SOLAR ENERGY MARKET RESEARCH REPORT

THE EXISTING AND POTENTIAL MARKET FOR RESIDENTIAL

SOLAR ENERGY USE IN CALIFORNIA

MASTER

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DIANA RAINS

STAFF DRAFT

SOLAR OFFICE
ANALYSIS AND COORDINATION GROUP
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EXECUTIVE SUMMARY
Recommendations for CEC Action

"The greatest obstacle to the widespread use of solar energy is the lack of an adequate delivery system in each state to provide consumers with the information, front-end money and consumer protection they require to make the necessary solar investments."

TVA Chairman, S. David Freeman
The Miami Herald, 21 February 1980

The above statement virtually summarizes the remaining barriers to widespread solar use. Much progress has been made in California with respect to removing many initial barriers to residential solar use including: improving technology performance, implementing provisions for solar access, establishing a tax credit incentive, developing an equipment testing program, formulating passive design concepts and training hundreds of builders, local government officials and financial representatives in general and technical solar energy concepts.

Barriers which yet remain are those which confront the consumer directly:

1. Lack of adequate, objective information from which to make a purchase decision;
2. Inadequate availability of front-end monies, low interest loans and grants;
3. Perceived lack of formal equipment performance standards, warrantee assurances and distributor/installer credibility and reliability.

The findings from the Commission's four-part solar market survey program overwhelmingly support the need for more information, reduced up-front costs and consumer protection. Although builders and architects and local government officials are becoming better informed and educated about solar energy, the public, that is--the average homeowner--is far behind with respect to understanding the solar technologies, their availability and their costs and benefits. The media has been successful in raising the public's awareness level in a shot-gun approach but has not provided the follow-up information which would enable consumers to make a purchase decision. Only one in eight Californian's are able to cite any uses for solar energy in the home. Conversations with builders and lenders throughout California underscore our findings that the technology is ready and available but demand is lagging. Only 3-4% of all Californian's feel that they are likely to install a solar system within the near future. And even these people will have socio-economic characteristics and attitudes which may not be characteristic of the "typical mainstream" California homeowner. They will be opinion leaders, do-it-yourselfers, slightly wealthier individuals who want to install a solar system or purchase a solar home for a variety of reasons.

The Tax credit, though important, is not the primary motivating force behind a solar investment. A solar investment appears much more attractive if the high first cost can be cushioned. However, once the decision has been made by an individual to purchase a solar system, the tax credit plays an extremely valuable role in positively reinforcing or "validating" the purchase decision. Furthermore, the fact that the State is providing a substantial tax credit reinforces its commitment to prioritizing solar development in California.

According to numerous surveys, CEC solar programs (e.g., solar hotline, tollfree information number, establishing 3 year warranties, Cal SEAL) have not

achieved the visibility necessary to determine their level of success. Although hundreds of thousands of individuals have received CEC solar publications and called-in for information, these services are not adequate in providing follow-up information needed to motivate a purchase decision nor are we reaching a wide enough segment of the population. Moreover, those who indicate that they are most likely to install a solar energy system within the next 1-2 years utilize information channels that the Commission has failed to exploit. These are discussed in more detail within this summary report.

With respect to consumer protection, early solar adopter's above-average income and keen interest in the technology have given them a high tolerance for imperfections in the equipment. As the technology moves into the mainstream of California's market, homeowners considering the purchase of solar equipment will be less interested in the status associated with and the novelty of the purchase and more concerned about the reliability and cost-effectiveness of the product. Furthermore, perceptions of payback periods were one of the principal predictors of whether people intended to buy solar or not.

Based on well-documented evidence the normal diffusion period for a new technology introduced in the housing market is considered to be about 18-20 years.

If the California Energy Commission is to play a more prominent and direct role in accelerating solar energy use, it must meet these remaining barriers head-on.

The following recommendations are based on a year's in-depth study of the consumer and solar energy awareness levels, attitudes, buyer behavior and the decision-making process.

RECOMMENDATIONS

1. SERIES OF EDUCATIONAL ONE-MINUTE TELEVISION SPOTS

Purpose: To expand the breadth and depth of solar knowledge among the general public.

Description: The CEC would contract with a professional advertising firm to develop a sequential series of public service solar energy spots to raise awareness levels and expand consumer awareness about solar technologies, availability of the tax credit and low cost solar alternatives. This media campaign would include testimonials from local solar system owners. (New federal legislation requires that the networks provide more free air time for public service messages.)

Justification: While newspapers reach less than 40% and magazines less than 30% of the general public, the electronic media captures over 95% of the entire California population. Nearly one half of all Californians claiming to have any knowledge of solar, received that knowledge from television. Benefits to CEC include more positive program visibility and support.

2. EXPAND DISTRIBUTION OF PUBLIC INFORMATION BROCHURES

Purpose: Reach additional market segments and provide much needed follow-up.

Description: Research and prepare updated information focusing on costs, benefits, incentives and practical consumer buyer tips for solar--especially low cost solar alternatives. Expand distribution channels to

include banks, grocery stores, hardware stores, building supply stores libraries and utilities.

Justification: Although CEC is responsive to over 2,000 requests per month for information, it is inadequately staffed/funded to be effective in reaching out to the general public. Only a very narrow segment of the population (approximately 6%) is utilizing government as an information channel - the large majority utilize non-governmental communication channels for information.

3. ESTABLISH STATE SUPPORTED WARRANTEE ASSURANCE

Purpose: Mitigate widely held belief that the solar industry, because it has such a short track record, and because of horror stories reported in the media, will be unable to back even minimum warranties. This perception has led to a "wait and see" attitude among prospective buyers.

Description: Establish warranty assurance fund program through legislation.

Justification: Consumers indicated that if large corporations like Sears, Montgomery Wards and General Electric sold and serviced solar systems (kits) their fears about the technology would be greatly diminished because these organizations have established reputable track records for their products. Small firms with reliable products are unable to compete with Sears reputation and may eventually be forced out because there is no industry-wide state-supported product warranties.

4. CATER DIRECTLY TO THE "DO-IT-YOURSELF" MARKET

Purpose: Our surveys have definitely found that having some "handyman" capabilities or inclination is an important predictor of installing a solar system. This program would reach out directly to this market segment in providing necessary information from which to build or install a solar system.

Description: Channel more technical information (stock plans, low cost solar system specs, material needs and cost information) to popular magazines (Sunset, Popular Mechanics, etc.), and distribute at nurseries, building supply and hardware stores which cater to "do-it-yourselfers."

Justification: Data indicates that this market segment (mainly comprised of blue collar workers) are not afraid of the technology and are willing to make the investment if solar can be proven to be cost-effective.

5. GATHER DATA AND RESALE VALUE OF SOLAR HOMES

Purpose: To provide lending institutions, insurance companies, realtors, builders and consumers with solid data on resale experience with solar equipped homes.

Description: Only available data base on resale values of solar homes is in Davis which is still considered a model community not representative of other solar homes statewide which are currently being resold.

Justification: Surprisingly, most new solar homeowners believe that solar will add to the resale value of their home. However, some second owners are dissatisfied with the solar--either because they are unfamiliar

with the technology, aesthetics, etc. and feel that the solar may detract from their future resale. No reliable data is currently available on resale values, experiences or attitudes.

6. PROVIDE MECHANISMS FOR UTILITY FINANCING OR SERVICING OF SOLAR SYSTEMS

Purpose: To accelerate solar use throughout various market segments using a reputable and established institution.

Description: RCS is an excellent mechanism for implementing this recommendation.

Justification: Utilities are highly regarded by the public in their roles as "service oriented" institutions. Although public opinion opposes outright utility ownership of or control over the solar energy market, utility financing and/or servicing of systems is supported throughout the state.

7. PHASE-IN MANDATING OF PASSIVE DESIGN AND SOLAR HEATING OF SWIMMING POOLS OVER TIME AND GEOGRAPHICALLY

Purpose: To accelerate solar use and reduce unnecessary gas consumption but allow areas with marginal cost effectiveness (with tax credit benefit) to phase in overtime. This will help insure a smoother transition with respect to demand and solar industry production increases.

Description: Investigate cost-effectiveness of Passive Solar Design and Active Pool Heating in various service areas. Phase in geographical areas based upon back-up energy costs through Title-24 for passive and statewide enabling legislation for local pool mandating (where solar is cost effective--must be mandated). Tax credit should remain in place

to provide government support--if all options to consumer are removed except mandating, then tax credit should assist homeowner in the transition.

Justification: In all surveys, public overwhelmingly supported (over 70%) mandating passive design in new construction* and solar heating for all new pools. Given the high level of public acceptance for these policies, implementation should enjoy more success than originally anticipated.

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* Because the majority of respondents were unfamiliar with the term "passive", the question was phrased as follows: "Designing the home to take best advantage of natural sunlight and shade for heating and cooling of the home (passive solar design)."

SUMMARY OF MARKET SURVEY DEVELOPMENT

Factors important in motivating or inhibiting a solar purchase decision were isolated in the first three surveys in order to design and construct the statewide survey.

Summary of Findings
Attitudes/Characteristics
by Market Segment

Retrofit Consumer

- o Generally higher level of solar awareness than non-solar neighbors.
- o Would have more solar in next home (pleased with equipment)
- o Tend to be somewhat innovative, also do-it-yourselfers who are not afraid of the technology
- o Generally higher income, education (college)
- o Pay higher utility bills, have larger families
- o Concerned about warranties, quality of installation
- o 2/3 paid cash for solar installation; 1/3 financed
- o Most important information sources: friends with solar equipment
- o Expect larger future increases in cost of electricity
- o 2/3 favor mandating solar for pool heating and 50% favor mandating for DHW

New Solar Home Buyer

- o low to moderate levels of solar awareness and understanding of the technologies
- o most favor having solar in next home
- o expect much lower utility bills as a result of solar
- o expect moderate increases in electricity prices in next 3 years
- o middle, upper middle to higher incomes, high school and some college education (young professionals)
- o systems financed through mortgage
- o over 1/2 said that solar was a positive factor in their purchase decision
- o mandating solar pool heating, DHW and passive were favored by over 60%
- o builders or sellers of home played a major role in educating buyer about solar
- o many concerned about warranty coverage

Non-Adopter (Potential Solar Market)

- o younger, more highly educated professionals with relatively higher incomes and utility bills more likely to be aware of and to have seen solar equipment
- o only one in eight were able to cite any home uses for solar energy
- o more than half have never seen solar equipment in place anywhere
- o one in four is aware of solar and knows someone who has a solar system
- o ideas about cost very vague but still perceived as first or second biggest barrier
- o 1/3 feel solar would be an impractical purchase for them personally
- o 3/4 feel solar would raise resale value of value of home
- o awareness of tax credit does not influence attitudes toward solar strongly
- o median payback estimated for DHW system was 5 years
- o only 3-4 percent foresee purchasing any solar in the near future

Retrofit Consumer

- o 86% applied for tax credit although over ½ felt that the tax credit was "not important at all" in their purchase decision
- o Active in marketing solar to friends and neighbors
- o Invest more money in real estate, make more home improvements than non-adopter counterparts
- o Most active energy conservers in the home, more ecology minded than other 2 groups

New Solar Home Buyer

- o large majority felt that tax credit did not affect decision to purchase solar equipped home (although builders did take credit in half the cases)
- o somewhat active in marketing solar to friends
- o The majority felt that cost and lack of information were major barriers
- o buyers were predominantly Caucasian (over 75%) and over 10% were Oriental

Non-Adopter (Potential Solar Market)

- o incentives favored over mandates generally
- o government should set standards for equipment

Figure 1. Percent of R^2 Change Resulting at Each Successive Step of the Multiple Stepwise Regression of Independent Variables Predicting Intention to Adopt Solar ($N = 432$).

⁺
Combined Index of Education, Income and Occupation

⁺⁺
Eight other variables were entered into the regression equation but each predicted less than one percent of the variance and was therefore dropped: (1) probability of moving; (2) awareness of tax credit; (3) utility bill; (4) respondent's age; (5) attitude towards the energy situation; (6) perceived effect of solar equipment on house resale value; (7) mechanical ability, and (8) expectations about future energy cost increases.

Demographic Descriptors

Respondent Age

Highest Level Education

Total Household Income

Highest Level Occupation

Likelihood of Moving

Utility Bill

Influences on Awareness Level

Attitudes Towards Energy Situation

Number of Solar Owners Known

Belief in Community Interest in Solar

Intention to Adopt

Influences on Attitudes Towards Solar

Estimated Payback Periods

Anticipated Future Energy Costs

Estimated Costs of Water Heating System

Degree of Voluntary Simplicity

Ability to Make Home Repairs

Support for Government Mandates

Support for Other Government Programs

Attitudes Towards Solar

Belief Solar is Technically Developed

Belief Solar is Desirable

Belief Solar is Personally Practical

Figure 2. Zero-Order Correlations of Independent Variables with Intention to Adopt.

* $p < .001$; all other reported correlations are significant at $p < .01$; non-significant relationships ($p > .01$) are indicated by n.s.

SUMMARY OF SURVEY FINDINGS

I. INTRODUCTION

In 1979, the California Energy Commission initiated four market surveys which were designed to provide the Commission with a more complete and detailed understanding of the solar consumer and the potential solar energy market in California. The results of the research are of specific use to policy makers and implementors concerned with energy conservation and solar energy technologies.

The impetus for this comprehensive, four-part market survey program stemmed from a realization on the part of the Commission that although significant amounts of information were being gathered on factors associated with the supply of solar devices-- system types, performance, cost, equipment availability, and location of installations---there existed a tremendous gap in the availability of reliable data on factors associated with demand: 1) the types of people buying solar systems, their motivations, experiences with the equipment, financing, and resale; and 2) potential solar users: the types of consumers most likely to be purchasing solar equipment within the very near future--the potential solar market. Determining how this market could best be reached, influenced and encouraged to install a solar system became a major objective within the Solar Program.

The rationale for undertaking this program was that availability of solar devices and cost-effectiveness were not prerequisites for the success of solar in the marketplace. The failure rate of new products introduced into the marketplace is extremely high--over 95% fail to achieve commercialization. Varying attitudes and beliefs regarding the energy situation, as well as demographic characteristics and the individual's perception of his/her status with

respect to the economy will influence acceptance of solar energy. Confronted with rapidly rising energy costs, consumers are pressed to re-evaluate their energy use behavior and purchase more energy-efficient goods.

A. BACKGROUND

Despite high levels of interest in solar and frequently expressed desires for energy independence, favorable solar attitudes have not, thus far, been converted into significant levels of investment or buying behavior. Although California can point to its 50,000+ solar installations, less than 1% of the entire residential housing stock has a solar pool heating, domestic water heating or space conditioning system. Economic and financial incentives are necessary but not sufficient for consumer acceptance of solar energy systems. Both incentive and education programs depend upon an indepth understanding of the non-economic, as well as the economic characteristics of the population involved.

Among consumers, there is no universal response to a given economic stimulus. Varying levels of conservation enthusiasm, risk-taking, time perspectives and other behavioral differences determine the decision-making of various groups. Individual decisions appear to be based upon a blend of economic and behavioral forces. Cost and benefit themselves have not, in the past, been viewed in a uniform manner in surveys of the residential energy consumer. Therefore cost-benefit analysis alone, without added insight into the attitudes and values of the consumer will not yield consistent and useable data.

The state has established a goal of 1.5 million solar installations by 1985. In addition to retrofitting a significant number of homes per year (200,000), such a goal could only be met by incorporating solar into fifty percent of all new construction annually. Policies designed to accelerate the market penetration of solar technologies include financial incentives, regulation, education and mandating. Equity as well as benefit-cost issues have to be addressed.

Who pays? Who benefits? Are social changes forthcoming? How will the housing market be affected? Can changes in lifestyle be predicted? Can the success of new policies designed to accelerate solar use be anticipated prior to implementation?

Since its inception, the state's solar energy program has recognized that the ultimate measure of success is the amount of energy produced by solar energy systems resulting in conservation of natural gas, oil and electricity. In attempting to accelerate solar energy commercialization, the Commission must develop programs that enhance solar market acceptance. To this end, the Commission determined that it was necessary to understand the factors that influence decisions about solar energy by the millions of individual decision-makers who are ultimately affected and to understand how these decisions can be influenced by government action.

B. FRAMEWORK FOR ANALYSIS

Prior to embarking headlong into a comprehensive market survey program and to avoid duplication of surveys also being undertaken by the utilities, PUC, DOE, and others, a thorough literature search revealed that much superficial information was indeed available on general attitudes towards the energy situation. It was learned that the greatest drawback to previous studies was a lack of consistency, generalizability and comparability. In addition, they did not adequately respond to the needs of the California Energy Commission which was looking for direction on major solar policy decisions. These decisions included:

1. Which Energy Commission programs, if any, were having a positive impact on increasing public awareness about solar energy technologies?

2. Which programs appeared to be effective in reducing consumer's fears and uncertainties about solar system quality and performance?
3. How can the future market success of solar energy technologies be estimated?
4. What factors most influence the use or adoption of solar energy technologies and what specific state programs could promote solar energy use most effectively?

The framework for analysis selected was "diffusion research", a body of research which has been applied to numerous other technological innovations in the housing market including heat pumps, dishwashers and air conditioners. "Diffusion" is the process by which an innovation spreads. Several government agencies have funded this type of research because it promises results which are practical and implementable. Examples include the Department of Agriculture's Cooperative Extension Service, the National Institute of Health's research on technological diffusion among hospitals, the Solar Energy Research Institute's research nationwide on diffusion of passive design applications, and the National Institute of Education's research on educational innovation diffusion among public schools. This approach has provided information which will be useful to the California Energy Commission, the Legislature and local governments in resolving solar energy policy issues and in designing effective solar energy programs.

C. APPROACH

In order to assess the existing and potential solar market, the residential sector was split into four subgroups. Each subgroup was interviewed in-

depth. These surveys are briefly described below:

1. Solar Retrofitters: This was a pilot study undertaken by the Institute of Communication Research at Stanford. The survey team interviewed 111 homeowners living in the Bay Area who had retrofitted their houses with solar and one hundred of their neighbors. The purpose was to determine the level of homeowner awareness about residential solar energy systems, describe characteristics of solar adopters (whether they represent identifiable market segments), identify major motivations for installing solar equipment and communication channels which influenced their decision, determine remaining barriers among non-adopter neighbors to solar use, identify needed incentives to accelerate commercialization and assess attitudes towards various state actions and programs. Issues and questions explored were used in the development of a statewide survey of 800 homeowners to determine generalizability of the results. The statewide study is described in part four below.

Report title: "Solar Diffusion in California: A Pilot Study"

October 1979. Available from Publications Unit.

2. New Construction Solar Home Market and Buyers:

Seven new solar subdivisions and seven adjacent subdivisions (similar housing type, age and cost) were selected statewide for an in-depth analysis of the effect of solar on the purchase decision, use of the tax credit, satisfaction with equipment performance, problems with financing, demographic characteristics of the buyers and the role of the builder in marketing the solar home. An additional useful dimension to this study is that utility bills of both

groups are being provided by the respective utilities to determine the extent to which the solar-equipped homes are saving energy over the non-solar homes. The survey was conducted during the summer of 1979 and the sample size was 341. Utility consumption records are still being collected. Analysis of the data is proceeding in-house by Diana Rains and Debbie Dunipace. A draft report on initial findings will become available at the end of May.

3. Focus Groups of Non-Solar Homeowners: This was a study to investigate motivations behind an individual's decision to postpone or not purchase a solar energy system for a home. The CEC contracted with Dr. Misch and Dr. Margolin of the Behavioral Studies Group at George Washington University to conduct a series of panels comprised of homogeneous groups of individuals who were not solar adopters, to probe for underlying attitudes about solar and, through the group dynamics process, elicit information which generally cannot be obtained using a standard questionnaire. The results shed new light on consumer perceptions about solar energy use, the solar industry, government's role and risk perceptions which, in turn, directly affect the individual's decision to adopt or not adopt a solar energy device.

Report Title: "California Solar Energy Study: Decision-Analysis Panel Report." September 1979. Available from Publications Unit.

4. Statewide Survey

Based upon findings from the above three surveys which isolated the more important factors affecting the solar purchase decision (negatively or positively), a major questionnaire was developed to survey a statewide random sample of 812 households. The Institute for Communication Research team at Stanford and the Behavioral Studies

Group team from George Washington University designed the questionnaire. Field Research Corporation was selected to deliver the 812 forty-five minute in-house interviews. Stanford had the overall responsibility of analyzing the data and also soliciting input from the other two contractors.

The purpose of this study was to determine the nature of the potential market for residential solar equipment among California homeowners. Of importance in this study was that sub-markets for solar energy equipment were identified for future targeting of promotional and education efforts. The study was carried out in the late fall and winter of 1979.

Report Title: "The Potential Market for Solar Equipment Among California Homeowners." January 1980. To become available from Publications in May 1980.

D. EXPECTED RESULTS

Thousands of new products, most of which have been preceded by elaborate product screening, concept testing, product development and market testing are introduced into the market each year. Yet, not less than 95% fail. In view of this diffusion research has become vital for better marketing management decisions concerning new product introduction, including pricing promotion and distribution strategies. Stated differently, estimates of the rate of adoption or market penetration are highly important to most marketing management decisions concerning the diffusion of new products to target consumer groups.

The California Energy Commission formulated three major objectives for its comprehensive solar energy survey programs:

1. Collect attitude and behavioral data on solar energy users (retro-fitters and new solar home buyers) to help in program planning and evaluation;
2. Collect data comparing solar and non-solar consumer knowledge about the energy situation, awareness of solar energy technologies and the solar tax credit to assist CEC in educational activities.
3. Determine consumers response to various new incentives or programs which may be implemented (e.g. utility financing, low interest loans, mandating) at some future date.

The California Legislature has directed the CEC to develop and implement a variety of programs (Solar Tax Credit Guidelines, Standards for Equipment Testing, Passive Design Guidelines, Plan for Maximum Feasible Solar Implementation in California by 1990 and others). In response, the CEC determined that it was essential to establish a residential energy consumer attitude and behavioral base to help plan and evaluate various energy programs. Such feedback was essential in determining the market acceptance for solar and eliminating subtle yet persuasive socio-economic, institutional and psychological barriers.

Where monies are allocated to various programs, estimates of the energy savings expected from a particular technology and when those contributions can be

delivered are considered fundamental. Diffusion research may be capable of improving the credibility and reliability of previous efforts to project market penetration. It is well known, for example, that several factors in addition to simply cost influence the diffusion rate or market penetration of a new technology. However, market penetration analyses done to date both utilizing traditional forecasting methodologies and penetration models treat cost vis-a-vis the conventional technologies as the only important factor. Of importance now, especially with respect to those solar technologies (passive, pool and DWH heating) which appear cost competitive with electricity and natural gas, is identifying additional factors which affect solar energy adoption and determine their significance. In addition to being a useful tool for making market penetration estimates, diffusion research could also identify information needed to specify requirements that technologies must meet to achieve market success.

A well-informed energy consumer is very important in the development of the above program. A lack of awareness or belief about the energy situation, available solar technologies and incentives on the part of the consumer, can, in itself, be a significant disincentive towards a purchase decision. By identifying the public's knowledge (deficiencies or misconceptions, which can be furthered by socio-economic or geographic characteristics) about the nature of these programs or the reality of rapidly rising energy prices, the CEC can better design its educational programs to ensure success.

Finally, the public can provide valuable input and feedback to the Commission on proposed education, incentives and regulatory policies. Programs often fail because they are misunderstood, misguided or clearly unacceptable to the public in a particular form.

Diffusion PROCESS

how an innovation spreads through society

(Saturation)

Number of
Adopters /
Solar In-
stallations

How diffusion leads to Commercialization
of a Technology

E. GENERALIZABILITY AND LIMITATIONS OF THE DATA

The first three surveys were performed on groups which were not randomly selected statistically. The reasons are that no data base currently exists that included the names of all solar homeowners in California from which a statistically valid sample could be drawn. Names and addresses of people who had retrofitted their homes with solar were generously provided by solar energy manufacturers and distributors for the purpose of this study. In addition, selection of solar subdivisions was based on obtaining a representative cross-section of housing types and range of prices but was limited because there were less than twelve major solar subdivisions which had been completed by last summer.

Though the results of the first three studies could not be generalized to the entire population, they provided a wealth of information useable to the Commission. In efforts to maximize the use of the results, the major factors identified from each of the first three surveys as being important in the purchase decision or perceived as barriers were selected to be included in the statewide survey. Therefore, once the major diffusion factors were identified, they were tested in the statewide survey which was a statistically representative random sample drawn by Field from its comprehensive statewide data base.

II. Summary of Findings

A. Solar Retrofitters

1. The research reported in this study was undertaken to answer five major research questions:
  - a. How much and what kinds of information about residential solar systems do Californians have now?
  - b. What are the characteristics of individuals purchasing solar equipment, and do these individuals represent identifiable market segments?
  - c. What are the major channels through which information about solar equipment is flowing?
  - d. What are the principal barriers to, and incentives for, the adoption of solar systems?
  - e. What are public attitudes towards government regulations regarding the use of solar energy?

2. Findings

The findings are summarized below but a discussion of the findings as they relate to the above five questions are contained in Appendix A.

(Retrofitters)

The sample of adopters and nonadopters exhibited the following characteristics:

- o Adopters in the sample were somewhat wealthier, lived in slightly larger homes, paid higher utility bills, and averaged one more family member than their nonadopter neighbors.
- o The solar systems had all been installed since 1974 and most cost from \$200 to \$3,000; all circulated water through their solar collectors, which averaged about 234 square feet per system.
- o Adopters and nonadopters were compared on many variables which might explain the diffusion of residential solar systems: Sources of information about solar; attitudes towards and experience with solar equipment; attitudes toward, and acts of, energy conservation; attitudes toward, and acts of, home improvement; demographic descriptions, etc.

Further findings included the following:

- o Most individuals in our sample learned about the potential for solar within the past eight years, especially during 1973-76.
- o Most nonadopters have heard about solar swimming pool, hot water, and space heating systems; 80 percent know of someone who is using solar equipment.
- o The most important sources of information about solar for both adopters and nonadopters are interpersonal: friends and solar equipment sellers.

(Retrofitters)

- o Nonadopters would potentially utilize more sources of information about solar than adopters have, but the two populations rank order the top few information sources very similary.
- o While nonadopters say they would have utilized more decision factors in deciding whether or not to purchase solar equipment than did adopters, the two populations' rank-orderings of decision factors were quite similar.
- o The most important decision factors for adopting solar selected by all 215 respondents were: lower or no energy bills; the initial cost of the equipment; easing the energy shortage; and lessening pollution.
- o For adopters (especially swimming pool owners), the probability of not having to reduce energy consumption in the future was also a major factor in their decision to install solar equipment.
- o Almost all respondents had heard of the (California) state tax credit for solar adopters; adopters (77 percent) were much more familiar with the tax than nonadopters (18 percent). Half the adopters said it was "not at all important" in their purchase decision although 86 percent of the adopters had applied for the tax credit.
- o Only a third of the adopters had obtained bank loans to finance their purchase of solar equipment.
- o Adopters expect larger future increases in the cost of energy than non-adopters and are more optimistic about the payback periods of all types of solar equipment.

(Retrofitters)

- o Over half of the nonadopters either have decided against buying solar equipment or have never considered such a purchase. Over half the nonadopters either do not know how much a solar hot water system costs, or else over-estimate the expense.
- o Two-thirds of the adopters and just over half of the nonadopters favor legislation requiring solar equipment on new home construction, with the most popular options being, first, swimming pool heaters, and next, water heating.
- o Adopters are highly satisfied with their equipment, would install more in a custom-built home, and report no troublesome changes in family routine occasioned by use of solar.
- o Both adopters and nonadopters cite high cost as the major deterrent to more widespread adoption of residential solar equipment. Cost was the major problem with solar that nonadopters had heard adopters complain about.
- o About two-thirds of the adopters have had to make at least minor repairs to their equipment.
- o Adopters are active in marketing solar installations to friends and neighbors, although only two-fifths of the nonadopters have actually seen a solar system in place.
- o Adopters invest more money in real estate, make more home improvements, and are capable of making more home repairs themselves than nonadopters.

- o Adopters are more active energy-conservers in their homes and hobbies than are nonadopters (although on average they pay higher utility bills).

- o Solar water heater owners are more ecology-minded, more active conservers, and engage in more Voluntary Simplicity behaviors to lessen consumption, than do other adopters and nonadopters.

B. New Construction Solar Home Buyers

This survey investigated consumer motivations for choosing a new solar equipped home when the non-solar or conventional model was also available. The approach was to test the relative importance of demographic characteristics, dwelling unit characteristics and heating system characteristics in household decisions of whether to purchase a home equipped with solar. A statistical model is being developed to examine the relationship between the types of home buyers (as an identifiable market segment) and the decision to purchase a solar home. (See Appendix B).

The following questions are addressed:

1. Do solar home buyers actually conserve energy compared to owners of similar sized and priced conventional housing?
2. Are solar homeowners more concerned with saving energy or realizing a payback from their systems?
3. What variables are most critical in affecting household energy consumption (physical characteristics, appliance mix, behavior patterns, etc.)
4. Do solar consumers also evidence other types of conservation behavior?
5. To what extent did the solar component of the house influence the purchase decision?
6. What sources of information were most important in promoting the buyer's awareness, knowledge and purchase decision?

(New Solar Home Buyers)

- o 36% felt utility bills taking a serious bit out of household budget
- o The majority feel that their monthly energy bills would be less than \$80/month three years from now.
- o 86% feel solar is practical for today's home.
- o 84% conserved during the drought and 51% continue to do so.
- o 41% have received their awareness/knowledge about solar through the news media. The rest have utilized a wide variety of sources including the builder, friends, work, school, magazines, military and government publications, demonstrations, etc.
- o 80% were not looking to purchase their home when shopping around.
- o 90% would still have purchased their home if it did not include solar.
- o Over fifty percent said that solar was a minor-major influence in purchase decision although 40% said it made no difference.
- o Two-thirds felt that the system would pay for itself in savings although three-fourths never calculated their payback periods.
- o 74% said that the tax credit did not affect their decision to purchase a solar home.
- o When asked why more people aren't buying solar, cost and lack of information ranked highest while readiness of technology was next.

(New Solar Home Buyers)

- o 83% felt that solar will raise the resale value of their home.
- o 38% required some maintenance - mainly freezing and leaking pipes. No insulation of pipes was another problem.
- o 76% felt that systems was saving them money each month, 15% didn't know and 6% said it was not saving money.
- o Of those who said that the system was not saving them money, the cost of electricity back-up, inadequate storage and system not working were cited as major reasons. 7% didn't know what was wrong.
- o Builders or sellers of solar homes played a major role in educating prospective buyers about the technology.
- o Two-thirds felt system provided 9-25% of total energy needs. The 2 households which felt that solar was providing 75% of energy needs also had active space heating.
- o Only one homeowner indicated having difficulty financing home due to solar
- o 61% said they would retrofit next home w/solar 31% said they would not.

Respondents indicated that the following

Features that should be required on all new housing

70% - passive design

67% - solar domestic water heating

(New Solar Home Buyers)

63% - solar for pool heating

35% - indicated that following "other" types including:

space conditioning, daylighting, maximum solar, complete

passive and hot tubs, jaccuzzis should have solar.

Factors which most influenced the solar home purchase included:

51% - increase in resale

47% - not having to pay monthly utility bills

51% - ease energy shortage

32% - lessen environmental pollution

Factors which new solar home buyers were most wary of included:

29-36% - possible unreliability of equipment and firms manufacturing
equipment.

31% - getting the warrantee covered

21% - solar may run out on cloudy days

Most important info. sources

TV & Magazines

Newspapers

Friends

Sellers equipment

Demo bldgs.

Utilities

The majority of individuals learned about solar in the past 2 years,
most of the remaining within the past 8 years.

(New Solar Home Buyers)

Of the 6.6% that felt that CEC Toll free information number was a useful source of information about solar, it was not ranked in the top five.

C. Focus Groups of Non-Solar Homeowners

This survey utilized a somewhat different method for investigating in-depth attitudes about solar energy than the normal questionnaire. The "Decision Analysis Panel" technique, similar to the conventional "focus group" technique, is a method of collecting attitudinal and behavioral data by convening small, generally homogeneous groups of individuals to discuss a given topic. It was developed by the Behavioral Studies Group at George Washington University over a period of ten years. DAP's have been used and perfected in studies of transportation, energy utilization, public health, education, etc. It can be used as a more sensitive, effective substitute for surveys or as a method for isolating, for use in survey construction, critical issues and feelings characteristic of populations to be studied, that may not be immediately available to the survey designers.

For purposes of this project, ten panels comprised of up to ten individuals representing various homogenous groups (e.g. panels of senior citizens, retired military, young professional, blue collar, etc.) were convened in Northern and Southern California for periods of up to three hours. Each session was taped and transcribed. The participants were not owners of solar equipment.

(Focus Groups)

- o The "up-front" costs of solar is an essential element but not the critical issue as a barrier to the acceptance of solar energy.
- o The "fly-by-night" vendor is a source of great concern.
- o Fear that installations will not be well done was a reoccurring theme.
- o People expressed concern that the solar industry cannot produce a reliable, cost-effective product; that it cannot provide a satisfactory warranty; and that it is generally inefficient.
- o Consumers do not want government regulation but do want protection.
- o All are unsure about reliability about the quipment.
- o All but the lowest socio-economic groups do not take the current energy crisis seriously.
- o There is an overwhelming risk element associated with solar energy represented by high up-front costs, lack of confidence in the vendor and equipment and lack of confidence in government's ability to protect the consumer.
- o Fear that solar is basically unaesthetic and not likely to increase the value of their property (raises spectre of losing a sizeable investment).

(Focus Groups)

On the positive side -

- o California's a good location for solar application.^S_A
- o Solar is a vehicle for producing energy independence from OPEC and large utilities--both viewed a victimizing the public.
- o Perceived as a clean source of energy--cleaner than nuclear.

D. Statewide Survey

This survey instrument was designed by the Institute for Communication Research (input based on survey of retrofitters and neighbors), George Washington University (input based on findings from focus groups), Diana Rains from the Solar Office (input based on findings from survey of new solar home buyers) and Field Research Corporation which would perform the in-home interviews and could also provide valuable input with respect to maximizing the collection of basic marketing data. A total of 812 homeowners were randomly selected and interviewed statewide over a one-month period (September-October, 1979).

The specific research questions guiding the study were:

1. How much do homeowners know about, and understand, the uses of residential solar equipment?
2. What factors are related to relatively greater awareness of solar equipment?
3. What are homeowners' present attitudes toward residential solar equipment?
4. What factors are related to favorable attitudes toward solar equipment?
5. What channels of communication might be best utilized to promote solar adoption?
6. How interested are California homeowners in adopting solar equipment?
7. What factors are related to relatively greater intention to adopt solar equipment?

8. What role can government play in promoting the purchase of solar equipment?

The findings as they pertained to these questions are discussed in more detail in Appendix A-3. A brief summary of characteristics and attitudes of the general public toward solar are listed below:

- o Only one in eight were able to cite any uses in the home for solar energy when asked in an open-ended question.
- o Over one-half of the respondents (424) had never seen any solar equipment in place anywhere.
- o One in four homeowners is aware of solar and knows someone who has installed solar equipment.
- o Homeowners believe that solar equipment is expensive but their ideas about costs are sometimes vague. Nearly 1/3 of the respondents also estimated that a solar water heating system would cost under \$1,500.
- o Younger, more highly-educated professionals with relatively higher incomes and utility bills are more likely to be aware of and to have seen solar equipment. Those younger homeowners without children are more aware than those with children.
- o Most respondents feel their communities are interested but not active in promoting solar.
- o Direct exposure to solar equipment is a class related experience (higher income, Whites and Asians).

- o Over three-fourths of the 812 respondents believe that solar equipment will raise the resale value of the home, and only 4.3 percent either believe solar will lower resale value or do not know what the effect will be.
- o Expense is still perceived as the first or second most important barrier to solar adoption.
- o Demographics other than age have little or no influence on attitude towards solar. While education, income and occupation are related to levels of awareness about solar and the intention to purchase solar equipment, they are unrelated to attitudes about solar.
- o Seeing solar equipment aids individuals in forming favorable opinions about solar technology.
- o That favorable opinion is much more pronounced if the respondent is personally exposed to a solar owner.
- o Awareness of the tax credit does not influence attitudes towards solar very strongly.
- o The median number of years estimated by the respondents for payback on solar heating of swimming pools and domestic water heating systems is about five years, whereas for space heating, the median estimate is over seven years.
- o Over 50% of California homeowners believe that solar technology "still has some [bugs]" and over one-third feel that solar equipment would be an impractical purchase for them personally.

- o Interpersonal sources of information and especially solar owners are the strongest influences on potential adopters of residential solar equipment.
- o The three most useful source of information about solar selected where the utilities, solar equipment sellers and solar demonstrations.
- o Most homeowners do not foresee purchasing any kind of solar in the near future. Only 2.6 to 4.1 percent think it is "very likely" that they will make such a purchase, with a hot tub heater being the most popular option.
- o Asked under what circumstances they might consider installing a solar heating system, three-fifths of the respondents said news that the heating bills were going to double or anticipation of installing a new swimming pool are the potential situations which would lead to serious consideration of solar.
- o Finding solar equipment which the respondent could "install easily" himself was the third most motivating circumstance.
- o The most popular government actions to accelerate solar use are economic incentives, investment in R&D and setting standards for solar equipment.
- o Respondents were divided over whether utility companies should be required to make loans for solar equipment.
- o Requiring use of solar on public buildings was heavily favored.

- o Two-thirds supported mandating passive solar design in new homes.
- o Support drops to 50% for mandating solar equipment on pools.
- o Incentives are generally favored more than mandates.