DIFFUSION OF SOLAR ENERGY TECHNOLOGIES IN THE NEW-CONSTRUCTION MARKET:

A Survey of New Solar-Home and Conventional-Home Buyers

by

Diana Rains
Deborah Dunipace
C. K. Woo

California Energy Commission
February, 1981

CONTRACT FG01-79EI10189

DISCLAIMER

NEW CONSTRUCTION SURVEY REPORT

Chapter 1

Introduction

This research was undertaken to identify the determinants of conservation behavior, or more specifically, the motivating factors which lead towards the adoption and use of solar energy systems by the consumer. Although there appears to be a unified call to rapidly implement solar technologies throughout the housing market, the consumer is generally not being forced to buy solar equipped homes and builders are not required to include solar in new housing in most parts of the state. Hence, the installation rate of solar systems will be, a product of several factors including: The cost of conventional fuels, the consumer's cultural beliefs and perceptions about the benefits and drawbacks of solar energy, and ability to purchase or finance the equipment.

A. The popular explanation for people not purchasing solar is that the cost of the equipment was too high.

B. A popular explanation for people purchasing solar is that they are characteristically wealthy, liberal, status-conscious or environmentalists, etc.

C. Unlike other areas of sociology, consumer behavior, and political science, there is no body of literature and models which adequately describe this situation.

The study of conservation behavior does, however, make an important contribution to our general understanding of consumer behavior and decision-making. The normative social and economic factors

which shape conservation behavior act and interact in subtle ways, and it is difficult to detect their impact in trying to predict behavior. Thus, empirical studies of behavior with increasing energy costs and decreasing supply, provide information useful to understanding consumer behavior in general.

There are a number of perspectives which might be used to study solar energy use. Models which apply to conservation behavior, housing choice, appliance choice or individual decision-making would have implications for solar energy adoption. Human ecology, economics, applied behavioral science, psychology, sociology and demography could be used to frame questions about the determinants of solar energy adoption. Rogers and Barton and others have, simultaneously with this research, undertaken a study of individuals who have opted to retrofit their homes with solar energy technologies to determine major motivating factors. More and more people are retrofitting with solar, but by far the majority of homes with solar equipment are new homes, mostly in tracts and built in high growth areas. Of primary interest in this study is the question: "Given the choice between a new solar and new non-solar home of similar price and in the same residential zone, what factors motivated the solar purchase decision or non-purchase decision?" And, of those factors was solar a major motivating factor for buyers, and conversely an inhibitant for non-buyers. If so, what characteristics of the systems were either attractive or unattractive. In a period where housing starts fall short of demand (1979 housing starts were about 229,000 with demand near 325,000) the availability of new housing alone may be the biggest selling feature. However,

in areas of much building activity and consequently competition among pricing, features offered and marketing, to what extent can we ascertain that the energy conservation features in a new home contribute significantly to its saleability, compared to the conventional home.

In an attempt to understand at least a few aspects of solar energy purchase decisions in detail, the CEC funded a major solar energy market survey program of which this particular study was a major part.

SUMMARY OF SURVEY PROGRAM FINDINGS

BACKGROUND

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 energy 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. Before describing the findings of one of these four market surveys which is the purpose of this report, it is useful to describe the rationale for utilizing a four-pronged approach and how the results of this New Solar Home Buyer Survey mesh with the others. 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 in areas associated with the supply of solar energy devices--system types, performance, cost, equipment availability, and location of installations--there was a tremendous gap in the availability of reliable data on factors associated with demand: 1) the types of people buying solar energy systems, their motivations, experiences with the equipment, financing, and resale; and 2) potential solar energy users: the types of consumers most likely to be purchasing solar energy equipment within the very near future--the potential solar energy market. Determining how this market could best be reached, influenced and encouraged to install a solar energy system became a major objective within the Solar Energy Program.

The rationale for undertaking this program was that the availability

of solar energy devices and their cost-effectiveness, unlike most innovative technologies, were not prerequisites for the success of solar energy technologies in the marketplace. The failure rate of new solar energy 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.

B. CONSUMER ACCEPTANCE

Despite high levels of interest in solar energy technologies and frequently expressed desires for energy independence, favorable solar energy attitudes thus far have not been converted into significant levels of investment or buying behavior. Although California can point to its 74,000 + solar energy installations, less than one percent of the entire residential housing stock has a solar energy pool heating system, domestic water heating or space conditioning system. Economic and financial incentives are necessary but insufficent for consumer acceptance of solar energy systems. Both incentive and education programs depend upon an in-depth 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 enthusiam, risk-taking, time perspectives and other behavioral differences determine the

THIS PAGE

WAS INTENTIONALLY

LEFT BLANK

decision-making of various groups. Individual decisions appear to be based upon a blend of economic and behavioral forces. In the past, cost and benefit have not 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 usable data.

The state has established a goal of 1.5 million solar energy system 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 energy technologies into 50 percent of all new construction annually. Policies designed to accelerate the market penetration of solar energy technologies include financial incentives, regulation, education and mandating. Equity as well as benefit-cost issues must 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 energy use be anticipated prior to implementation?

Since its inception, California'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 the market acceptance of solar energy technologies. Consequently, the Commission determined that it was necessary to understand the factors that influence decisions about solar energy, and to

understand how these decisions can be influenced by government action.

C. 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, generalization and comparability. In addition, they did not adequately respond tothe needs of the California Energy Commission which was looking for direction on major solar energy 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 consumers' fears and uncertainties about solar energy system quality and performance?

3. How can the future market success of solar energy technologies be estimated?

4. What factors most influence the use and adoption of solar energy technologies and what specific state programs could promote solar energy use most effectively?

The framework selected for analysis is termed "diffusion research", which is a body of research applied to numerous other technological innovations in the housing market including heat pumps, dishwashers

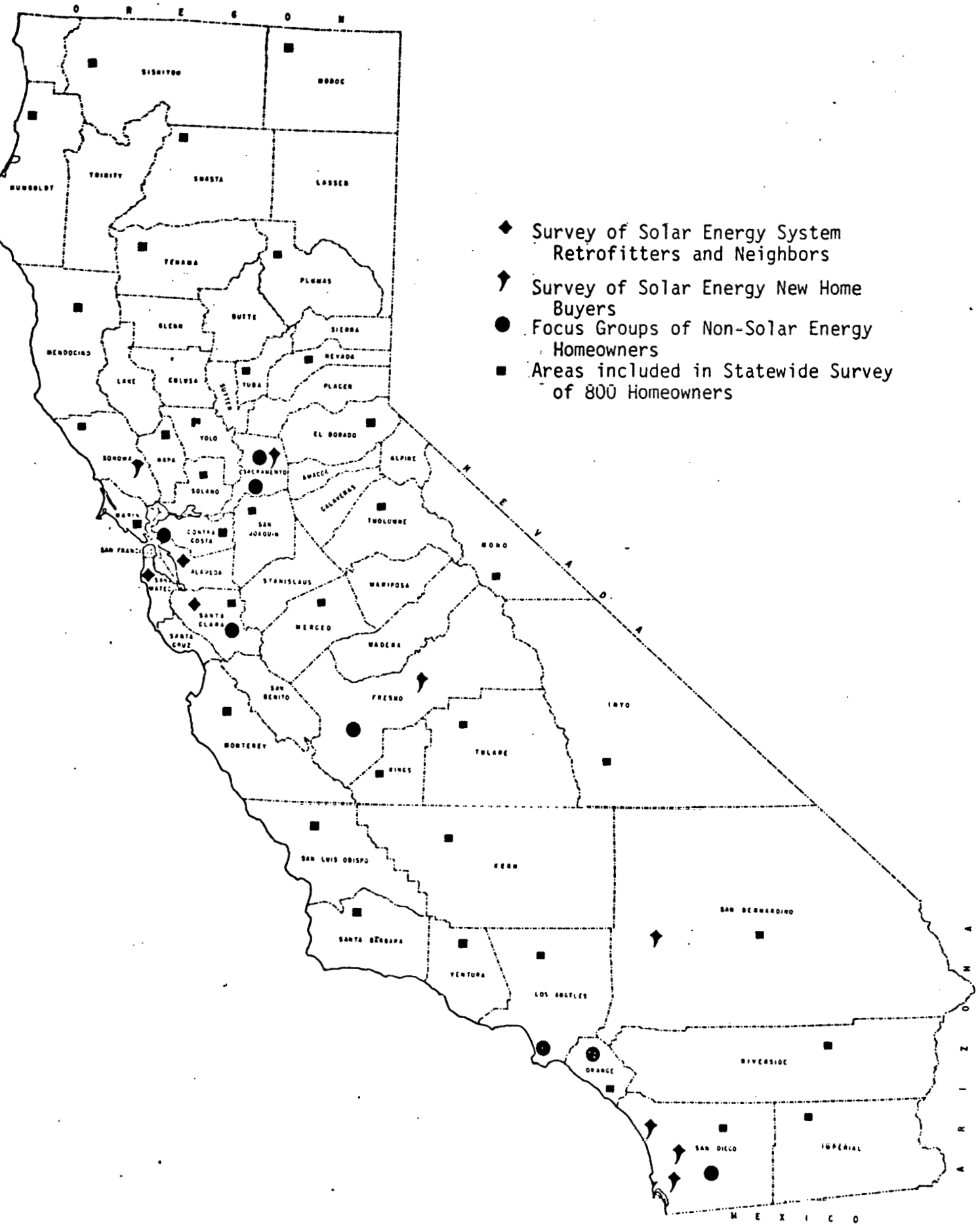
and air conditioners. "Diffusion" is the process by which an innovation spreads. Several government agencies have funded this type of research because it promises results which are practical and implementable. Examples include the Department of Agriculture's Cooperative Extension Service, the National Institute of Health's research on technological diffusion among hospitals, the Solar Energy Research Institutes's research nationwide on diffusion of passive solar energy 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.

D. APPROACH

In order to assess the existing and potential solar energy market, the residential sector was split into four subgroups. Each subgroup was interviewed in-depth. These surveys are briefly described below:

1. Solar Energy Retrofitters: This was a pilot study undertaken by the Institute of Communication Research at Stanford University. The survey team interviewed 111 homeowners living in the Bay Area who had retrofitted their houses with solar energy systems 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 energy adopters (whether they represent identifiable market segments), identify major motivations for installing solar energy equipment, and identify communication

CALIFORNIA'S SOLAR ENERGY MARKET SURVEY PROGRAM



- ◆ Survey of Solar Energy System Retrofitters and Neighbors
- ◆ Survey of Solar Energy New Home Buyers
- ● Focus Groups of Non-Solar Energy Homeowners
- ■ Areas included in Statewide Survey of 800 Homeowners

channels which influenced their decision, determine remaining barriers among non-adopter neighbors to solar energy 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 generalization 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.
California Energy Commission, 1111 Howe Avenue
Sacramento, CA 95825

2. New Construction Solar Energy Home Market and Buyers:

Seven new solarized subdivisions and seven adjacent non-solar subdivisions (similar housing type, age and cost) were selected statewide for an in-depth analysis of the effect of solar energy 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 energy equipped home. An additional useful dimension to this study is that utility bills of both groups were provided by the respective utilities to determine the extent to which the solar energy equipped homes consume energy compared to non-solar energy equipped homes. The survey was conducted during the summer of 1979; the sample size was 341. Utility consumption records have been collected and analyzed and the findings are presented in the next sections of this report.

3. Focus Groups of Non-Solar Energy 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 discussions by panels comprised of homogeneous groups of individuals who were not solar energy adopters, to probe for underlying attitudes about solar energy 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 energy industry, and 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 California Energy Commission, Publications Unit, 1111 Howe Avenue, Sacramento, CA 95825.

4. Statewide Survey

Based upon findings from the above three surveys which isolated the more important factors affecting the solar energy 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 conduct the 812, forty-five minute, in-house interviews. Stanford University staff had the overall responsibility of analyzing the

data, as well as soliciting input from the other two contractors.

The purpose of this study was to determine the nature of the potential market for residential solar energy equipment among California homeowners. In this study, 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. Available from California Energy Commission Publications Unit, 1111 Howe Avenue, Sacramento, CA 95825.

E. 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 that 95% fail to achieve commercialization. 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 conerning 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 (retrofitters and buyers of solar energy equipped new homes) to help in program planning and evaluation;

2. Collect data comparing solar energy and non-solar energy consumer knowledge about the energy situation, awareness of solar energy technologies and the solar energy income 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 data.

The California Legislature has directed the CEC to develop and implement a variety of programs (Solar Energy Income Tax Credit Guidelines, Standards for Equipment Testing, Passive Design Guidelines, Plan for Maximum Feasible Solar Energy 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 data base to help plan and evaluate various energy programs. Such feedback was essential in determining the market acceptance for solar energy technologies and providing programs to eliminate subtle yet persuasive socioeconomic, institutional and psychological barriers.

Where monies are allocated to various programs, estimates of the energy savings expected from a particular technology and expected time frame within which those contributions can be delivered are considered fundamental information to the program. 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 completed to date utililizing both 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 energy technologies (passive solar energy designs, 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 such a program. A lack of awareness of belief about the energy situation, available solar energy technologies and incentives on the part of the consumer, by itself, can 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.

F. 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 includes the names of all solar energy system homeowners in California from which a statistically valid sample could be drawn. Names and addresses of people who had retrofitted their homes with solar energy systems were generously provided by solar energy manufacturers and distributors for the purpose of this study. In addition, selection of solar energy equipped subdivisions was based on obtaining a representative cross-section of housing types and range of prices, but was limited because there were less than 12 major solar energy subdivisions which had been completed by the summer of 1979.

Although the results of the first three studies could not be generalized to the entire population, they provided a wealth of usable information 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.

Summary of Findings
Attitudes/Characteristics
by Market Segment

Retrofit Consumer

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

Solar Energy New Home Buyer

- Display low-to-moderate levels of solar energy awareness and understanding of the technologies.
- Most favor having solar energy system in their next home.
- Expect much lower utility bills as a result of using solar energy.
- Expect moderate increases in electricity prices in next 3 years.
- Middle, upper middle to higher incomes, high school and some college education (young professionals).
- Systems financed through mortgage
- Over ½ said that solar energy was a positive factor in their purchase decision.
- Mandating solar energy pool heating, DWH and passive was favored by over 60% of those responding.
- Builders or sellers of the home played a major role in educating the buyer about solar energy systems.
- Many were concerned about warranty coverage.

Non-Adopter(Potential Solar Energy Market

- Younger, more highly educated professionals with relatively higher incomes and utility bills and more likely to be aware of and to have seen solar energy equipment.
- Only one in eight were able to cite any home uses for solar energy.
- More than half have never seen solar energy equipment in place anywhere.
- One person in four is aware of solar energy technologies and knows someone who has a solar energy system.
- Ideas about solar energy system cost were very vague but still perceived as the first or second biggest barrier.
- One-third feel a solar energy system would be an impractical purchase for them personally.
- Three-fourths feel a solar energy system would raise resale value of their home.
- Awareness of the income tax credit does not influence attitudes toward solar energy strongly.
- Median payback estimated for a solar energy domestic hot water system was 5 years.
- Only 3 to 4 percent foresee purchasing any solar energy technology in the near future.

Retrofi onsumer

- Eighty-six percent applied for income tax credit although over ½ felt that the tax credit was "not important at all" in their purchase decision.
- Actively market solar energy knowledge to friends and neighbors.
- Invest more money in real estate, make more home improvements than non-adopter counterparts.
- Most active energy conservers in the home, more ecology minded than other 2 groups.

Solar Energy New Home Buyer

- Large majority felt that tax credit did not affect decision to purchase solar energy equipped home (although builders did take credit in half the cases).
- Somewhat active in marketing solar energy knowledge to friends.
- The majority felt that cost and lack of information were major barriers.
- Buyers were predominantly Caucasion (over 75%) and over 10% were Oriental.

Non-Adopter(Potential So... Energy Marke

- Incentives generally favored over mandates.
- Government should set standards for equipment.

II New Construction Solar Energy Home Buyers

This survey investigated consumer motivations for choosing a solar energy equipped new home when the non-solar or conventional model was also available. The approach was to test the relative importance of demographic, dwelling unit and heating system characteristics in household decisions to purchase a home equipped with solar energy devices. Two statistical models were developed: one to examine the relationship between the types of home buyers (as an identifiable market segment) and the decision to purchase a solar energy equipped home, and the other to compare the energy use of solar vs. conventional homes selected in the sample.

The following questions are addressed:

1. How do the consumption patterns of solar energy home buyers compare to owners of similar sized and priced conventional housing?

2. Are solar energy homeowners more concerned with saving energy or realizing a payback from their solar energy systems?

3. What variables are most critical in affecting household energy consumption (physical characteristics, appliance mix, behavior patterns, etc.)?

4. Do solar energy equipment consumers also practice other types of innovative (e.g. conservation, simplified lifestyles)?

5. To what extent did the solar energy 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?

(Solar Energy New Home Buyers)

A. Findings Regarding Attitudes of Solar/Non-Solar Home Buyers

° Thirty-six percent felt utility bills were taking a serious bite out of the household budget.

° The majority feel that their monthly energy bills would be less than $80/month three years from now.

° Eighty-six percent feel solar is practical for today's home.

° Eighty-four percent conserved water during the drought and 51% continue to do so.

° Forty-one percent have received their awareness/knowledge about solar energy 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.

° Eighty percent were not looking to purchase their home when shopping around.

° Ninety percent would still have purchased their solar equipped home if it did not include a solar energy system.

° Over 50% said that solar energy was a minor to major influence in purchase decision although 40% said it made no difference.

° Two-thirds felt that the system would pay for itself in savings, although three-fourths never calculated their payback periods.

° Seventy-four percent said that the tax credit did not affect their decision to purchase a solar energy equipped home.

° When asked why more people aren't buying solar energy equipment, cost and lack of information ranked highest while readiness of technology was next.

° Eighty-three percent felt that the solar energy equipment will raise the resale value of their home.

° Thirty-eight percent required some maintenance - mainly freezing and leaking pipes. No insulation of pipes was another problem.

° Seventy-six percent felt that their systems were saving them money each month, 15% didn't know and 6% said they were not saving money.

° 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. Seven percent didn't know what was wrong.

° Builders or sellers of solarized homes played a major role in educating prospective buyers about the technology.

° Two-thirds felt system provided 9-25% of total energy needs. The two households which felt that solar was providing 75% of energy needs also had active solar energy space heating.

° One one homeowner indicated having difficulty financing a home with the added solar energy equipment.

° Sixty-one percent said they would retrofit their next home with solar energy equipment. 31% said they would not.

Respondents indicated that the following features should be required on all new housing:

70% - passive solar energy design

67% - solar energy domestic water heating

63% - solar energy for pool heating

35% - indicated that "other" types, including:
space conditioning, daylighting, maximum solar, complete passive and hot tubs, and jaccuzzis, should be equipped with solar energy water heating systems.

Factors which most influenced the solar energy equipped home purchase included:

51% - increase in resale valuc

47% - not having to pay monthly utility bills

51% - ease energy shortage

32% - lessen environmental pollution

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

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

31% - getting the warrantee covered

21% - solar energy system gain may be significantly reduced on cloudy days

Most important information sources included:

Friends

TV & Magazines

Newspapers

Equipment sellers

Demonstration buildings

Utilities

The majority of individuals learned about solar energy technologies in the past two years, most of the remaining within the past eight years.

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

B. Findings Comparing Energy Use of Both Groups

This section compares the energy expense of two mutually exclusive types of houses, namely, solar vis-a-vis non-solar. Since utility rates and consumption pattern are highly seasonal, annual expense is disaggregated into summer (i.e. May - October) and winter (i.e. November - April).

An appropriate statistical technique for comparing energy use variables from both groups is the two way analysis of variance. It was shown that a linear regression model with binary variables would provide identical results. Further-

more, the regression technique permits more flexibility in forming testable hypotheses.

The maintained hypothesis is that utility bill variations are attributable to the type of house and seasonal differences. Thus, the unrestricted model is

$$BILL = b_0 = b_1 \ SOLAR + b_2 \ SEASON + b_3 \ SOSE + U$$

(1) Where BILL = Utility bill ($);

SOLAR = 0, no solar,

1, otherwise;

SEASON = 1, summer,

0, otherwise;

SOSE = SOLAR = SEASON, a variable allowing interaction effects;

U = Random error; $\sim N\ (0, 6^2 I)$

A solar subdivision of twelve homes and a non-solar subdivision of fourteen homes constituted the sample for analysis. All homes are located in Roseville. Except for two houses, they are all electric homes. Since a distinction between summer and winter bills is made, the sample size is 52.

Four restricted models are estimated as well. They are built under the following hypotheses:

Model 2: No interaction effect;

Model 3: No seasonal effect;

Model 4: No solar effect;

Model 5: No solar and seasonal effect.

Each of these restricted models was tested against the unrestricted model. The regression results and the F test statistics are presented in Tables 1 and 2 respectively.

Table 1: Regression Results

Coefficients	Model 1	Model 2	Model 3	Model 4	Model 5
b_0	329.5 (22.16)* †	321.97 (19.33)*	291.34 (16.52)*	308.15 (16.29)*	277.52 (12.18)*
b_1	-46.24 (32.61)	-29.95 (22.94)	-29.95 (24.32)	-61.26 (23.03)*	
b_2	-76.29 (31.33)*	-61.26 (22.87)*			
b_3	32.57 (46.12)				
R^2	.1622	.1535	.0296	.1240	.0001
Standard Error	82.89	82.47	87.42	83.05	87.86
Log of Likelihood Function	-301.42	-301.69	-305.24	-302.15	-306.02
Sum of Squared Residuals	329 862	3332 90	3820 78	3448 88	3936 76

* Signigicantly different from zero at 5% level

† Values in ( ) are standard errors

Table 2

	Number of Restrictions	F
Model 2	1	.50
Model 3	2	3.67*
Model 4	2	1.09
Model 5	3	3.09*

* Significant at 1% level

** Significant at 5% level

From Table 1, the following remarks can be made:

(a) From Model 1, solar homes do have lower utility bills; but the difference is not statistically significant. On the average, the drop in utility bills is $46.24 which is (46.24/252.71) = 18% of the summer utility bill of a non-solar home; or (46.24/329.5) 14% of the winter bill.

(b) Seasonal variation in utility bills is quite substantial. On the average, the winter bill is higher than the summer by $76.29 which is also statistically significant.

From Table 2, the following remarks can be made:

(a) Model 2 is not signigicantly different from Model 1. That is the interaction effect is not important in terms of explaining utility bill variations.

(b) Model 3 excludes seasonal effect but it is decisively rejected.

(c) Model 4 ignores the distinction between solar and non-solar homes. The hypothesis that they have utility bills of the same amount is not rejected.

(d) Model 5 is rejected decisively because of (b).

Although solar homes seem to have lower utility bills, this proposition lacks strong empirical evidence. There are two possible explanations. First, solar homes cannot reduce consumption of conventional energy. This is not plausible because there is ample evidence to support the contrary. An alternative explanation can be as follows: From the Tax Credit Analysis, solar homeowners tend to be in higher income brackets. Thus, if energy is a normal good, prior to the solar installation, a solar homeowner would have a higher energy bill than a non-solar. Even if the solar homeowners energy bill does go down after putting in solar equipment, the utility bill is still not

substantially lower than a non-solar homeowner's. To conclude, we suggest a further analysis that includes factors such as income, the type of solar system installed and its cost and energy prices be performed. However, the scope of this project does not permit the time or resources to develop a more rigorous model than the simple one presented here.

APPENDIX A

Methodology

Sample

The survey sample was selected by the Energy Commission from their data base containing names of solar homeowners and solar subdivisions. The Experimental Group consisted of seven solar water heated subdivisions and the Control Group consisted of seven conventionally heated subdivisions. The Experimental and Control Groups were matched by general buidling specifications and location. The subdivisions selected were the following:

Huntington Creek III and Cirby Ranch in Roseville

Dutton Manor and Pines Creek Meadows in Santa Rosa

Van Dyck Estates in Clovis (½ solar and ½ non-solar)

El Rancho Verde and Mountain View Estates in Rialto

Windsong in Poway

Cardiff Homes in Cardiff-by-the-Sea

Bonita Greens in National City

There were originally 523 target homes to be surveyed with an expected return rate of between 340 and 370 completed surveys. During the course of the survey it became necessary to expand the sample to meet the expected return. Neighboring residences in the Windsong subdivision in Poway, and the Miramar subdivision in Mira Mesa were included to complete the total. The total number of target homes was increased to 820. The rate of return fluctuated greatly between subdivisions but overall return rate was 41%. There were 153 solar homes surveyed and 189 non-solar homes surveyed.

APPENDIX B

Introductory letter

Utility Bill Release

Hello, I'm_____from the Energy Commission. We are doing a study on California's attitude towards the use and conservation of energy. Such information will help to plan for meeting consumer needs in the future. Therefore, it is important to gain your opinions as a home owner about energy issues. The interview will take approximately 45 minutes. Would you agree to participate?

(If "yes") - It is important to obtain data about your energy use from the utility company. This data will be related to attitudes and will be used for research purposes only. The date will be aggregated across people and your individual data will not be used by itself. Complete privacy will be maintained. Will you agree to give us your utility billing data?

_____No - Why?_____

_____Yes

UTILITY BILL RELEASE FORM

Electric Utility

In order to assist in the data collection efforts of the Energy Commission, I (the undersigned) request that the following utility forward a copy of my utility billing for the past year's service and the next one year's service at the address listed below, to the Energy Resources Conservation & Development Commission, Solar Energy Office, 1111 Howe Avenue, Sacramento, CA 95825.

( ) Pacific Gas & Electric Co.

( ) Southern CA Edison Co.

( ) Los Angeles Department of Water & Power

( ) Sacramento Municipal Utility Dist.

( ) Southern CA Gas Co.

( ) San Diego Gas & Electric Co.

( ) Other, specify_____

_____

Please print name exactly as it appears on bill:_____

Signature_____

Address_____

_____

Account No._____

Date_____

Gas Utility

In order to assist in the data collection efforts of the Energy Commission, I (the undersigned) request that the following utility forward a copy of my utility billing for the past year's service and the next one year's service at the address listed below, to the Energy Resources Conservation & Development Commission, Solar Energy Office, 1111 Howe Avenue, Sacramento, CA 95825.

( ) Pacific Gas & Electric Co.

( ) Southern CA Edison Co.

( ) Los Angeles Department of Water & Power

( ) Southern CA Gas Co.

( ) San Diego Gas & Electric Co.

( ) Others, specify_____

_____

Please print name exactly as it appears on bill:_____

Signature_____

Address_____

_____

Account No._____

Date_____

APPENDIX C

I. survey questionnaire: both groups

II. survey questionnnaire: adopters

III. survey questionnnaire: non-adopters

TO BE ADMINISTERED VERBALLY - ADOPTERS

1. How long have you lived at this address?_____years

2. How likely is it that you will move within the next three years? (Check the appropriate space)

   _____Not likely at all

   _____Possible

   _____Likely

   _____Very likely

3. Do you feel that your utility bills are taking a serious bite out of your household budget?

   Yes_____ No_____

4. For the same period three years from now, what would you expect to pay for your utilities?

   $_____

5. Do you feel that solar energy is practical for today's home?

   Yes_____ No_____ Don't Know_____

6. Californians experienced water rationing in 1977 in many parts of the state.

   a. Did you attempt to conserve water during that period?____Yes ____No

   b. Are you still practicing water conservation?

      _____Yes _____No _____Not as much

   c. Do you think household rationing of electricity and gas should be required in California if the energy situation worsens?

      _____Yes _____No _____Don't Know

7. Where and from whom did you first learn that it is possible to heat with solar energy?

   _____

   _____

   When was that? (YEAR)_____

8. When you were shopping for a home before purchasing this one, were you looking to buy a solar-equipped home?

   _____Yes _____No

9. Would you have purchased this home if it did not have solar?

Yes_____ No_____

10. Did you live in a solar-equipped home prior to purchasing this house?

Yes_____ No_____

11. Would you say that the solar feature of this home was a major or minor factor or made no difference in your decision to purchase this home?

_____Major _____Minor _____Made no difference

12. Who in your household felt that the benefits of having a solar system outweighed the additional cost?

_____husband (adult male) _____wife (adult female)

_____children _____live-in relative

13. Do you expect that your solar equipment will eventually pay for itself in savings on utility bills?

Yes_____ No_____ Don't know_____

14. If yes, how many years do you think it takes for solar equipment to pay for itself?_____

15. When you considered purchase of this solar home, did you attempt to calculate how much money would be saved per year?

Yes_____ No_____

16. Did you also estimate how long it would take to recover your investment?

Yes_____ No_____

17. Did the California Tax Credit affect your decision about buying the solar equipment?

Yes_____ No_____

If yes, would you have still purchased this home if the solar tax credit had not been available?

Yes_____ No_____

18. If yes, was it because you liked the house enough to pay extra for the solar?

Yes_____ No_____

19. Why aren't more people buying solar?

_____

_____

INTERVIEWER: MAKE ADDITIONAL NOTES ABOUT THE INTERVIEW ON BACK

NEW CONSTRUCTION DIFFUSION STUDY

ADOPTERS QUESTIONNAIRE

1. Generally speaking, how much do you know about solar energy?

   Nothing at all 1 2 3 4 5 A great deal

   Some

2. a. To how many people have you shown your solar equipment?

   b. To how many people have you recommended buying solar equipment?

   c. How many of these people (EITHER CATEGORY) have bought solar equipment for their homes?

	NUMBER OF PEOPLE						
	NONE	1-5	6-10	11-15	16-20	21-25	More than 25
SHOWN TO:							
RECOMMENDED TO:							
BOUGHT AFTER YOU SHOWED/RECOMMENDED							

3. Do you expect that the addition of solar equipment will raise, lower or not affect the resale of your house?

   _____ Not affect _____ Lower _____ Raise

   If "RAISE":

   As much as the price of the equipment?

   No_____ Yes_____

4. Which of the following kinds of solar systems or features do you have installed?

   _____ Swimming pool heater _____

   _____ Hot tub or spa _____

   _____ Water heater (for house) _____

   _____ Space heater (inside house) _____

   _____ Greenhouse _____

   _____ Passive heat storage in walls,etc. _____

5. Has any of your solar equipment required any maintenance or repairs?

___No ___Yes

IF YES:

What were the problems? (e.g. breakdowns; leaks)

_____

How were the costs involved covered?

___warrantees ___insurance ___self ___other

___self ___other (specify) _____

6. Do you feel that your solar system is saving you money each month?

___Yes ___No

IF NO, WHY?

_____

_____

7. What percent of your total energy needs does your solar system provide?

☐ 9-25%

☐ 26-50%

☐ 51-75%

☐ over 75%

8. Which three features of this home were the most attractive to you in your purchase decision?

1. _____

2. _____

3. _____

9. Did you have any difficulty financing the solar equipment in your mortage?

☐ Yes ☐ No

10. If yes, could you please describe those difficulties for me?

_____

_____

_____

11. When you purchased your home, what was your estimate of the total cost of the solar system as a built-in feature.

Estimate $_____

☐ $0-$500 ☐ $501-$1,000 ☐ $1,001-$1,500

☐ $1,501-$2,500 ☐ $2,501-$3,500 ☐ $3,500-$4,500

☐ Over $4,500

12. Can you roughly estimate the cost of installing your conventional water heating system?

Estimate $_____

☐ $0-$500 ☐ $501-$1,000 ☐ $1,001-$1,500

☐ $1,501-$2,500 ☐ $2,501-$3,500 ☐ $3,501-$4,500

☐ Over $4,500

13. If you move to a different house that is not equipped with a solar installation, do you think you will add solar equipment?

☐ Yes ☐ No

IF YES:

Would you install other kinds of solar equipment besides that which is included in this house?

☐ No ☐ Yes

IF YES:

What other kinds of equipment?

____ Swimming pool heater

____ Hot tub or spa heater

____ Water heater (house)

____ Space heater (house)

____ Other (specify)

_____

_____

14. Following are descriptions of solar energy features that could be included in new homes. Please check the features you feel should be legally <u>required</u> in all new home construction:

(CHECK ALL THOSE THAT APPLY):

____ Required architectural designs which take advantage of the heat from sunlight (passive solar).

____ Required solar equipment installed to heat swimming pools. At an additional cost of about $1,800-$2,300 per pool.

____ Required solar equipment installed to heat domestic water systems (in the house), at an additional cost of $1,500-$2,500 per house.

____ Other (please specify)

_____

____ None

CARD RANKINGS - ADOPTERS

Here is a stack of cards, each listing one possible source of information about solar energy. I would like you to separate these cards into two piles: one with sources of information which you learned about solar energy from, and the other with sources of information you did not use.

WHEN RESPONDENT HAS SORTED CARDS, TAKE AWAY CARDS HE/SHE "DID NOT USE."

Now would you please show me which five of these information sources you used were the most useful to you, and rank order them, so that the most useful source is on top, the second most useful second, and so on.

WHEN RESPONDENT HAS FINISHED RANKING, TAKE RANKED CARDS AND DOUBLE CHECK TO MAKE SURE YOU KNOW WHICH CARD IS #1 AND WHICH IS #5. THEN HAND RESPONDENT

Thank you very much. Now I'd appreciate your filling out the attitudes portion of this questionnaire on your attitudes about energy issues.

WHILE RESPONDENT FILLS OUT QUESTIONNAIRE, FILL IN HIS CARD RANKINGS BELOW: MARK THE TOP FIVE (1-5) WITH NUMBERS: PLACE AN "X" BESIDE ALL OTHER INFORMATION SOURCES WHICH WERE USED.

	Rank
Sellers of solar equipment	
Utility companies	
Alternative technology groups	
Friends or neighbors	
Consumer groups	
Demonstration buildings	
Textbooks	
Magazines	
Newspapers	
State Energy Commission Toll-Free Telephone Number	
Radio	
T.V.	
Seminars/workshops	
Energy fairs	
Other (specify)	

_____

_____

29. TAKE OUT "DECISION" CARDS

I would like to ask you again to sort some cards into two piles. Please include in one pile the factors that enter(ed) your decision to buy this solar equipped home, and put the factors that you do not (did not) consider into the other pile.

WHEN RESPONDENT HAS SORTED CARDS, TAKE AWAY THE PILE HE/SHE "DID NOT USE."

Thank you. Now I would like you to place the five factors that are most important to your decision in order of their importance, with the most important on top, the second most important second, etc.

WHEN RESPONDENT HAS FINISHED RANKING, TAKE RANKED CARDS, AND DOUBLE CHECK TO MAKE SURE THAT MOST IMPORTANT IS ON TOP. THEN TELL RESPONDENT TO PROCEED WITH (DEMOGRAPHICS) OF THE QUESTIONNAIRE.

Thank you very much. Now if you would fill out this questionnaire, we will be all through.

WHILE RESPONDENT FILLS OUT QUESTIONNAIRE, FILL IN HIS/HER CARD RANKINGS BELOW: (MARK THE TOP FIVE, 1-5, WITH NUMBERS; PLACE AN "X" BESIDE ALL OTHER SOURCES WHICH WERE USED).

____	a. Initial cost of solar equipment	____
____	b. Possible increase in resale value of house	____
____	c. Cost and difficulty of getting solar equipment covered by homeowner's insurance	____
____	d. Possible increase in property tax assessment due to installation of solar equipment	____
____	e. Not having to pay monthly energy bills	____
____	f. Not being forced to reduce energy consumption in the future	____
____	g. Possibility of running out of solar energy on long stretches of cloudy days	____
____	h. Effects of solar panels on attractiveness of house	____
____	i. Safety of solar equipment	____
____	j. Operating reliability of solar equipment	____
____	k. Possible damage to solar panels from dirt, vandalism, storms, or corrosion	____
____	l. Reliability of solar firms and suppliers	____
____	m. Expense of maintaining solar equipment	____
____	n. Lessening harmful effects on the environment (e.g., less pollution)	____

___ o. The contribution of solar to easing the energy shortage ___

___ p. The possibility that neighboring structures might be built which cut off sunlight to the solar panels ___

___ q. Risk that solar equipment now on the market will soon be obsolete, and better equipment will then be available. ___

___ r. Risk that the price of solar equipment would drop after yours was installed ___

___ s. Problems of obtaining a home loan to finance the solar equipment ___

___ t. Warranty coverage for the solar equipment ___

___ u. Installer may go out of business ___

Non-Adopters To Be Administered Verbally

1. Do you feel that solar energy is practical for today's home?

_____Yes _____No _____Don't know

2. In your opinion, what is the biggest barrier in the widespread use of solar equipment in the home?

_____

_____

_____

3. Do you feel that your utility bills are taking a serious bite out of your household budget?

_____Yes _____No

4. For the same period three years from now, what would you expect to pay for your utilities?

$_____

5. If you knew that energy prices were going to double in the next three years, would you install a solar system on this home?

Yes_____ No_____ Do Not Know_____

6. Californians experienced water rationing in 1977 in many parts of the state.

   a. Did you attempt to conserve water during that period?____yes _____no

   b. Are you still practicing water conservation?

      Yes_____ No_____ Not as much_____

   c. Do you think household rationing of electricity and gas should be required in California if the energy situation worsens?

      Yes_____ No_____ Don't Know_____

7. Are there any solar energy homes located near you?

   Yes_____ No_____ Do Not Know_____

8. Prior to purchasing this house, had you looked at any solar houses?

Yes_____ No_____

9. If yes, why did you not purchase one?

_____

_____

10. Do you have friends, acquaintances or relatives who have installed solar equipment or who purchased a solar equipped home?

Yes_____ No_____

IF YES:

a. About how many?_____people

b. Are most of them, in your opinion:

_____Satisfied with the solar equipment.

_____Dissatisfied with the solar equipment.

c. Have they recommended that you install a solar water heating system?

Yes_____ No_____

d. Have you heard of any difficulties these people have had with their equipment?

Yes_____ No_____

IF YES:

What?_____

_____

11. How long have you lived at this address?_____years

12. How likely is it that you will move within the next three years? (Check the appropriate space)

_____Not likely at all

_____Possible

_____Likely

_____Very likely

INTERVIEWER: MAKE ADDITIONAL NOTES ABOUT THE INTERVIEW ON BACK

NEW CONSTRUCTION DIFFUSION STUDY

NON-ADOPTERS QUESTIONNAIRE

1. Where or from whom did you ~~first~~ learn that it is possible to heat with solar energy?

_____

_____

_____

How many years ago was that?_____years

2.

	Swimming Pool Heater	Hot tub or spa heater	Water heater	Space Heater	Other (Specify)_____
a. What kinds of solar equipment for the home have you heard of? (CHECK ALL NAMED)					
b. Which of the following kinds of solar equipment have you seen in a home or being used (e.g., in a friend's house, in a demo)					
c. Was the solar equipment you saw installed for demonstration purposes?	Yes/ No	Yes/ No	Yes/ No	Yes/ No	Yes/ No

3. Approximately how much do you think a good quality solar water heating system (manufactured and installed by a solar company) would have cost for your house during construction?

_____$500 - $1,499

_____$1,500 - $2,499

_____$2,500 - $3,499

_____$3,500 - $4,499

_____More than $4,500

4. What is your present attitude towards buying a new home already containing solar water heating:

_____Definitely want to purchase

_____Have not considered

_____Have considered, but would not purchase

_____May purchase

5. If a solar energy system for hot water heating had been an available option when you purchased this house, how likely would you have been willing to pay extra for it:

_____Definitely buy one

_____Probably buy one

_____Might or might not

_____Probably not

_____Definitely not

6. What is your present attitude towards installing solar equipment in your existing home?

_____Definitely plan to install (i.e., have obtained cost estimates and/or equipment) (Go to question 7)

_____Have not considered (Go to 7)

_____Have considered, and will not install (go to 7)

_____May install (Go to A) but have not made a final decision.

A. IF MAY INSTALL:

Check main reasons why you have not made definite plans to install.

_____Awaiting further information about solar equipment

_____Awaiting more money

_____Waiting to see if there is further shortages in energy

_____Waiting to see if the equipment works for others

_____Waiting for the price to come down

_____Other (specify)

_____

_____

7. A. If you have decided or may decide to install a solar energy system, which of the following would you choose for financing?

Government assistance

_____1. 55% of the cost of purchase and installation, income tax credit (begins year installed).

_____2. Direct rebate of 25% of the cost of the system to be received within three months of purchase.

_____3. 6% low interest loan over 15 years ($21 per month). compared to a 12% loan over 15 years ($40 per month).

_____4. No government assistance.

B. Assume that the purchase and installation cost of a solar system incorporated into a new home is $2,100 or the purchase and installation cost of installing solar water heating on an existing home is $2,500. Which of the following purchase options would you prefer:

_____1. Buy it outright and maintain it.

_____2. Lease the system.

If buy, a. Would you rather pay cash or_____

b. Finance the system _____

If lease, a. Would you rather lease the system from your local utility or_____

b. Would you rather lease the system from the equipment manufacturer?_____

8. What form has your interest in solar energy taken?

_____I have only read and heard about solar energy.

_____I have talked to solar equipment sellers.

_____I have received written estimates on equipment.

_____Other (please explain)_____

_____

9. Would you like to get more information regarding solar equipment?

_____No _____Yes

IF YES:

Information about_____General (how to use it, what it does, etc.)

_____Cost _____Maintenance

_____Installation _____Other (specify)

10. a. Do you think that solar equipment will eventually pay for itself in savings on utility bills?

_____No _____Yes _____Do not know

IF NO OR DO NOT KNOW, GO TO QUESTION 11

IF YES:

How many years will it take for solar equipment to pay for itself in savings?

	YEARS
Swimming pool heater	_____
Hot tub or spa heater	_____
Water heater (house)	_____
Space heater (house)	_____
Other (specify)	_____

_____

_____

11. Are you aware of the California tax credit regarding the purchase of solar equipment for the home?

_____No _____Yes

IF YES:

a. How familiar are you with the way the tax credit works?

_____Not at all (have heard of it only)

_____Somewhat (am unfamiliar/confused about the details)

_____Quite familiar (could explain how it works to others)

b. How important would the tax credit be in your decision to buy solar equipment for your home?

_____Not at all

_____Somewhat

_____Very

12. Following are four descriptions of types of solar energy features that could be included in new homes. Please check which, if any, of the following should be legally required in all new home construction.

What type of equipment should be required? (Check all those that apply.)

_____Require architectural designs which take advantage of the heat from sunlight (passive solar).

_____Require solar equipment installed to heat swimming pools, at an additional cost of about $1100 - $2000 per pool.

_____Require solar equipment installed to heat domestic water.

_____Require solar equipment installed to heat domestic water systems, at an additional cost of about $1,500 - $2,500 per house.

_____Other (please specify)

_____None

CARD RANKINGS

Non-Adopters

Have you considered solar energy in your home?

A. Here is a stack of cards, each listing one possible source of information about solar energy. Which of these sources would you go to first for information, please rank-order the five sources according to their importance to you as a potential source of information.

Not Considered

B. Here is a stack of cards, each listing one possible source of information about solar energy. I would like you to separate these cards into two piles: one with sources of information from which you learned about solar energy, and the other with sources of information you did not use.

C. WHEN RESPONDENT HAS SORTED CARDS, TAKE AWAY CARDS HE/SHE "DID NOT USE".

D. Now would you please show me which five of these information sources you used were the most useful to you, and rank order them, so that the most useful source is on top, the second most useful second, and so on.

Considered

The remainder of Question 15 applies to all respondents:

WHEN RESPONDENT HAS FINISHED RANKING, TAKE RANKED CARDS AND DOUBLE CHECK TO MAKE SURE YOU KNOW WHICH CARD IS #1 AND WHICH IS #5. THEN HAND RESPONDENT ATTITUDES QUESTIONNAIRE.

Thank you very much. Now I would appreciate your filling out the attitudes part of this questionnaire on your attitudes about energy issues.

All

WHILE RESPONDENT FILLS OUT QUESTIONNAIRE, FILL IN HIS CARD RANKINGS BELOW: MARK THE TOP FIVE (1-5) WITH NUMBERS: PLACE AN "X" BESIDE ALL OTHER INFORMATION SOURCES WHICH WERE USED.

RANK:

_____Sellers of solar equipment
_____Utility companies
_____Alternative technology groups
_____Friends or neighbors
_____Consumer groups
_____Demonstration buildings
_____Textbooks
_____Magazines & Newspapers
_____State Energy Commission-Toll-free telephone
_____Radio
_____Television
_____Seminars/Workshops
_____Energy Fairs
_____Other (specify)

_____ _____

_____

What, in your opinion, are the three most reliable sources of information regarding the energy situation?

SHOW SOURCE CARDS

(PLEASE RANK ORDER THEM USING THE FOLLOWING CARDS)

WHEN RESPONDENT HAS FINISHED RANKING. TAKE RANKED CARDS AND FILL IN HIS/HER CARDS RANKING BELOW:

RANK

____Radio/Television commentators

____Editorial

____News reporters (factual reports, not opinion pieces)

____Columnists

____Freelance writers (e.g. magazine articles)

____Academic "experts" or researchers

____Spokesperson for consumer groups

____Spokesperson for state government

____Spokesperson for oil companies

____Spokesperson for utility companies

____Other (specify)

_____

_____

TAKE OUT "DECISION" CARDS

I would like to ask you again to sort some cards into two piles. Please include in one pile the factors that would enter your decision to buy solar equipment, and put the factors that would not be considered into the other pile.

WHEN RESPONDENT HAS SORTED CARDS, TAKE AWAY THE PILE HE/SHE "DID NOT USE."

Thank you. Now I would like you to place the five factors that are most important to your decision in order of their importance, with the most important on top, the second most important second, etc.

WHEN RESPONDENT HAS FINISHED RANKING, TAKE RANKED CARDS, AND DOUBLE CHECK TO MAKE SURE THE MOST IMPORTANT IS ON TOP.

WHILE RESPONDENT FILLS OUT QUESTIONNAIRE, FILL IN HIS/HER CARD RANKINGS BELOW: MARK THE TOP 5 (1-5) WITH NUMBERS; PLACE AN "X" BESIDE ALL OTHER SOURCES WIHICH WERE USED.

RANK

____a. Initial cost of solar equipment

____b. Possible increase in resale value of house

____c. Cost and difficulty of getting solar equipment covered by homeowner's insurance

____d. Possible increase in property tax assessment due to installation of solar equipment

____e. Not having to pay monthly energy bills

____f. Not being forced to reduce energy consumption in the future

____g. Possibility of running out of solar energy on long stretches of cloudy days

____h. Effects of solar panels on attractiveness of house

____i. Safety of solar equipment

____j. Operation reliability of solar equipment

____k. Possible damage to solar panels from dirt, vandalism, storms or corrosion

____l. Reliability of solar firms and suppliers

____m. Expense of maintaining solar equipment

____n. Lessening harmful effects on the environment (less pollution)

____o. The contribution of solar to easing the energy shortage

____p. The possibility that neighboring structures might be built which cut off sunlight to the solar panels

____q. Risk that solar equipment now on the market will soon be obsolete, and better equipment will then be available

____r. Risk that the price of solar equipment would drop after yours was installed

____s. Problems of obtaining a home loan to finance the solar equipment

____t. Warranty coverage for the solar equipment

____u. Installer may go out of business

Q#_____

Group#_____

Address_____

_____

NEW CONSTRUCTION DIFFUSION STUDY
(Both Groups)
Questionnaire

1. Please check major appliances which you use regularly in your home:

_____ freezer
_____ refrigerator _____ frost free _____ not frost free
_____ washer
_____ dryer
_____ oven _____ self-cleaning _____ not self-cleaning
_____ microwave oven
_____ television _____ color _____ black and white
_____ air conditioner _____ central _____ room
_____ home heating _____ central _____ floor or wall
_____ dishwasher
_____ stereo

2. Approximately how much was your last gas and electric bill?

_____ $0-10 _____ $21-30 _____ $41-50
_____ $11-20 _____ $31-40 _____ $51-75
_____ over $75

3. For the same period three years from now, what would you expect to pay for your utilities? $_____

4. There are a number of ways that society can encourage conservation of energy. One of those ways is to require certain energy conservation measures. Rank the following in the order that you would implement them if you were making the policy. Do not rank those items which you feel would be ineffective (cards). (1 is highest, 5 is lowest).

_____ Ban the use of natural gas hook-ups for new swimming pools

_____ Require solar water heating systems in all new homes

_____ Require all new major home appliances to be energy efficient

_____ Require all new homes to be energy efficient (well insulated, good ventilation)

_____ Require all existing homes to become more energy efficient

5. How would you rate the competence of the following people and organizations in handling the energy situation? The rankings are excellent, good, fair and poor.

	(1) Excellent	(2) Good	(3) Fair	(4) Poor	(5) Don't Know
a. The President's Administration	___	___	___	___	___
b. The Congress	___	___	___	___	___
c. Oil companies	___	___	___	___	___
d. Utilities companies	___	___	___	___	___
e. Labor unions	___	___	___	___	___
f. The American public	___	___	___	___	___
g. People in your neighborhood	___	___	___	___	___
h. Governor Brown's Administration	___	___	___	___	___
i. State government	___	___	___	___	___
j. Local government	___	___	___	___	___
k. Your friends					
l. Yourself					

6. Californians experienced water rationing in 1977 in many parts of the state.

a. Did you attempt to conserve water during that period? ____ Yes ____ No

b. Are you still practicing water conservation?

____ Yes ____ No ____ Not as much

c. Do you think household rationing of electricity and gas should be required in California if the energy situation worsens?

____ Yes ____ No ____ Don't know

7. Do you feel that your utility bills are taking a serious bite out of your household budget?

_____ Yes _____ No

8. Please check the phrase below which best completes the following sentence:

"Installing solar equipment is a statement of _____."

_____ a. commitment to help the world get through a serious energy problem.
_____ b. intention to simplify one's lifestyle.
_____ c. interest in innovative technology.
_____ d. independence from utility companies.
_____ e. commitment to protect our environment against pollution.
_____ f. being a responsible person
_____ g. other (specify)_____.

9. Should the state government assume a major role in promoting solar energy use?

_____ No _____ Yes

IF YES:

a. On a scale of one to five (1 is highest priority), what should be the role of State government in promoting the use of solar energy in California?

Provide economic incentives (low-interest loans, tax credits, etc.)

Very important 1 2 3 4 5 Not important

Investment in solar research

Very important 1 2 3 4 5 Not important

Standardization of quality of solar equipment

Very important 1 2 3 4 5 Not important

Expand consumer information distribution

Very important 1 2 3 4 5 Not important

Require utility companies to lease solar equipment to home owners

Very important 1 2 3 4 5 Not important

Other (specify)

_____

_____

10. Do you feel that solar energy is practical for today's home?

_____ Yes _____ No _____ Don't know

11. Solar energy is appropriate for which purpose: (please check as many as you think apply)

____ hot water in the home
____ electricity for the home
____ swimming pool heaters
____ heating industrial buildings
____ electricity for industry
____ don't know
____ other (specify:_____)
____ none

12 How much do you think your last month's utility bill will be for the same month three years from now?

$_____

---

13. Please tell me which of the following apply to you OR your spouse within the past 12 months. (Check those items that apply.)

_____ Watch at least one hour of TV per day.

_____ Have made a gift instead of purchasing one.

_____ Have bought a major piece of furniture second-hand or made one.

_____ Family has a meatless main meal one or more days a week (meat includes fish).

_____ A family member canned, froze, or preserved fruit of at least two types last summer.

_____ Have a compost pile.

_____ Have and use a dishwasher.

_____ A family member or friend changes the oil in the family car.

_____ Recycle at least 75% of the newspapers used at home.

_____ Recycle at least 75% of the glass jars/bottles used in my home.

_____ Recycle at least 75% of the cans used in my home.

_____ Buy a major item of furniture or clothing at a garage sale (over $15).

_____ Grow 15% or more of the vegetables you and your family consume during a summer season.

_____ Belong to a cooperative organization such as a food co-op or car repair co-op in which you are required to provide some of the labor.

_____ Have taken a class to increase your self-reliance; for example, in carpentry, car tune-up and repair, or plumbing.

14. How large is your house?

Square feet _____

Number of bedrooms _____

Number of bathrooms _____

15. How long have you lived at this address? _____ years

16. How likely is it that you will move within the next three years? (Check the appropriate space.)

_____ Not likely at all

_____ Possible

_____ Likely

_____ Very likely

17. Many people believe that the potential of solar energy is very great. Below are several reasons suggested as possible causes for solar home heating systems not being very widely distributed in the United States today. Please indicate how much you agree with or disagree with each reason stated here by checking (x) in the appropriate box.

REASONS	(1) Strongly Agree	(2) Agree	(3) Strongly Disagree	(4) Disagree	(5) Don't Know
No equipment quality standards	___	___	___	___	___
Too expensive	___	___	___	___	___
Aesthetically Ugly	___	___	___	___	___
Not enough information	___	___	___	___	___
Governmental red tape	___	___	___	___	___
Systems not reliable	___	___	___	___	___
Low utility rates	___	___	___	___	___
Restrictive building codes	___	___	___	___	___
Increased property tax	___	___	___	___	___
Inadequate income tax credit	___	___	___	___	___
Problems with storing heat	___	___	___	___	___
Utility company opposition	___	___	___	___	___
Lack of research and development funding	___	___	___	___	___
Difficult to obtain financing	___	___	___	___	___
Cloudy weather	___	___	___	___	___

PART I

Attitudes Questionnaire

On these next questions, I will be asking whether you agree or disagree with a number of statements. The scale is one to five with one representing strong disagreement to five representing total agreement.

1. Most of the homeowners I know won't feel obligated to conserve energy until the government passes laws requiring conservation.

:_____:_____:_____:_____:_____:

1 2 3 4 5

Totally Disagree — Totally Agree

2. To live an adequate life in the U.S., I have to use a lot of energy.

:_____:_____:_____:_____:_____:

1 2 3 4 5

Totally Disagree — Totally Agree

27. My friends expect me to save energy in my home.

:_____:_____:_____:_____:_____:

1 2 3 4 5

Totally Disagree — Totally Agree

3. My personal life has gotten so complex, I have to let the government worry about national issues such as energy conservation.

:_____:_____:_____:_____:_____:

1 2 3 4 5

Totally Disagree — Totally Agree

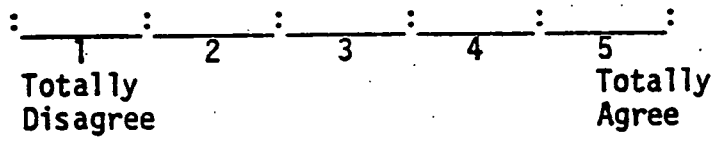
4. If each family in the U.S. made a consistent effort to conserve natural gas, it would make a real difference in the amount available nationally.

:_____:_____:_____:_____:_____:

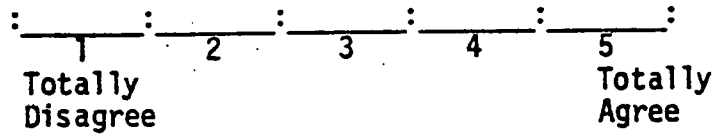
1 2 3 4 5

Totally Disagree — Totally Agree

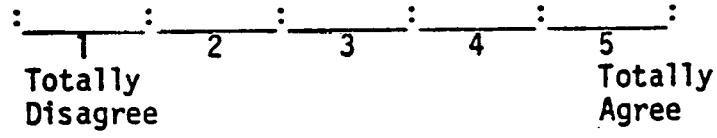
5. Regardless of the cause, we are facing a long-term energy shortage (natural gas, gasoline, electricity).



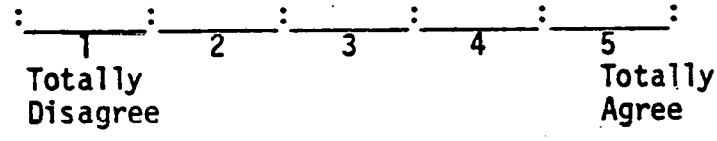
6. Scientific discoveries in the next 20 years will provide for all the energy we could ever use.



7. I do not expect to have to change my lifestyle because of energy shortages in the future.



8. There are so many conflicting stories about energy that I do not know if it is really necessary for my family to conserve or not.



Please indicate which word best describes your family's routine by checking the appropriate blank.

9. Turn off the furnace pilot lights during summer months.

1	2	3	4
Never	Occasionally	Usually	Always

10. In winter, close the drapes at night, open them during the day on the sunny side of the house.

1	2	3	4
Never	Occasionally	Usually	Always

11. Wash clothes in warm or cold water rather than hot.

1	2	3	4
Never	Occasionally	Usually	Always

12. Turn the furnace thermostat down to 65^{o} daytime, lower at night.

1	2	3	4
Never	Occasionally	Usually	Always

13. Set the air conditioner at 78^{o} or above during the summer.

1	2	3	4
Never	Occasionally	Usually	Always

14. Set the thermostat on the water heater to 120^{o} (140^{o} if you have a dishwasher).

1	2	3	4
Never	Occasionally	Usually	Always

16. What, in your opinion, are the three most reliable sources of information regarding the energy situation?

SHOW SOURCE CARDS

(PLEASE RANK ORDER THEM USING THE FOLLOWING CARDS)

WHEN RESPONDENT HAS FINISHED RANKING, TAKE RANKED CARDS AND FILL IN HIS/HER CARDS RANKING BELOW:

RANK

___Radio/Television commentators
___Editorial/
___News reporters (factual reports, not opionion pieces)
___Columnists
___Freelance writers (e.g. magazine articles)
___Academic "experts" or researchers
___Spokesperson for consumer groups
___Spokesperson for State government
___Spokesperson for oil companies
___Spokesperson for utility companies
___Other (specify)

_____

_____

17. Would you like to get more information regarding solar equipment?

___No ___Yes

IF YES:

Information about____General (how to use it, what it does, etc.)
____Cost
____Installation
____Maintenance
____Other (specify)

_____

_____

18. a. Do you think that solar equipment will eventually pay for itself in savings on utility bills?

___No ___Yes ___Do Not Know

IF NO OR DO NOT KNOW, GO TO QUESTION 19

IF YES:

How many years will it take for solar equipment to pay for itself in savings?

	YEARS
Swimming pool heater	_____
Hot tub or spa heater	_____
Water heater (house)	_____
Space heater (house)	_____
Other (specify)	_____

_____

_____

19. Are you aware of the California tax credit regarding the purchase of solar equipment for the home?

___No ___yes

IF YES:

a. How familiar are you with the way the tax credit works?

___Not at all (have heard of it only)

___Somewhat (am unfamiliar/confused about the details)

___Quite familiar (could explain how it works to others)

b. How important would the tax credit be in your decision to buy solar equipment for your home?

___Not at all

___Somewhat

___Very

20. I would like to show you 4 descriptions of types of solar energy features that could be included in new homes. Please tell me which, if any, of the following should be legally required in all new home construction

What type of equipment should be required? (Check all those that apply.)

___Require architectural designs which take advantage of the heat from sunlight (passive solar).

___Require solar equipment installed to heat swimming pools, at an additional cost of about $1100 - 2000 per pool

___Require solar equipment installed to heat domestic water

RANK

___a. Ir
___b. Pc
___c. Cc
ir
___d. Pc
oi
___e. Nc
___f. Nc
___g. Pc
___h. Ei
___i. Sa
___j. Oj
___k. Pc
___l. Rc
___m. Ei
___n. Lc
___o. Tl
___p. Tl
s
___q. R
b
___r. R
i
___s. P
___t. W
___u. I

In your
equipmen

_____

_____

_____

INTERVIE

___Require solar equipment installed to heat domestic water systems, at an additional cost of about $1,500 - $2,500 per

___Other (please specify)

___None

21. TAKE OUT "DECISION" CARDS

I would like to ask you again to sort some cards into two piles. Please include in one pile the factors that would enter your decision to buy solar equipment, and put the factors that would not be considered into the other pile.

WHEN RESPONDENT HAS SORTED CARDS, TAKE AWAY THE PILE HE/SHE "DID NOT USE."

Thank you. Now I would like you to place the five factors that are most important to your decision in order of their importance, with the most important on top, the second most important second, etc.

WHEN RESPONDENT HAS FINISHED RANKING, TAKE RANKED CARDS, AND DOUBLE CHECK TO MAKE SURE THE MOST IMPORTANT IS ON TOP. THEN TELL RESPONDENT TO PROCEED WITH PART TWO OF THE QUESTIONNAIRE.

Thank you very much. Now if you would fill our PART TWO of the questionnaire, we will be all through.

WHILE RESPONDENT FILLS OUT QUESTIONNAIRE, FILL IN HIS/HER CARD RANKINGS BELOW: MARK THE TOP 5 (1-5) WITH NUMBERS; PLACE AN "X" BESIDE ALL OTHER SOURCES WHICH WERE USED.

PART II

DEMOGRAPHIC CHARACTERISTICS
(Have Respondent Fill Out)

1. Ethnic background or race

   ___ Caucasion ___ Mexican American ___ Oriental ___ Black ___ Other

2. Sex: ___ Male ___ Female

3. In what category does your age fall? (Please check one.)

   ___18-24; ___23-34; ___34-44; ___45-54; ___55-64; ___65-74; ___75 and over.

4. Are you employed (earning a wage)? ___ Yes; ___ No (please check one)

5. If yes, are you: ___ a salaried employee (working for someone else); ___ self-employed; ___ retired; ___full-time ___part-time

6. What (was) is your occupation? (Include a housewife, mother, student, etc.) _____.

7. What is your marital status? (Please check one)

   ___single; ___widowed; ___married; ___divorced; ___separated; ___other (specify: _____.)

8. How many people live in your house (including yourself)?

   ___Adults (18 years and older); ___Children

9. In which bracket does your total annual gross household income fall? (Please check one.)

   ___Less than $9,999; ___$10,000-$14,999; ___$15,000-$19,999;

   ___$20,000-$24,999; ___$25,000-$29,999; ___$30,000-$34,999;

   ___$35,000-$39,999; ___Over $40,000

10. What is your educational background? (Please check highest level.)

    ___Completed elementary school; ___Some high school; ___High school graduate;

    ___Some college; ___Junior College diploma; ___Commercial College degree;

    ___College degree (B.A. & B.S.); ___Advanced graduate work; ___Teaching

    credential; ___Ph.D. degree; ___Other (specify:_____)

11. What political preference do you have? (Please check one.)

    ___Don't know; ___Liberal; ___Moderate; ___Conservative; ___Other

12. Number of cars in household: _____

13. Do you rent or own (buying) your residence? ___Rent; ___Own (buying);
___Other (specify _____). If rent, do you pay utilities? _____

14. If you were asked to place yourself in one of the following categories, what class would you say you are a member of (Please check one).
___Upper Class; ___Middle Class; ___Working Class; ___Lower Class;
___Other (specify: _____); ___Don't Know

15. Do you belong to professional organizations or provide any kind of community leadership?
___Yes; ___No; ___Don't Know

16. Have you written a letter or sent a telegram to your congressman on any environmental issue during the past year? ___Yes ___No

17. Are there one or more people home during the day? _____

18. Does wife work outside the home? ___Yes ___No
If yes, Approximately how many hours per week? _____