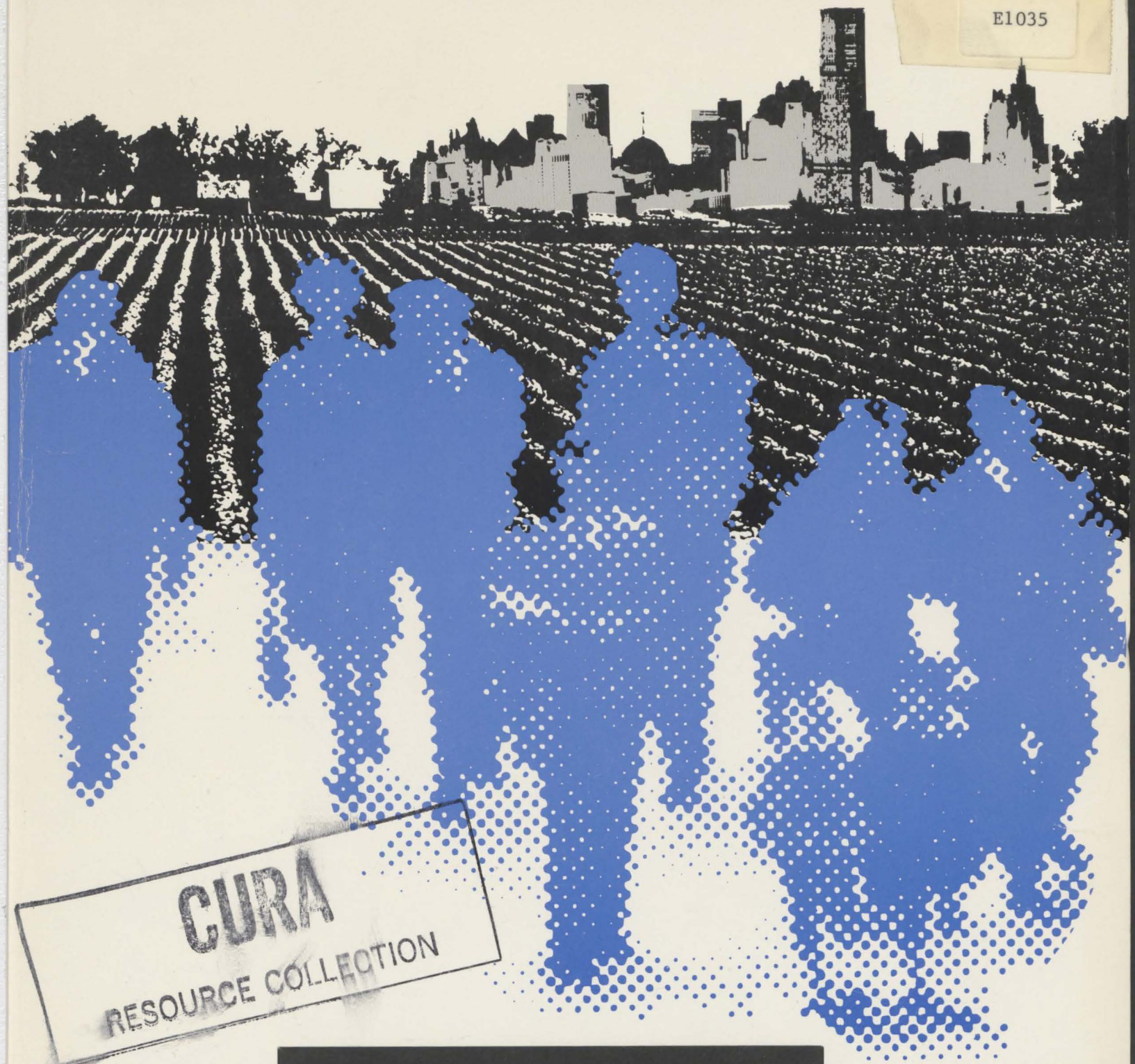

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HOMEOWNERS THAT USE SOLAR ENERGY:

A Study of the Social Aspects of Diffusion of Solar Technology

by

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A note to our readers:

Data in this publication differs from data in the CURA Reporter summary article ("Who Uses Solar Energy?" May 1983) because the authors made changes in this report's Tables 1, 3 and 6 after the May Reporter had gone to press.

Judith H. Weir
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EXECUTIVE SUMMARY

In order to identify the unique characteristics and motivations of residential solar technology users, a study was designed to find and interview any solar users locatable within the Twin Cities metropolitan area. Telephone interviews were conducted with 98 solar adopters, and for each one a non-adopter was sampled from within the neighborhood. Thus we had a "matched" comparison group design of 98 users and 98 non-users. The data were collected in the late spring of 1980.

Both the users and non-users were much more likely than the average citizen to be married, with a high income, and a high educational background. The solar users resembled the non-users demographically except that the users were slightly more likely to have a high education level, and they were more likely to rate themselves as politically independent.

Solar system users had a wide variety of systems installed, although most of them were active rather than passive systems. In addition, about two-thirds were retrofits and most used air rather than liquid as the heat transfer medium. Nearly 40 percent built their own systems. The cost varied greatly but the median cost was $2,000. Most used their own savings and most took a federal and state tax credit on the installation costs. While 14 percent reported disconcerting problems and another 25 percent mentioned minor problems, the users were on the whole very satisfied with their system.

Solar adopters were asked about sources of encouragement and discouragement for their adoption decision. While a great deal of support came from friends and family, a significant number of adopters sought advice from government agencies as well as solar industry representatives before making their decision. Discouragement came from utility companies, and to some extent the solar industry and government agencies.

Consensus existed among both users and non-users that governments at all levels were not doing enough to develop solar energy. For each level (local, state, and federal) solar users were more likely than non-users to believe that government was not doing enough. Both groups also strongly supported incentives of low interest loans and tax credits; they also supported the establishment of consumer protection measures.

Both groups were asked about other energy conservation behavior. Relatively inexpensive, ordinary measures (such as weatherstripping and caulking) were much more common than costly, exotic, or unusual activities (such as using wind energy). Nearly 95 percent claimed to have lowered their home thermostats.

Lifestyle differences related to conservation in some areas differentiated the solar users from the non-users. Solar users were much more likely to walk or bike, to use food

co-ops, to grow their own food, and to store food. They were also slightly more likely than non-users to use a wood stove and to be involved in recycling.

Some have claimed that the role of the government is unimportant, unnecessary, or unwise in the promotion of residential solar adoption. For instance, it has been argued that tax incentives do not motivate acquisitions and should therefore be dropped. The results of this study do not support these views. While it appears that solar adopters seemed to be propelled toward their decision by a set of convictions about the world and how they should relate to it, government support did play an important role. Nearly 75 percent took federal tax credit for their investment, and some of the remaining may not have been eligible. Many of them went to government agencies for help, and while not all were encouraged as a result, they almost universally now believe that the government should do more to promote solar energy. And the vast majority of the non-users believe that also. Both solar users and non-users were fairly well informed about the federal and state tax laws pertaining to solar credits. The solar decision for the home owner is one that involves a variety of considerations including economics; institutional support from both the solar industry and the government; personal beliefs and values; and, last but not least, the availability of relevant, technical data on the technology.

INTRODUCTION

Discussions of the energy situation and responses to it frequently focus on "technical fix" issues, to the exclusion of the sociological context in which the energy situation is embedded. For example, one may encounter articles about anticipated breakthroughs in the cost of photovoltaic cells. Such articles often include the implicit assumption that the energy problem would be well on its way to solution if only the technical questions could be answered. Some argue that this perspective is reinforced by state and federal energy policies (Regens 1980). Ignored in the "technical fix" approach is the fact that the spread of a new technology takes place in a complex and highly interconnected technology delivery system which is closely linked to social arrangements, institutions, and processes (Ezra 1975; Gerlach, Renz, and Brown 1979).

A major focus of this research has been on the role of institutional representatives in the diffusion of residential solar technology--representatives such as contractors, architects, government agencies, and financial institutions. To what extent are representatives of these groups "change agents" in promoting the use of residential solar technology?

The solar adopters in this study were included primarily for their use of solar energy to provide residential space heating and/or hot water. While these are two of the applications most frequently encountered in research on this topic, some adopters were also found who had included relatively exotic devices such as wind energy conversion systems.

This project involved a survey of all identifiable residential solar users in the Twin Cities metropolitan area, excluding so-called "pillow collectors" and single panel, passive units that are marketed as learning devices for those who wish to become more familiar with basic principles of the technology. Solar users were interviewed to obtain information about their values, attitudes, lifestyles, and demographic characteristics, as well as to obtain descriptions of their solar decision-making and interaction with change agents. In addition, interviews were conducted with a matched cohort of non-users living in the same neighborhoods as the users. Comparisons of users with non-users would allow for the identification of unique characteristics of solar adopters. The resulting data have utility for present and future energy policy and program assessment.

METHODOLOGY

The first task was to identify a population of residential solar users in the Minneapolis-St. Paul metropolitan area. We began with a list of 151 names compiled by the Solar Information Office of the Minnesota Energy Agency (MEA). This office had systematically collected names of solar users over a one and one-half year period. They did this mainly through surveys but also through staff observations and referrals from others. Because this list contained the names of people who intended to adopt solar energy technology as well as people who had actually adopted solar systems, the file was significantly reduced after elimination of those who had not followed through on their intention. However, additional names were obtained from an MEA publication, Energy Design 79, which contains various award-winning energy-saving designs. A third source of names resulted from the snowballing aspect of the survey itself. That is, in some cases a solar user volunteered the name of another user who was then included in the sample. Also, some users were identified in the "non-user" matched cohort sample. Seven of the non-users were actually users, so these respondents were then interviewed as users. Finally, an ad was placed in Alternative Sources of Energy magazine requesting solar users to participate in our study. The final sample size was 106, but eight were used for pretesting the questionnaire. Thus, the survey finally included 98 solar users.

When a household was contacted, interviewers asked for the person in the household who was most knowledgeable about the household's experience with the solar adoption process.

Non-user names and telephone numbers (excluding commercial establishments) were randomly selected from a reverse telephone directory. This selection process entailed locating a solar user's address in the directory and then using a table of random numbers to select five non-user candidates from the same block (or road, in the case of some less populous suburban areas). In all cases the interviewers were able to find one cooperative respondent out of five possible candidates. Interviewers were successful in gaining the cooperation of a total of 98 matching non-users. As was done in the user sample, renters were not included. Interviewers requested to speak with the person in the household contacted who "would be most involved in a decision to adopt solar technology."

QUESTIONNAIRE AND PRE-TESTING

Two questionnaires were constructed: one for solar users and one for non-users. The user form differed in that it contained technical questions that were not applicable to non-users; for example, users were asked questions on system description, performance,

and experience. Both forms, however, included demographic, attitude, and lifestyle measures. The user form was pretested twice with a total of eight subjects. The non-user form was pretested once with three subjects.

DATA COLLECTION

Telephone interviews were conducted by a professional interviewing service between early April and mid-June, 1980. Interviewers participated in a two-hour training session conducted by the project staff. This session included a review of the questionnaires and a briefing on solar terminology.

Solar user interviews averaged fifty-three minutes in length, but the range was from thirty to ninety minutes. The non-user interviews averaged twenty-six minutes, but they ranged from ten to fifty-five minutes. Interviewers reported that most solar users were unusually willing to share information and time. Non-users, on the other hand, were sometimes reluctant to respond.

DEMOGRAPHIC CHARACTERISTICS

Since the population of residential solar users was very small, we might expect to find an unusual demographic profile for them. Furthermore, all but one of the solar installers were home owners. Solar adoption requires commitment of a significant investment of money and personal time in research and planning. Consequently we might expect solar adopters to be a selective group demographically.

These expectations were borne out in the data. Solar users were much more likely than the general public to be married, to have a relatively high income, and to have a relatively high level of education (see Table 1). Comparatively high income and education levels are considered by some to be prerequisites of early innovation (Rogers and Shoemaker, 1971). These comparisons are based upon a Minnesota Poll of adults in the seven county metropolitan area. As Table 1 also shows, the comparison group of solar non-users residing in the same neighborhood as the users is, for the most part, a demographically unique group as well. Except for years of education, the users and non-users have the same profile, as might be expected when matching is done on the basis of neighborhood proximity. The solar users have a somewhat greater number of years of education than the non-users, and both groups are more educated than the public at large.

Solar users were contrasted with non-users and the Minnesota poll respondents on several other characteristics: religion, mobility, and ethnic origin. No differences were found except in political party identification. Solar users were more likely to select

"independent" as their political party identification than were non-users. Solar users were also less likely to identify themselves as Republican than non-users, however both groups leaned toward Republican more than the public at large in the metro area.

TABLE 1. DEMOGRAPHIC CHARACTERISTICS

	Solar Users (N = 98)	Solar Non-Users (N = 98)	Minn. Poll 1980 (N = 582)*
Married	91%	89%	60%
Income:			
$0 - $15,000	6%	7%	39%
$15,000 - $20,000	9	9	15
$20,000 - $35,000	44	47	36
$35,000 +	34	28	10
No answer	7	9	--
Education in Years			
0 - 8	2%	8%	4%
9 - 11	3	5	8
12	19	29	42
13 - 15	32	20	21
16 +	44	36	25
No answer	--	2	--
Political Party Identification			
Republican	26%	34%	16%
Democratic	31	34	34
Independent	34	16	49
No answer	9	16	1

*The 1980 Minnesota Poll data is limited to the seven-county metropolitan area.

SYSTEM CHARACTERISTICS

Solar system characteristics are shown in Table 2. The use of solar energy for domestic hot water heating or space heating was reported by 95 percent of the users. About one-quarter (26 percent) of the users reported combining space and water heating systems. More frequent was the use of space heating technology alone (42 percent). Slightly more than one-quarter (28 percent) reported domestic hot water heating use, but not space heating applications.

TABLE 2. CHARACTERISTICS OF THE SOLAR SYSTEM

	Percent
Type of System	
Active	64.2
Passive	18.4
Hybrid	8.2
No answer	9.2
TOTAL	100.0
Heat Transfer Medium	
Liquid	36.7
Air	63.3
TOTAL	100.0
Collector Square Footage	
0 - 99	46.4
100 - 199	25.8
200 +	27.8
No answer	1.0
TOTAL	100.0
Installation	
Retrofit	66.3
When home constructed	33.7
TOTAL	100.0
How Obtained	
Purchased commercially	59.2
Custom-built	38.8
Other	2.0
TOTAL	100.0

The data also show that solar units are almost twice as likely (63 percent) to have air for the heat transfer medium as they are to have liquid (37 percent). "Active" systems, those that use pumps or fans to move the heat transfer medium, are reported by slightly less than two-thirds (64 percent) of the users. Almost one-fifth (18 percent) are passive systems, and 8 percent are hybrids, or combinations.

Systems varied in the total square footage of collector area. Just less than half (46 percent) had areas of 99 square feet or less. About one-fourth (26 percent) had between 100 and 199 square feet, and slightly more (28 percent) reported collector areas of 200 square feet or more.

Installation of solar systems can take place when a home is built or can be added on later as a "retrofit." Two-thirds (66 percent) of the systems in the user sample were retrofitted, the remaining third (34 percent) were installed when the home was built. Commercially available systems were installed by 59 percent of the users and almost two-fifths (39 percent) were custom built.

SYSTEM COSTS AND FINANCING

If respondents' system costs are separated into quartiles, Table 3 shows that the lowest quartile had a total cash outlay of under $900. The second quartile ranged from $900 to $2,000, the third was over $2,000 but less than $5,000, and the top 25 percent had cash outlays of $5,000 or more. The median cash outlay was $2,000. While a complete analysis of the relationship between system costs and system components remains to be done, preliminary results show that combined domestic hot water and space heating systems are disproportionately over-represented in the highest cost category while no exclusively domestic hot water systems are found in that cost category. Exclusively space heating systems are over-represented in the "under $900" category, and exclusively domestic hot water systems are over-represented in the two middle categories.

Financing for systems was obtained from a variety of sources, but the main source was personal savings. About three-fifths (60 percent) of the solar users financed more than half of their system's cost through personal savings. Slightly less than one-fifth (17 percent) financed over half of the cost by including it in a mortgage. Commercial loans or loans from relatives, friends, or others were reported by 9 percent and 7 percent of the users, respectively.

Costs can be defrayed to some extent by "investing" one's labor, or the donated labor of others, in the system. Slightly more than one-fourth (28 percent) of the users invested over forty hours of time in working on the system. Somewhat less than one-half (45 percent) invested up to forty hours and slightly more than one-fourth (28 percent) had no time invested in the system. The median number of hours invested was twenty-eight.

Another mechanism by which costs can be defrayed is through the Federal Energy Tax Credit. Almost two-thirds (64 percent) of the users reported receiving this credit, slightly less than one-fourth (24 percent) reported not receiving the credit, and the remainder (12 percent) didn't know if the credit had been received.

TABLE 3. SYSTEM COSTS AND FINANCING

	Percent
Total Cash Outlay*	
Under $900	25.3
$900 - $2,000	25.2
$2,001 - $4,999	24.2
$5,000 +	25.3
TOTAL	100.0
Main Source of System Financing (Greater than 50% from this source)	
Savings	60.2
Mortgage	17.3
Loan from bank or association	9.1
Loan from relative, friend, or other	7.1
Hours of Labor Invested**	
None	27.6
Up to 40	44.9
Over 40	27.5
TOTAL	100.0
Federal Energy Tax Credit Received	
Yes	64.3
No	23.5
No answer	12.2
TOTAL	100.0

*Median cost: $2,000.
**Median hours invested: 28

SATISFACTION

Satisfaction with the system's performance was found to be high (see Table 4), a result consistent with previous research (Unseld and Crews, 1979). A substantial majority (58 percent) was "very satisfied" and slightly more than one-quarter (28 percent) were "somewhat satisfied." Additional evidence for high satisfaction is found in responses to other questions in the interviews. When asked if they would again use solar technology if they were to re-locate, 96 percent responded affirmatively. When asked if they planned to continue use, expand use, or discontinue use of solar technology, more than half (54 percent) of the respondents indicated continuation of use and 45 percent indicated the intention to expand usage.

TABLE 4. REPORTED SATISFACTION AND EFFECTIVENESS OF SYSTEM

	Percent
Expected Energy Gain	
Up to 33%	50.0
34% - 63%	36.7
64% +	8.2
No answer	5.1
TOTAL	100.0
Achieved (perceived) Energy Production	
Lower	23.5
About the same as expected	45.9
Higher	20.4
Don't know	9.2
No answer	1.0
TOTAL	100.0
Satisfaction with System	
Very satisfied	58.2
Somewhat satisfied	27.6
Somewhat dissatisfied	11.2
Very dissatisfied	2.0
No answer	1.0
TOTAL	100.0

Responses to questions about system performance suggest that the high levels of satisfaction are not ungrounded. About two-thirds (66 percent) indicated that the system's energy production was higher than or at the level that they had expected. Expected energy gains ranged widely with a median expected gain of almost 33 percent. There appeared to be relatively few problems with system functioning. A large majority (87 percent) reported no problems with system overheating, and about three-fifths (59 percent) reported no problems with air or fluid leakage. The last figure increases to 83 percent if those who indicated leakage was a "slight" problem are included. Of the fourteen users who expressed dissatisfaction, four said there was "not enough sunshine," two mentioned insufficient reduction in heat bill, three mentioned incorrect installation or malfunction, two mentioned poor construction, and three complained about the lack of a warranty or service availability.

CONTACT PRIOR TO ADOPTION DECISION

GOVERNMENT AGENCY CONTACTS

Before deciding to adopt solar technology, one-third (33 percent) of the users contacted at least one government agency (Table 5). Additional questions were asked of these users to determine the level(s) of government contacted and whether such contacts were encouraging, discouraging, or neither. However, percentages in this section are based on all users, not just those who responded positively to this question.

Federal and state agencies were almost equally likely to have been contacted by users, with federal agency contact (20 percent) being slightly more frequent than state agency contact (18 percent). Equal numbers of respondents (17 percent) reported these contacts as encouraging solar energy. Discouragement was less frequent but almost equally likely from federal (4 percent) and state (5 percent) agencies.

Contacts at the local (9 percent) or regional (8 percent) governmental levels were less frequent than at the federal or state levels. Contacts with regional government agencies were more likely to be reported as encouraging (7 percent) than discouraging (2 percent).

Results were mixed at the local level. Encouragement was reported by 4 percent of the users, discouragement reported by 3 percent, and 5 percent reported such contacts as neither encouraging nor discouraging.

TABLE 5. SOURCES OF ENCOURAGEMENT/DISCOURAGEMENT*

	Type of Contact	Encouraging	Discouraging	Neither
Government Contacts				
Any government agency	33%	N.A.	N.A.	N.A.
Federal	20	17%	4%	1%
State	18	17	5	0
Regional	8	7	2	0
Local	9	4	3	5
Interpersonal Contacts				
Household family members	--	61%	12%	31%
Friends	38%	30	4	3
Co-workers	34	24	8	2
User acquaintances	30	26	3	3
Other relatives	18	12	2	1
Neighbors	12	8	1	1
Institutional Contacts				
Solar manufacturers	50%	43%	10%	2%
Solar dealers	50	45	5	3
Solar contractors	31	30	2	0
Architects	22	19	2	1
Lending institutions	14	6	2	6
Solar citizen's organizations	12	11	1	1
Utility companies	10	5	4	2

*Due to multiple responses, row percents do not necessarily total.

INTERPERSONAL CONTACTS

Household family members were predominately encouraging (61 percent) about solar energy. Slightly more than one-tenth (12 percent) reported discouragement from household family members, and almost one-third (31 percent) reported neither encouragement nor discouragement.

Of the remaining types of interpersonal contact, the most frequent was with friends (38 percent). Encouraging contacts with friends were reported by 30 percent of the respondents, and almost equal numbers reported them as either discouraging (4 percent) or neither (3 percent).

Contacts with co-workers were reported by one-third (34 percent) of the solar users. Almost one-quarter of the users (24 percent) reported co-worker contacts as encouraging, 8 percent reported these contacts as discouraging, and 2 percent reported them as neither. Solar user acquaintances were less likely to have been contacted (30 percent) than were co-workers. About one-quarter (26 percent) of the users indicated these contacts provided encouragement. Contacts with solar user acquaintances were equally likely to be reported as discouraging (3 percent) or neither (3 percent).

Relatives other than household family members were contacted by 18 percent of the users prior to the adoption decision and these contacts were more likely to be reported as encouraging (12 percent) than discouraging (2 percent) or neither (1 percent).

Twelve percent reported contacts with neighbors. Encouragement from them was indicated by 8 percent. Discouragement was reported by 1 percent and 1 percent reported "neither."

INSTITUTIONAL CONTACTS

Contacts with representatives of the solar industry were the most frequently reported type. Half (50 percent) of the solar users reported contacts with solar manufacturers and an equal number reported contacts with solar dealers. These contacts were primarily encouraging with solar dealers (45 percent) slightly more likely than manufacturers (43 percent) to be so reported. About 10 percent of the users indicated that manufacturers were discouraging, compared to 5 percent of the dealer contacts. Manufacturers (2 percent) and dealers (3 percent) were equally likely to be reported as neither encouraging nor discouraging.

Solar contractors were contacted by 31 percent of the users and almost all (30 percent) reported them as encouraging.

Architects were contacted by slightly more than one-fifth (22 percent) of the users. These contacts were almost exclusively encouraging (19 percent), though 2 percent were reported as discouraging and 1 percent reported as neither.

Lending institutions were contacted by 14 percent of the users. These contacts were equally reported as encouraging (6 percent) or neither (6 percent) encouraging nor discouraging. Two percent indicated that such contacts were discouraging.

Contacts with solar-oriented citizen organizations were indicated by slightly more than 12 percent of the users. Encouragement from these contacts was reported by 11 percent, 1 percent reported discouragement, and 1 percent responded "neither."

One-tenth (10 percent) of the users had contacted a utility company about solar energy before deciding to adopt. The experience varied with 5 percent of the users indicating such contacts were encouraging, 4 percent that things were discouraging, and 2 percent that such contacts were "neither."

ENERGY POLICY ISSUES

A review of 115 surveys that were conducted between 1973 and 1978 and dealt with energy issues uncovered thirty surveys which measured public perceptions of the seriousness of the energy situation (Farhar et al. 1979). The review concluded that, after a period of some fluctuation, public opinion has stabilized. Specifically, 80 percent of the respondents in these studies endorsed the view that the energy situation is serious. And about two-fifths defined the situation as "very serious."

A Gallup Poll conducted shortly before the 1980 presidential election showed that 31 percent of the respondents chose solar energy as the energy source they would most like to see developed to meet U.S. energy demands. Nuclear power, chosen by 8 percent, was the least preferred alternative. It was chosen less often than conservation, oil, and natural gas (each selected by 14 percent).

Since 1980, the subsidy for nuclear energy in the federal government's budget has increased 36 percent; for example, $230 million was budgeted for the Clinch River Breeder Reactor. However, the solar budget was reduced by 67 percent, and the conservation budget decreased by more than three-fourths.

The future of solar energy under the Reagan Administration is, at best, uncertain. Administration sources justify cutbacks in government support for solar programs by arguing, in part, that the basic solar technology has been developed and proven. They believe it is time to let the marketplace determine solar's future, unaffected by government's distorting influence. Another interpretation was expressed by Dennis Hayes in his farewell speech as executive director of the Solar Energy Research Institute (SERI). He said, "Secretary of Energy James Edwards has embarked upon a careful, methodical campaign to destroy America's best energy hope."

Given the salience of the energy situation to the American public and the evidence that the public prefers solar energy, it is important to explore the public's view of the activities and role of government in promoting solar energy. Under previous administrations solar energy received more direct government support than it does now. Some insight may be gained about the reception of current administration energy policies by asking those who had adopted residential solar technology about the adequacy of government involvement under a previous, more supportive administration.

How do solar adopters view the amount of government activity at the federal, state, and local levels? How do their views compare with those of non-uses? In what directions should government activity be headed? What were the experiences, opinions, and behaviors of people who had taken the concrete action of adopting solar technology? And, are these people waiting for government to solve the entire energy problem, or are they taking independent action while expecting government to share the burden and take an active role where appropriate?

THE ROLE OF GOVERNMENT

We have already noted the seriousness of the energy situation as indicated in numerous surveys of public perceptions over a five-year period. Data from this study were consistent with the previous findings. An over-whelming majority of solar users (93 percent) and non-users (83 percent) agreed or strongly agreed that the energy shortage is a serious problem. In both groups, moreover, the most frequently selected response was "strongly agree" (62 percent of solar users and 46 percent of non-users). But it should also be noted that the solar users were more likely to select the extreme category than were non-users: almost two-thirds of the users selected this response.

How did respondents view the roles of various levels of government in meeting the problems of the enegy situation through the development of solar energy? Respondents were asked, "Would you say that enough or not enough is being done to develop solar energy by: the federal government? state government? local government?"

FEDERAL GOVERNMENT

A majority of respondents in both subgroups indicated that the federal government was not doing enough, although more solar users (76 percent) than non-users (63 percent) expressed this view (see Table 6). Among solar users and non-users, almost one-fifth (18 percent) thought that enough was being done by the federal government. The remaining non-users were "uncertain" (18 percent), and the remaining solar users responded "don't know" (6 percent).

TABLE 6. GOVERNMENT ACTIVITY IN DEVELOPING SOLAR ENERGY

	Solar Users (N = 98)	Non-Users (N = 98)
Federal		
Not enough	76%	63%
Enough	18	18
Uncertain	0	18
Don't know	6	0
TOTAL*	100%	99%
State		
Not enough	78%	63%
Enough	12	16
Uncertain	0	20
Don't know	9	0
TOTAL*	99%	99%
Local		
Not enough	82%	64%
Enough	11	13
Uncertain	0	22
Don't know	7	0
TOTAL*	100%	99%

*Totals do not equal 100% due to rounding.

STATE GOVERNMENT

State government was viewed somewhat more critically by respondents than was the federal government. Almost four-fifths (78 percent) of the solar users felt that state government was not doing enough, 12 percent thought enough was being done, and 9 percent didn't know.

Among non-users, nearly two-thirds (63 percent) were dissatisfied with efforts at the state level, but one-fifth (20 percent) were uncertain. Sixteen percent of this subgroup thought that state government was doing enough.

LOCAL GOVERNMENT

Solar users were more critical of local government than of the other levels of government. Eighty-two percent said local government was not doing enough. About one-tenth (11 percent) of this subgroup thought local governments were doing enough.

Fewer non-users (64 percent) than users were dissatisfied with local government efforts, although a substantial majority was in this category. While 13 percent thought that enough was being done, more than one-fifth (22 percent) were uncertain.

SUMMARY

Efforts to develop solar energy at all levels of government were viewed as "not enough" by substantial majorities of both solar users and non-users. Moreover, the more local the level of government, the higher the proportion of respondents who thought that not enough was being done. In addition, solar users tended to be more critical than non-users of all government levels.

ACTIONS TO PROMOTE SOLAR ENERGY

Given the widely held opinion that all levels of government were not doing enough to develop solar energy, the next question was what types of actions should government be taking. The questionnaire included several items that presented various types of actions, some concrete and some fairly general. The respondents were asked to indicate whether or not they thought government should take each action.

RENEWABLE ENERGY RESOURCES

A substantial majority of solar users (89 percent) and non-users (85 percent) agreed or strongly agreed that "the federal government should shift its emphasis from non-renewable to renewable energy resources." Among solar users, slightly more than half (52 percent) strongly agreed with this action.

Non-users were somewhat more likely to be uncertain about this action (11 percent) than were solar users (7 percent). Both subgroups had 3 percent who disagreed or strongly disagreed with the statement.

INCENTIVES: DEDUCTIONS AND LOANS

Income tax deductions and low interest loans for residential solar equipment were favorably viewed as mechanisms by which government could promote solar energy.

That "the installation of solar energy equipment should receive a greater tax deduction than it does now" was supported by substantial majorities of both users and non-users. Almost three-fourths (72 percent) of the users and two-thirds of the non-users agreed or strongly agreed with this position. Uncertainty about tax credits was greater among non-users (24 percent) than it was among users (11 percent), and disagreement or strong disagreement was greater among users (16 percent) than it was among non-users (11 percent).

Even greater support was found for the idea that "low interest loans should be made available by government programs for the installation of solar technology in private homes." Slightly more than four-fifths (82 percent) of the users and almost three-quarters (73 percent of the non-users agreed or strongly agreed with government involvement of this type. Both subgroups had approximately the same percentage of those who were uncertain (5 percent). Slightly more than one-fifth of the non-users (21 percent) and 13 percent of the users disagreed with this mechanism, but no respondents strongly disagreed.

CONSUMER PROTECTION

A provision that "consumer protection measures should be established by policy-makers to protect buyers of solar equipment" was endorsed by approximately four-fifths of both subgroups, with non-users (82 percent) slightly exceeding users (81 percent). Disagreement or strong disagreement was also equally represented in both subgroups (13 percent of the users and 12 percent of the non-users). Even fewer respondents in each group were uncertain about this issue (5 percent of the users and 6 percent of the non-users).

RELIANCE ON GOVERNMENT

While the previous discussion indicates specific areas in which respondents welcomed more government involvement, this does not mean that they thought total reliance should be placed on government to solve the energy problem.

Substantial majorities of respondents in both subgroups agreed or strongly agreed with the statement that "government cannot be relied on to solve the energy problem," although this view was stronger among solar users (82 percent) than it was among non-users (69 percent). Disagreement with this statement was more prevalent among non-users (21 percent) than it was among users (13 percent), and less than one-tenth of each group expressed uncertainty (6 percent of the users and 9 percent of the non-users).

SUMMARY

The respondents in this survey were found to be very similar to respondents in previous research in their perceptions of the seriousness of the energy situation. What might government do? One federal action endorsed by substantial numbers of respondents was to place greater emphasis on renewable energy sources rather than on non-renewable sources. In addition, both users and non-users favored greater incentives to solar adoptors through low interest loans and tax deductions for equipment. Finally, there was considerable support for the view that solar adoptors should be protected through the establishment of some type of consumer protection measures.

ENERGY CONSERVATION

The use of solar technology is but one means by which individuals can directly reduce their energy consumption. Is use of solar technology accompanied by a greater likelihood of conserving energy in other ways? Or has the public become so convinced of the need for specific energy conservation measures that the less exotic actions have become commonplace?

In order to determine the extent of energy conservation behavior respondents were asked: "In the past two years have you: added weatherstripping, insulation or caulking to your home? set your house thermostat at a lower level than you're used to? turned down the thermostat on your hot water tank? used wind power generation for part of your energy needs? had your home inspected for energy inefficiency? added a day-night clock thermostat to regulate house temperature?"

Home weatherization (in the form of weatherstripping, insulation, or caulking) was reported by substantial majorities of the respondents in both subgroups (see Table 7). Almost three-quarters of each subgroup responded positively to this alternative (72 percent of the solar users and 74 percent of the non-users).

Another energy conservation technique is to set one's home thermostat at a lower level than in the past. As with home weatherization, substantial majorities of both subgroups responded positively, with non-users (94 percent) slightly exceeding solar users (81 percent).

TABLE 7. CONSERVATION ACTIVITIES

		Solar Users (N = 98)	Solar Non-users (N = 98)
1.	Added weatherstripping, insulation or caulking	72%	74%
2.	Set house thermostat at a lower level	81	94
3.	Hot water tank thermostat turned to lower level	68	56
4.	Used wind energy	6	1
5.	Home inspected for energy inefficiency	24	26
6.	Automatic day/night home thermostat installed	10	12

A somewhat less obvious means of reducing energy consumption is to lower the thermostat setting on one's hot water tank. This action was reported by a majority of respondents in both subgroups, but it was not reported as frequently as lowering the home's thermostat. Solar users (68 percent) were somewhat more likely to have done this than were non-users (56 percent).

A very uncommon method of reducing consumption of non-renewable energy is the use of wind energy. Very few respondents in either group reported using this source, but solar users (6 percent) were more likely to respond positively than were non-users (1 percent).

Having one's home inspected for energy inefficiency is one way to determine areas of heat loss. Inspections can vary in complexity and can include sophisticated technology, such as infrared heat-sensing cameras. A majority of respondents reported not having had their homes inspected, and the likelihood of having an inspection, or energy audit, was not related to solar usage. Nevertheless, about one-fourth of each subgroup reported having had an inspection (24 percent of the solar users and 26 percent of the non-users).

Installing an automatic setback thermostat means that temperatures in the home may be kept lower than usual for parts of the day or night. The data indicated that most

respondents had not installed these devices and that no difference existed between solar users and non-users in this regard. About one-tenth of each group reported having installed one (10 percent of the solar users and 12 percent of the non-users).

In general, these data revealed no strong pattern of differences between solar users and non-users. One-half of the actions showed no important differences between groups, two of the actions were more frequent among solar users, and one action was more frequent among non-users. This last item dealt with turning down one's home thermostat and, while reported by large majorities of both groups, non-users responded positively more frequently than did users.

Although little evidence of consistent user/non-user difference was found, these data demonstrate considerable variation in the use of different conservation techniques among both users and non-users. Actions such as turning the house thermostat lower were reported by a large majority of respondents, whereas the use of wind energy was relatively infrequent. However, the three most commonly reported actions (home weatherization and the two types of thermostat setback) are neither exotic nor expensive. Manual thermostat set-back incurs no cost whatsoever, and the various weatherization activities can be relatively inexpensive. In contrast, wind energy is exotic, relatively expensive, and of questionable value in the metropolitan area. Home energy audits are limited by factors such as the availability of certified energy auditors. And automatic setback thermostats require the replacement of the existing thermostat.

The data indicate that those actions which are relatively inexpensive, available, and "ordinary" are much more common than those which are expensive, unavailable and exotic.

ECOLOGICAL LIFESTYLE

Discussions of solar energy and its use frequently evoke sterotypical images of the counterculture, which include elements of lifestyle, ideology, and even physical appearance. For example, certain notions about self-sufficiency, community, appropriate technology, and conservation often come to mind. Is there any basis for such sterotypes? Are there differences between solar users and non-users in behaviors suggested by these ideas which, in turn, might reflect something we call an "ecological lifestyle?"

Respondents were asked the following question: "How often do you engage in the following types of activities? Regularly? Sometimes? Or not at all? Recycling of glass, tin cans or newspapers. Bicycling or walking instead of driving a car. Use wood stove to heat or cook. Shop for food at co-ops. Produce your own food in quantity. Preserve and store your food. Use second-hand items of clothes, etc."

Recycling behavior was almost equally frequent among solar users and non-users (see Table 8). Two-fifths (39 percent) of the solar users responded "regularly" compared with 32 percent of the non-users. About one-third of each subgroup reported recycling "sometimes" (32 percent of the solar users and 37 percent of the non-users), and slightly smaller proportions in each group reported recycling "not at all" (29 percent of the solar users and 32 percent of the non-users).

When asked if they walked or bicycled instead of driving, solar users were twice as likely (24 percent) as non-users (12 percent) to respond "regularly." About half of each group responded "sometimes" (48 percent of the solar users and 50 percent of the non-users). One-quarter (26 percent) of the solar users and about two-fifths (38 percent) of the non-users responded "not at all" to this item.

Substantial majorities of both subgroups reported not using woodstoves for cooking or heating, although solar non-users (70 percent) were also less likely to burn wood than were solar users (58 percent). The remainder of the solar users were evenly split between the "sometimes" category 20 percent) and the "regularly" category (20 percent). Among non-users the remainder was slightly more likely to report regular use of wood (16 percent) than it was to report use of wood "sometimes."

Shopping at food co-ops is another behavior which many people associate with the counter-culture ideology. Solar users were twice as likely (20 percent) to report regular shopping at food co-ops than non-users (10 percent). One-third (34 percent) of the solar users shopped at co-ops "sometimes" compared with 18 percent of the non-users. Therefore, while a substantial majority of non-users (70 percent) didn't shop at food co-ops at all, only slightly less than half (44 percent) of the solar users reported that they didn't.

Just as non-users were less likely than users to shop at food co-ops, they were less likely (56 percent) to produce their own food in quantity than were solar users (39 percent). Solar users (32 percent) responded "sometimes" more often than did non-users (24 percent). They also tended to respond "regularly" (29 percent) more frequently than did non-users (19 percent).

One-third (34 percent) of the solar users reported that they regularly preserved and stored food compared with one-quarter (24 percent) of the non-users. The two subgroups were very similar in the number of people responding "sometimes" (42 percent) of the solar users and 39 percent of the non-users). But there were more non-users (37 percent) than solar users (24 percent) who responded "not at all" to this item.

Non-users were somewhat more likely (37 percent) to report no use of second-hand items than were solar uses (24 percent). Almost equal percentages of each subgroup did this "regularly" (26 percent of the solar users and 24 percent of the non-users). But solar users were more likely 48 percent) to do so "sometimes" than were non-users (40 percent).

In general, solar users were more likely than non-users to engage in counter-cultural behaviors at least sometimes. This pattern holds for every listed activity, although the magnitude of the differences between the subgroups varies from item to item.

TABLE 8. ECOLOGICAL LIFESTYLE

		Not at All	Some-times	Regu-larly	No Answer	Total*
Recycling	Solar users	29%	32%	39%	1%	101%
	Non-users	32	37	32	0	101
Walk or bike	Solar users	26	48	24	2	100
	Non-users	38	50	12	0	100
Wood stove	Solar users	58	20	20	1	99
	Non-users	70	13	16	0	99
Food co-ops	Solar users	44	34	20	2	100
	Non-users	70	18	10	1	99
Grow food	Solar users	39	32	29	1	101
	Non-users	56	24	19	0	99
Store food	Solar users	24	42	34	1	101
	Non-users	37	39	24	0	100
Secondhand items	Solar users	24	48	26	1	99
	Non-users	37	40	24	0	101

*Totals may not equal 100% due to rounding.

CONCLUSIONS

Responses to this survey suggest some conclusions and also implications for future research. Government action to promote solar technology adoption is viewed as inadequate and some existing policies, for example current emphases on non-renewable resources, are seen as misdirected. It should be noted that these opinions were expressed before the Reagan administration was in office and before existing agencies, policies, and programs were curtailed or eliminated.

The efforts of local government were viewed most critically, but federal efforts were viewed only less critically, not positively. The fact that these views tended to be held by fairly large percentages of non-users and users both, suggests that these concerns are shared by broad segments of the population not just the energy "activists." The data suggest support for more aggressive action by government agencies at all levels to promote solar technology and other forms of renewable energy.

The comparatively higher income and educational levels of solar adopters, while consistent with the innovation literature, suggest that accelerated diffusion of solar technology may require more focused activity by change agents. For example, the typical finding that innovators tend to have higher incomes is explained by the argument that they literally can afford to risk innovative behavior. The relatively high use of personal savings to pay for systems, found in this research, supports this interpretation. Greater availability and promotion of low-interest loans and tax credits might have a broad impact on the diffusion process.

Another mechanism for reducing the risk associated with innovations of this type is through the establishment of consumer protection measures, an action strongly favored by users and non-users alike. The data do not allow us to determine if the support for this action reflects a special concern about solar technology or if it reflects a larger societal concern about consumer protection in general. These concerns can also be addressed through aggressive action by those within the solar industry to promote and maintain the highest levels of professional conduct. This would become increasingly important as the diffusion process encompasses segments of the population with little or no time or skills to "invest" in their systems. The availability of competent and reputable solar specialists will become more important if negative consumer experiences are to be minimized.

In addition to solar industry efforts regarding consumer protection, efforts could also be directed at other sectors of the technology delivery system. Hirshberg and Schoen (1974) mention "industrial culture" as a potential barrier to widespread residential solar energy. Attitudes and behaviors in the housing industry that are barriers can be identified and addressed to increase the acceptance of and knowledge about solar technology. The

housing industry is one area in which technical fixes, such as more efficient furnaces or better insulation, might be stressed at the expense of non-technical factors. All sectors of the technology delivery system could warrant further research of this type.

These are some of the implications of the present research. However considerable research remains to be done. Previous engineering studies (Goldstein, Schneider, and Clarke 1979) suggest that a portion of the unexplained variance in residential gas consumption may be attributable to "lifestyle" differences. This is one direction for further research.

Other sectors of the technology delivery system and their interactions could receive additional attention. For example, the industrial culture of the housing industry has been mentioned as a barrier. Similar barriers in the financial sector may also exist. More detailed study of sectoral barriers and how, if at all, they interact may be helpful. A larger systemic view is suggested.

Political factors need to be examined beyond the issues of tax incentives and provision of low-interest loans. One analysis examined the political organization of energy decision-making and concluded, "Perhaps the most striking conclusion from this review is that so little systematic research is available on the topic of energy decision-making in the American political system" (Jones 1979). Analyses of this type are particularly important if one accepts the view espoused by Lovins (1977) and others that energy choices and decisions made today will preclude other choices in the future.

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