acre citrus and nut farmer (M) explained that the CEC pump retrofit and replacement program made pump repair a viable alternative:

> My understanding is…that it is a pretty good program. …I may have a pump repair that may not make any sense to do at this time. Let's say I have a pump running at 55% efficiency. I might put that off a year or two, *but with this program, the math changes* [emphasis added].

Similarly, the horse rancher (S) said of the CEC solar rebate, "We never would have done it without the buy-down program. We could pay it off within the next 10 years." The consultant to family dairies (S), who was installing variable speed controls as a means of energy saving and vacuum control, used the local water and power district assistance program, and said it was essential to his success. The Resource Conservation District manager sees programs as a means to encourage energy-saving actions that might otherwise not be considered cost-effective to the individual agriculturist:

> I personally write a lot of grants for our district and some of it for cost-sharing installations incentives for beneficial practices. …If we cost-share, it might provide an incentive for them to install these practices—where the benefits are not clear for the individual, but the great greater public or downstream users would benefit.

While some looked for program opportunities to help define their actions—the frozen food engineer/manager (L) scans public sources for funds available while in the early stages of design and waits on planning details until he knows the program requirements—others made energy decisions and then looked for funds to pay for them. The vegetable post-harvest process manager (L) explained that when making decisions about energy use, actions must first have their own justification by improving the margin on the product. Then he looks for any assistance available to help him make a change that he is already committed to.

In summary, reducing the cost of energy required to maintain or improve product quality or quantity was the primary motivator of behavioral change regarding energy use for interview respondents. Conservation and environmental protection were considerations in decisions about energy use for a few respondents. Interestingly, those who spoke most forcefully about environmental impacts elected to use diesel as their best available option, despite their misgivings about emissions and fuel consumption. Finally, for some respondents, program intervention may be a motivator of change that "tips the scale" toward a particular behavior change.

Delivery Systems

Interviews with agriculturists illustrated that while prices, earnings through yields, and program opportunities were important motivators of behavior change, messages and systems of delivering energy efficiency alternatives were what ultimately *facilitated* or *prevented* participation in particular rebate programs. Several elements in delivery systems influence the effectiveness of messages about energy efficiency programs. These include: familiarity with the type of program, avenues of communication, program complexity, and rapport among change agents and opinion leaders.

Familiarity. First, several interview comments indicated that the pump retrofitting and repair program had higher participation because respondents had experience with similar programs. By "familiarity" we mean a level of acquaintance with the basic idea of the program that is sufficient to allow potential participants to believe that it is worth their time and trouble to take advantage of its offerings. For example, the citrus and nut farmer (M), who participated in the 2001 CEC peak load reduction program commented that he has been hearing of programs like this for over a decade: "In 1990 I put in my first low volume system in Madera; it was micro-jets with the California Energy Commission Low Interest Loan…It was very helpful." Other clients knew of, or had participated in, a similar but discontinued pump test program formerly run by Pacific Gas & Electric, and commented that the CEC program had "replaced" the PG&E program.

Avenues of communication. Secondly, an important element of the delivery system is the avenues through which potential clients receive information about opportunities and innovations. Among the agriculturists interviewed, large enterprises learned of utility rebates from one-on-one interaction with their utility representatives. The frozen foods engineer (L) commented, "We are on a first name basis with the utility company rep. We are pretty well kept aware of what is available and what is not. We have kept up with the California Energy Commission programs." In addition to the utility representatives, he uses the County Farm Bureau, the California League of Fruit Processors, and members of national frozen food commodity groups as information resources. He also accesses high speed Internet to research the public programs and agricultural industry sites. The post-harvest manager (L) described a similar avenue to access information: "We draw upon own power representative from PG&E. We drew on some of our own internal experts on power distribution systems."

Small and medium sized operations tended to learn about energy efficiency programs through paper sources, such as newspapers and agricultural newsletters. Several subjects learned of utility rebate programs through the electric utility's fliers that accompany their electric bills. While the fliers are not new, the 30% to 100% price hikes created a situation where the advantage of reducing peak-time consumption was highlighted. Other avenues of information mentioned were farm shows, word-of-mouth, and university programs such as agricultural extension. They did not appear to have relationships with utility representatives as a means to learn about energy alternatives.

Specifically in terms of the 2001 CEC peak load reduction efforts, very few respondents seemed to be aware of these. For example, the consultant to dairies for variable-speed and vacuum controls (S) said he used the local water and power district assistance program, but had never heard of the CEC peak load rebate program. The exception was the water pump testing and retrofitting program, which had several participants. Three respondents knew of the program through personal networks—knowing someone involved in the CEC rebate program. Only two respondents indicated knowledge of other components of the program—one learned of the program through a newspaper article, and the power and water district program manager, who administers a competing program, also knew of the program. The frozen foods engineer (L) had first learned of programs from his utility representative, and since then has "kept up with the CEC programs." However, even after prompting from the interviewer, he made no mention of the CEC peak load reduction rebate program. Despite the fact that many of the respondents were sampled from a database for the

CEC peak load reduction rebate program, they made no mention of the rebate program. Additionally, a number of the smaller organizations had some form of prior contact with the Fresno peak load reduction rebate program office. Overall, messages about the 2001 CEC peak load reduction rebate program did not appear to be in the consciousness of the sample of respondents in this study. Further research to explore improved methods of communicating program information for different sizes and types of firms is recommended.

Complexity and accessibility. Reasons that agriculturists reported for *not* taking certain actions are as important as their motivations *for* making changes in energy usage behavior. Some did not participate in particular peak reduction programs due to ineligibility (they exceeded size caps) or because they had already converted to diesel independently or through another program. However, several respondents hinted at barriers to participating in the CEC peak load reduction program. For example, the cotton water manager (L) alluded to bureaucratic delays as a barrier to peak reduction rebate program participation. He carried out his own pump tests without applying for the rebates "in order to get it done," implying that he expected delays from a program that required filling out forms and waiting for certified pump inspectors to be available. The 40-acre nut rancher (S) contacted two different CEC program offices, and left with the impression that the modifications he was planning for his well, including work on his electric motor, were not eligible for the program. He commented that he found it difficult to find someone in the program to talk to, and was confused when he got quite different impressions of the program from the two offices.

The Resource Conservation District manager (PS), who writes grants regularly to fund his program, found the CEC 2001-02 reduction rebate program confusing and too complex to be useful and cost-effective:

> The authors of it [the CEC peak reduction rebate program grant] wrote in such complexities that we found no use for it. The net value of the grant it turned out would have been a negative value, so we didn't subscribe to it. They wanted so much measurement of data that had to do with electrical pumps by agriculture.

The frozen foods process manager (L) had a similar comment. He remarked that rebate programs are helpful, but he thinks that due to the requirements,

> The average Joe Blow would have a hard time getting anything out of them. Because the average person that sits behind the desk or doesn't get out into the field and do the engineering work may become baffled with it. We have done it off and on for so long that we probably know the lingo and what you are doing.

The agricultural representative at the utility district (PS) describes person-to-person assistance as a means to overcome the barrier of complexity:

> The utility sponsors rebate programs...The forms are considerably more involved than the CEC peak load rebate program forms, but representatives sit down with customers and help them complete forms, after which they go to a central processing office. On the order of 20 to 25 customers have used this program this year.

Both the frozen foods process manager and the utility district representative's comments suggest that accessing rebate programs requires understanding the language of

experts—engineering knowledge on the one hand, and the language of grants and contracts on the other. Personal assistance with forms is not offered by the CEC, and may have impacts on program participation. Accessibility and program complexity were important elements in program subscription.

Rapport among change agents, opinion leaders, and potential innovators. The rapport that "change agents"—in this case, the State of California and the California Energy Commission—have with prospective program participants can be an important element in effecting change (see Rogers 1983). The water and power district manager (L) describes a general mistrust of the State as a possible barrier to participation in a State assistance program:

> To be quite honest, from the customers that I deal with there is a lot of hesitation dealing with the State. In this rural environment that we live in there is a heavy dairy concentration here. The less that they see of the State, the better. There is some animosity towards the State, because they want so much information on your business. I think some people think that Big Brother is here. If you want my money you have to tell me how many pounds of milk per day you produce. Farmers are a little bit hesitant to do that.

The Resource Conservation District manager (PS), the utility representative (PS), and the water and power agency manager (L), are "opinion leaders" that agriculturists look to for advice (see Rogers 1983). Their positions and programs provide an important avenue of communication with several of the agriculturists interviewed. Their impressions of the current CEC program are that it is too complex, it is often not worth the effort to apply for a grant, and that the State affiliation is a barrier for many growers.

Conclusion

Using in-depth interview data from twenty agriculturists, this paper has considered a range of understandings, perspectives, and reported behavior change related to energy use in the agricultural community. While we do not claim that the results are in any way definitive, they do shed light on some important dynamics affecting energy choices in the industry.

First, we examined the actions that respondents took in response to the energy crisis of 2001. The most common response was to upgrade diesel equipment, and for many, to switch from electricity to diesel generators as the primary peak power source. While the new diesel generators are cleaner than the old, increased diesel use in general has negative implications for air quality. One person, the horse rancher (S), converted to solar power, a cleaner energy source. Two of the larger firms have taken actions to move activities to off-peak hours.

Second, motivations for behavior change and investment in long-term efficiency were examined. The change in electricity price was the threat to product quantity or quality that drove most respondents to take action. A second finding was that improvements to yields and water supply motivated conservation activities for several of the agriculturists interviewed. For some, yields came before cost reduction or energy efficiency. For a few participants, energy conservation and environmental protection were considerations, even among those who ultimately chose energy alternatives they considered harmful, namely diesel. Finally, for

some respondents, program interventions appeared to be the opportunity that "tips the scale" toward taking action to conserve energy.

Third, messages and systems of delivering energy efficiency alternatives appear to be, in many cases, important motivators for change. Familiarity with the type of program intervention, avenues of communication, program complexity and accessibility, and rapport among potential program participants, opinion leaders, and change agents were important in facilitating or hindering participation in rebate programs. In the case of the California Energy Commission's agricultural peak demand reduction program, the majority of interview respondents were not aware of the program, despite the fact that many were sampled from a database of contacts provided by the CEC. Understanding the processes by which agriculturists receive information about energy efficiency programs is important to program success. In this study's sample, larger firms were more likely to learn of energy efficiency programs through personal interaction with utility representatives and internal experts. Among smaller operations, likely sources of information were newsletters, fliers in utility bills, university programs such as extension, word-of-mouth, and farm shows. Further research on avenues of communication is recommended. Also of note, the complexity of the grant application process and program requirements was a barrier to participation for a number of respondents and the agricultural clients that they serve. The pump retrofitting and replacement program has a streamlined application process, and has greater participation than other categories of the CEC rebate program. Streamlining procedures and requirements, as well as providing person-to-person application assistance, may be important in increasing program participation. Delivery systems for energy alternatives appear to be an underlying driver of change, ultimately facilitating or hindering particular responses to other key drivers of change—including price increases, external events, and program interventions.

References

California Energy Commission. 2001. Agricultural Peak Load Reduction Program, Program Description. Revised 8 August 2001. Accessed at: http://www.energy.ca.gov.

California Energy Commission. 2002. *The Summer 2001 Conservation Report*. Sacramento, Calif.: California Energy Commission.

Glaser, Barney G. and Anselm L. Strauss. 1967. *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New York, N.Y.: Aldine De Gruyter.

Lutzenhiser, Loren, Marcia Gossard and Sylvia Bender. 2002. "Crisis in Paradise: Understanding the Household Conservation Response to California's 2001 Energy Crisis." In *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings* (this volume). Washington, D.C.: American Council for an Energy-Efficient Economy.

Rogers, Everett. 1995. *Diffusion of Innovations*, Fourth Edition. New York, N.Y.: Free Press.