A MARKET ASSESSMENT FOR ACTIVE SOLAR HEATING AND COOLING PRODUCTS

CATEGORY B: A SURVEY OF DECISION-MAKERS IN THE HVAC MARKETPLACE

MEASUREMENT INSTRUMENTS

Report to

U.S. DEPARTMENT OF ENERGY
September 1980

OR/MS DIALOGUE, INC.
Cambridge, Massachusetts

DISCLAIMER

A MARKET ASSESSMENT FOR ACTIVE SOLAR HEATING AND COOLING PRODUCTS

CATEGORY B: A SURVEY OF DECISION MAKERS IN THE HVAC MARKET PLACE

SURVEY INSTRUMENTS

September, 1980

Prepared for:

Active Building Systems Branch
Office of Solar Applications for Buildings
U.S. Department of Energy

By:

OR/MS Dialogue, Inc.
Cambridge, Massachusetts

Project Directors

Dr. Gary L. Lilien
Paul E. Johnston

PROJECT STAFF

Project Directors	Dr. Gary L. Lilien Paul E. Johnston
Government Technical Representative	Fred A. Glaski Senior Program Coordinator Office of Solar Applications for Buildings Department of Energy
OR/MS Dialogue, Inc. Project Staff	Frank Fuller Kim Henson Cathlyn Hill Marian Johnson Shlomo Kalish Api Ruzdic Murray Wolinsky

Acknowledgements

The members of the study team wish to express their gratitude to the many individuals in the building, HVAC and solar industries as well as those in Federal and State agencies who gave generously of their time and counsel.

This report was prepared by OR/MS Dialogue, Inc. under DOE contract AC03-79CS-30209. The statements and conclusions contained herein do not necessarily reflect the views of the Department of Energy, nor does DOE make any warranty, express or implied, or assume responsibility for the accuracy or completeness of the information herein.

Table of Contents

THIS PAGE

WAS INTENTIONALLY

LEFT BLANK

RESIDENTIAL SEGMENT

TELEPHONE SCREENER QUESTIONNAIRE

THIS PAGE

WAS INTENTIONALLY

LEFT BLANK

VPIS JOB # 3750

Active Solar Products

Market Survey

STATE: [ ]

1 1-4

1 5-

Screener

Hello, I'm _____ from Dialogue an independent market research firm. We are conducting a national survey about solar energy.

I'd like to ask you a few brief questions.

1. Do you currently own a home?

yes_____ -1 no_____-2 (SKIP TO Q.6) 6-

2a. Does your home have a water heater, to supply hot water for baths, showers, dishwashing and so on? 7-

yes_____ -1 no_____-2 (TERMINATE AND TALLY)

2b. (IF YES TO Q.2a)
And what fuel does that water heater use? 8-

Gas _____-1
Electric _____-2
Oil _____-3
Solar _____-4
Other: (SPECIFY)
_____ -5

2c. If your water heater broke down and had to be replaced, would you replace it your self, or have someone do the work for you? 9-

Replace by self_____-1

And where would you buy the necessary parts? (DO NOT READ)

Plumbing supply house_____-1
Large merchandiser (Sears, etc.)_____-2
Hardware store, other small store____-3
Other (specify) _____-4
_____
10-

Have someone do work_____-2

And who would you be most likely to call to replace the broken water heater? ((DO NOT READ)

Plumber_____-1
Electric Co._____-2
Gas Co._____-3
Oil dealer_____-4
Solar dealer____-5
Friend, relative____-6
Other (specify)____-7
_____
11-

3. Are you currently using a solar energy system in your home?

yes_____ -1 (GO DIRECTLY TO YELLOW QUESTIONNAIRE) no_____-2 12-

4. How long have you owned your home? (READ LIST)

Keypunch: If "1" in cc 12 skip to yellow portion

less than 2 years _____-1
over 2 years _____-2
13-

5. When you moved in, was your home newly built, or was it owned by someone else?

newly built_____-1 owned by someone else_____-2 (TERMINATE IF Q.6 IS NOT "YES") 14-

6. Are you currently planning to build a new home or to buy a newly constructed home?

yes_____-1 no_____-2 (TERMINATE IF Q.5 IS NOT "NEWLY BUILT") 15-

(IF "LESS THAN 2 YEARS" IN Q.4 AND "NEWLY BUILT" IN Q.5, CONTINUE, OR IF "YES" TO Q.6, CONTINUE, OTHERWISE, TERMINATE)

7. Are you the person in your household who does most of the decision making about things like the heating and air conditioning?

(IF NOT: ASK TO SPEAK TO THE PERSON WHO IS AND REPEAT "HELLO, I'M _____ FROM DIALOGUE, AN INDEPENDENT MARKET RESEARCH COMPANY.")

We're conducting a study about solar energy and I'd like to ask you to participate. Its results will be used in the development of energy policy.

Let me tell you how the survey works. First, I'll ask you a few questions over the telephone. That will take about five minutes. When we're done, I'll mail you some information about solar energy systems. This material will also include a questionnaire. We ask you to read through the material that is sent and to discuss it with your family. Then, we'd like you to complete the questionnaire and return it in a prepaid return envelope.

I'll call you back again, in about a week, to answer any questions you may have about the questionnaire.

Our study is based on only 1500 respondents nationwide, and it's very important that we get a representative sample of households. In addition, most people who have already completed the survey have found it to be both interesting and informative. For these reasons I'd really like you to agree to take part. Are there any questions that you might have about the study? Will you participate?

yes_____ no_____ (GO TO DEMOGRAPHICS AND TERMINATE)

INDEX
16-17

STATE
18-19

REGION
20

1=North East
2=South
3=North Central
4=West

These are variables added to screener.

Terrific! Let me first get your name and address so that I can mail out the package of information.

RESPONDENT #:_____

Name_____ (PRINT CLEARLY! SOMEONE HAS TO COPY THIS OVER!)

Address_____

City_____ State_____ Zip_____

Telephone number (_____) _____

You will be receiving the information about solar energy equipment in a week or so. We'd like you to read the material, and to discuss it with your family if you think that would be appropriate. Enclosed with the literature will be some questions about the information presented. We would like you to complete the questionnaire and return it to us in the postage paid return envelope that will accompany it. I will be calling you back in a few days to answer specific questions you might have about the survey. If you don't have any questions, and can complete and mail the survey before I call again, please do so.

When would be a good time to call you next week?

DATE: _____

OUR TIME: _____ AM PM

(THEIR TIME: _____ AM, PM)

INTERVIEWER NAME:_____

DATE OF INTERVIEW: _____ TIME START:_____ TIME END:_____

(IF NECESSARY:) Of course, any information you will provide will be combined with all the other responses and will be used for statistical analysis only. Your participation will be completely confidential and your name will never be associated with this survey in any way.

Now, Mr./Ms. _____, let me ask you the first set of questions. To start with, ...

(STAPLE TO COMPLETED SURVEY FORM) 01 79-80

Duplicate 1-4

Introductory Telephone Survey

1. Prior to this survey, had you seen or heard anything about the use of solar energy equipment for home or water heating?

yes_____-1 no_____-2 (SKIP TO Q.15) 6-

2. In your area, can you currently buy solar energy systems for: (READ LIST)

	yes	no	not sure	
heating your home	_____-1	_____-2	_____-3	7-
providing electricity for your home	_____-1	_____-2	_____-3	8-
heating water	_____-1	_____-2	_____-3	9-
air conditioning your home	_____-1	_____-2	_____-3	10-

3a. Have you heard of any kinds of government sponsored financial incentives to home owners who install solar energy equipment?

yes_____-1 no_____-2 (SKIP TO Q.4) uncertain _____-3 (SKIP TO Q.4) 11-

3b. Do you know what kinds of forms any of these incentives take? (DO NOT READ LIST)

-tax rebate - is that
- federal, or _____ 13-1 (DON'T KNOW - WRITE IN "9") → what percent of the total cost of a solar energy system would that rebate pay? _____ 14-15 (DON'T KNOW - WRITE IN "99")
- state _____ 16-1 → what percent of the total cost of a solar energy system would that rebate pay? _____ 17-18

-low-interest loan - is that
- federal, or _____ 19-1 → what interest rate? _____ 20-21
- state _____ 22-1 → what interest rate? _____ 23-24

-lump sum payment or grant (outside of tax system) - is that

- federal, or _____ 25-1 → what percent of the total cost of a solar energy system would that payment cover? _____ 26-27
- state _____ 28-1 → what percent of the total cost of a solar energy system would that payment cover? _____ 29-30

- decreased fuel prices _____ 31-1

- other (please specify) _____ 32-1

- none mentioned _____ 33-1

4. Other than in a picture, have you ever seen a home equipped with solar collectors or solar panels?

yes_____-1 no_____-2 not sure_____-3 34-

5. Do you know anyone who is now using solar energy for home or water heating?

yes_____-1 no_____-2 not sure_____-3 35-

6. Have you actually gone looking for information about solar home or water heating equipment from a solar equipment manufacturer or dealer, a builder or an architect?

yes_____-1 no_____-2 (SKIP TO Q.8) 36-

7. For what kinds of solar energy systems have you looked for information?

water heating _____ 37-1
space and water heating _____ 38-1
heat pump _____ 39-1
other (SPECIFY) _____ 40-1

8. Are you likely or unlikely to have a solar home or water heating system installed in your home in the next year? (AS NECESSARY): Is that very likely/unlikely or somewhat likely/unlikely? And how about within the next 5 years? (AS NECESSARY): Is that very likely/unlikely or somewhat likely/unlikely?

	next year	next 5 years
very likely	_____-1	_____-1
somewhat likely	_____-2	_____-2
unsure	_____-3	_____-3
somewhat unlikely	_____-4	_____-4
very unlikely	_____-5	_____-5
	-41-	-42-

9. If you were to consider installing a solar energy system would you be interested or not interested in receiving information about_____? (READ TOPICS FROM BELOW, ONE AT A TIME) Would you be not at all interested, slightly interested, moderately interested, very interested? (READ FOR EACH TOPIC LISTED)

	Not Interested	Slightly Interested	Moderately Interested	Very Interested	
cost and savings	_____-1	_____-2	_____-3	_____-4	43-
how system works	_____-1	_____-2	_____-3	_____-4	44-
names of manufacturers	_____-1	_____-2	_____-3	_____-4	45-

10. Would you agree or disagree with the statement "I understand the financial merits of solar energy systems". (AS NECESSARY): Would that be strongly agree or disagree or moderately agree/disagree?

strongly agree	_____-1	
moderately agree	_____-2	
unsure	_____-3	47-
moderately disagree	_____-4	
strongly disagree	_____-5	

11. And would you agree or disagree with the statement "I understand how solar energy systems work." (AS NECESSARY) Would that be strongly agree/disagree or moderately agree/disagree?

strongly agree	_____-1	
moderately agree	_____-2	
unsure	_____-3	48-
moderately disagree	_____-4	
strongly disagree	_____-5	

12. Do you believe that you can or cannot currently obtain reliable and dependable solar energy equipment for home use? (AS NECESSARY): Is that definitely can/cannot or probably can/cannot?

definitely can	_____-1	
probably can	_____-2	
unsure	_____-3	49-
probably can not	_____-4	
definitely can not	_____-5	

13. Do you believe that you can or cannot currently obtain solar energy equipment that makes economic sense for home use? (AS NECESSARY): Is that definitely can/cannot or probably can/cannot?

definitely can	_____-1	
probably can	_____-2	
unsure	_____-3	50-
probably can not	_____-4	
definitely can not	_____-5	

14. Do you believe that solar energy equipment will or will not be widely used by homeowners in your area within the next five years? (AS NECESSARY): Is that definitely will/will not or probably will/will not?

definitely will	_____-1	
probably will	_____-2	
unsure	_____-3	51-
probably will not	_____-4	
definitely will not	_____-5	

(READ FOR RESPONDENTS WHO WILL NOT PARTICIPATE):

In order to be certain that we are interviewing a cross section of people, I would like to ask you a few statistical questions before we terminate.	52- 53 SP

(RESPONDENTS WHO REFUSE TO PARTICIPATE DO NOT COUNT TOWARD QUOTA)

Demographics

15. Finally, I would like to get a little more information about you and your household for classification purposes. Please tell me into which of the following age groups you fall? (READ LIST)

	under 25	_____-1
	25 - 34	_____-2
	35 - 44	_____-3
	45 - 54	_____-4
	over 55	_____-5
(DO NOT READ)	refused	_____-8

55-

16. What was the highest level of schooling completed by the head of your household? Was it: (READ LIST)

	Grammar school,	_____-1
	High school,	_____-2
	College or	_____-3
	Post-graduate work or degree	_____-4
(DO NOT READ)	Refused	_____-8

56-

17. Including yourself, how many people live in your home?

_____ 58-59

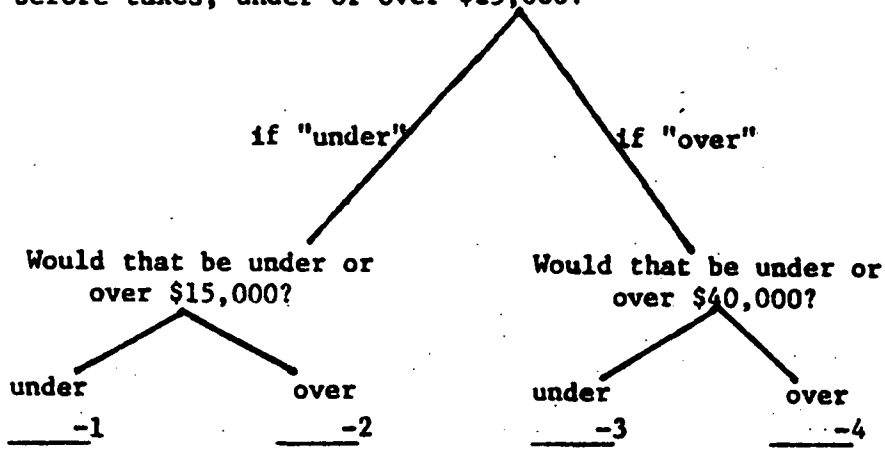
18. How many are: (READ)

Adults 18 or over	_____	60-61
Children under 18	_____	62-63

19. How many members of your household, including yourself, work outside the home for 30 hours or more per week?

64-65 _____

20. Finally, it would help us a great deal in our statistical analysis if we could get some idea about your income level. Was your total household income for last year, before taxes, under or over $25,000?



67- _____

(DO NOT READ) Refused _____ -8

21. (RECORD SEX:) Male ___-1 Female ___-2 68- _____

Once again, thank you for agreeing to participate in this study. I'll get the material in the mail today and you should have it soon. I'll talk to you again on (TIME AGREED UPON).

weight for screener . *69 70 71 72 73*

weight for main . *74 75 76 77 78*

(STAPLE TO SCREENER QUESTIONNAIRE)

02 79-80

(IF REFUSED TO ANSWER QUESTIONS 15, 16, or 20, DO NOT COUNT TOWARD QUOTA)

THIS PAGE

WAS INTENTIONALLY

LEFT BLANK

RESIDENTIAL SEGMENT

MAIL-OUT QUESTIONNAIRES

THIS PAGE

WAS INTENTIONALLY

LEFT BLANK

Existing Homes Segment

or/ms dialogue inc.

763 Massachusetts Avenue
Cambridge, Massachusetts 02139
(617) 661-9797

Dear Study Participant:

In this booklet you will find information about solar water heating systems. The description of the system is followed by a series of questions which relate to that particular description. The final section contains questions of a more general nature. Some of the questions here ask for information about your household energy usage. If you can, please use your records to answer these questions as accurately as possible. If you are unable to determine these answers exactly, please make an estimate. Other questions call for you to guess about the future, or ask for your opinions. On these kinds of questions there are no right or wrong answers, so just try to respond in a way that reflects your beliefs as accurately as possible.

We will be calling you back in a few days to answer specific questions you might have about the survey. The time agreed upon is_____. If, in the meantime, you have any questions about any of this material, please call us collect at Dialogue (617-661-9797) and we will try to help. If you don't have any questions, and can complete the survey before we call again, please do so.

Thank you very much for your help!

Sincerely,

Paul E. Johnston
Vice President

SOLAR DOMESTIC WATER HEATING SYSTEM FOR CALIFORNIA HOMES

A typical solar domestic water heating system is composed of a collector, a hot water storage tank, and the piping that connects them. The radiation of the sun heats the water as it passes through the collector. From the collector the warm water flows directly into a storage tank. The tank would be in the basement, or underground; it would be a standard size (about 80-90 gallons), of a type readily available. Controls keep the water circulating through the collector as long as the sun raises the temperature of the water. In general, this means that as long as the sun is out, the water will continue to circulate. At night, or when the weather is cold or cloudy, the water remains in the tank.

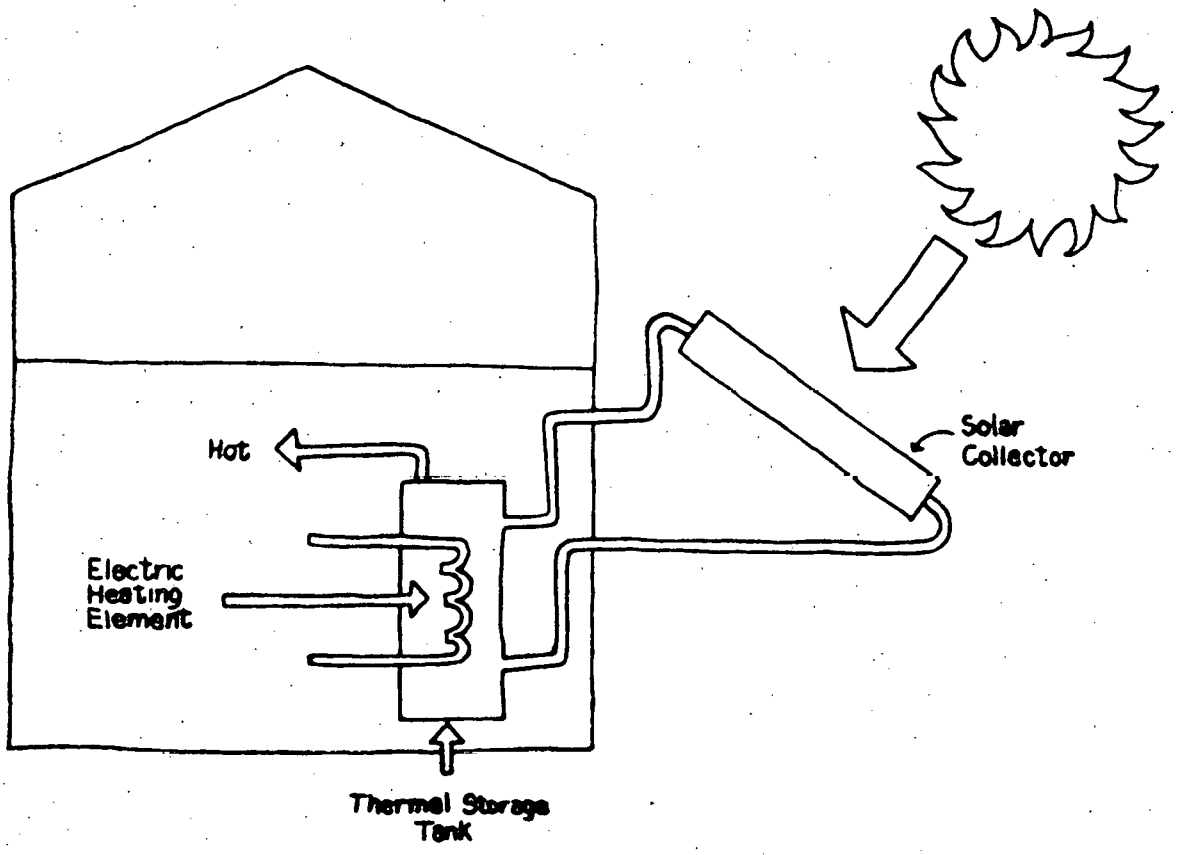
A solar system cannot, by itself, provide enough energy to meet all the hot water needs of an average family of four. In California, system manufacturers and dealers say that the system will supply between 60 and 80 percent of those needs. Any additional water heating that is required is provided automatically by a conventional backup system using oil, gas, or electricity.

Most families would need three solar collectors to trap the sun's heat. These collectors are a little bigger than an average door. They are made of a piece of metal painted black, covered with glass and mounted in a wooden or metal frame. Collectors may be mounted on your roof if you have a roof that faces south, or installed in your yard.

A solar domestic water heating system comes with a 5-year manufacturer's warranty. The system has an expected life of 15 years, which is comparable to the expected life of the roof of your home.

A diagram of a typical system is on the next page.

A TYPICAL SOLAR DOMESTIC WATER HEATING SYSTEM



Financial Information

PRICE: The gross price of a solar water heating system would be about $2300 for a family of four with average hot water needs. These numbers include materials and installation. However, both the federal government and the state of California offer refunds, paid to you as a lump sum subtracted from your income taxes. The actual cost to you would thus be lower than the gross price.

	Gross Price	$2300
(minus)	Tax Rebate	1265
	Actual Price	$1035

SAVINGS: The solar water heater will begin to save you money as soon as it is installed. However, the savings will grow because while the cost of alternative fuels will increase, the sun remains free. The amount that the average homeowner would save in lower energy costs during the first year of heating water with solar energy varies depending on what fuel is now being used to heat water (see below). The figures shown account for annual system maintenance and upkeep expenses.

Over the past 10 years, overall energy costs have increased at a rate of 12% per year. Rates of increase for individual fuels varied somewhat from the overall rate of increase. The most likely projections would have the rates of increase over the next years be about the same as over the last 10 years, as shown in the accompanying table. Under this assumption, the number of years it will take for total savings to add up to more than the original cost of the system (payback) has been calculated and is also shown in the table.

Solar Water Heating Savings by Fuel Currently Used

	Oil	Electricity	Gas
Rate of Fuel Price Increase			
Past 10 years	15%	10%	12%
Projected	15%	10%	12%
Estimated Savings			
First year	$131	$202	$ 28
Fifth year	$240	$300	$ 51
Years to Payback	5 1/2	4 1/4	13 1/4

The figures shown take into account:

1) energy used to run the solar water heater's pumps, and
2) annual maintenance and upkeep expenses, estimated at $25/year.

Questions About Solar Water Heating Systems

1. Please place a check next to the primary fuel that you use for heating water (for baths, showers, dishwashing, etc.) in your home. Check only one:

natural gas	_____	oil	_____
electricity	_____	other	_____
		(please specify)	_____

2. If the water heater you are now using were to break, how much would you expect to have to pay to replace it with a 40-50 gallon tank? (including installation) Check only one:

under $200	_____	$500 - 600	_____
$200 - 300	_____	$600 - 700	_____
$300 - 400	_____	$700 - 800	_____
$400 - 500	_____	over $800	_____

3. Have you ever seriously considered an alternative system for heating your water?

yes _____ no _____

4. Using the fuel indicated in Question 1, approximately how much did you spend for water heating last year? If you do not know approximately, please guess. How much do you expect to pay for water heating next year? How much do you think you will have to pay five years from now (in 1985)?

last year $_____	next year $_____ (guess)	in 1985 $_____ (guess)

5. The average price, including installation, of a solar water heating system, as described here, would be about $2300. This figure is for an average family of four with average hot water needs. Your family's needs may be more or less than the average, so you might need a larger or smaller system. Taking into consideration your family's hot water needs and what you know about both solar energy system prices and government incentives, how much would you expect such a system would cost <u>you</u>, if you were to buy one? Circle the letter over the column that is closest to this figure.

	A	B	C	D	E
Gross Price	$1600	$1900	$2300	$2600	$2900
(Minus) Tax Rebate	880	1045	1265	1430	1595
Actual Price	$ 720	$ 855	$1035	$1170	$1305

6. If you were to install a solar water heating system in your home now, <u>how much less</u> would you spend on hot water this year than you would spend using another system?

under $50	_____	$201 - 250	_____
$ 51 - 100	_____	$251 - 300	_____
$101 - 150	_____	$301 - 350	_____
$151 - 200	_____	over $350	_____

Please copy your "Actual Price" from Question 5 here:
This is your BASE PRICE

$_____ BASE PRICE

Please copy your savings estimate from Question 6 here:
This is your BASE SAVINGS

$ - _____ BASE SAVINGS

7a. Please look at your BASE PRICE and BASE SAVINGS, above. Thinking about your base figures, how likely would you be to buy a solar water heating system for your home in the next year? Please check the appropriate space:

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

7b. The description of a solar water heater says that a system usually comes with a 5-year warranty. Suppose now that the warranty is increased to cover the system for 15 years (with the same BASE PRICE and SAVINGS). How likely would you be to buy a system in the next year, if you could get this longer warranty? Please check the appropriate space:

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

7c. Prices for solar water heating systems may go down. Keeping your BASE SAVINGS (from above) in mind, suppose you could buy a system for 25% less than your BASE PRICE. (The new price of the system would then be 3/4 of your BASE PRICE.) How likely would you be to buy a system in the next year? Please check the appropriate space:

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

7d. Again using your BASE SAVINGS from above, suppose that you could buy a system for half of your BASE PRICE. How likely would you be to buy a system in the next year? Please check the appropriate space:

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

7e. Fuel prices may rise faster than we now expect. Go back to your BASE PRICE from above, but now suppose that your savings are 50% more than your estimated BASE SAVINGS. How likely would you be to buy a system in the next year, if you could get these increased savings? Please check the appropriate space:

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

8. If you were to purchase a solar water heating system, how would you be most likely to pay for it? (Check one space)

Personal savings	_____
Bank loan	_____
Other (please specify)	_____

9. If you were to purchase a solar water heating system, which of the following would you prefer to purchase it from? (Check only one)

A specialized solar system distributor/installer	_____
Your plumber	_____
Your builder	_____
Your electric or gas company	_____
Your oil dealer	_____
A large retail department store (for example, Sears)	_____
Other (please specify)	_____

10. What fuel, if any, do you use to heat the living space in your home? (If more than one, please check the <u>one</u> that is your <u>primary source</u> of energy.)

electricity	_____	other (please specify)	_____
natural gas	_____	_____	
oil	_____		
wood	_____	none	_____

General Questions

Please answer the following questions concerning the use of solar energy equipment in general.

1. Do you believe that you can currently obtain reliable and dependable solar energy equipment for home use?

   Definitely can ___
   Probably can ___
   Unsure ___
   Probably can not ___
   Definitely can not ___

2. Do you believe that you can currently obtain solar energy equipment that makes economic sense for home use?

   Definitely can ___
   Probably can ___
   Unsure ___
   Probably can not ___
   Definitely can not ___

3. Do you believe that solar energy equipment will be widely used by homeowners in your area within the next five years?

   Definitely will ___
   Probably will ___
   Unsure ___
   Probably will not ___
   Definitely will not ___

4. Please indicate, by circling a number on the scale, how strongly you agree or disagree with each of the following statements:

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a. I understand the financial merits of solar energy systems.	1	2	3	4	5
b. I understand how solar energy systems work.	1	2	3	4	5
c. Solar energy systems can provide a lot of protection from future energy shortages.	1	2	3	4	5

4. (continued)

		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
d.	A solar water heating system would greatly increase the resale value of my home.	1	2	3	4	5
e.	If a solar energy system that I installed failed and needed major repairs or replacement, it could mean a financial disaster for my family.	1	2	3	4	5
f.	Solar collectors would be very unattractive on my house.	1	2	3	4	5
g.	It would be very easy to obtain financing for a solar energy system.	1	2	3	4	5
h.	If a solar energy system that I installed gave less savings than I had expected, it could mean a financial disaster for my family.	1	2	3	4	5
i.	Solar equipment would protect me from increasing energy costs.	1	2	3	4	5
j.	I would vote for zoning restrictions to ban solar collectors from the front of houses in my neighborhood.	1	2	3	4	5
k.	Manufacturers of solar systems are mostly little companies that are here today and will probably be gone tomorrow.	1	2	3	4	5
l.	Solar energy equipment will produce maintenance nightmares for me.	1	2	3	4	5
m.	I would admire a neighbor who installed solar equipment.	1	2	3	4	5
n.	A political candidate who supports solar is progressive.	1	2	3	4	5
o.	Technological advances will soon make currently available solar equipment outdated.	1	2	3	4	5
p.	A solar water heating system might save me money in the long run, but the initial cost is just too high for me to consider buying one.	1	2	3	4	5
q.	If more people were aware of the information shown in this questionnaire, more of them would buy solar energy systems.	1	2	3	4	5

5. Please check the one space in each row that best indicates how interested you would be in more information about each of the items listed.

	Not Interested	Slightly Interested	Moderately Interested	Very Interested
cost and savings	____	____	____	____
how system works	____	____	____	____
names of manufacturers	____	____	____	____

6. Do you intend to look for additional information about solar energy systems within the next two or three months?

Yes _____ No _____ (If "NO", please skip to 0.8)

7. About what kinds of solar energy systems will you look for information?

solar water heating ____
solar-assisted heat pump ____
solar home heating ____
other (please specify) _____

8. How likely are you to have a solar home or water heating system installed in your home within the next year? Within the next 5 years?

	within the next year	within the next 5 years
Very likely	_____	_____
Somewhat likely	_____	_____
Unsure	_____	_____
Somewhat unlikely	_____	_____
Very unlikley	_____	_____

9. Which of the following categories best describes your family's composition? (PLEASE CHECK ONLY ONE SPACE)

No (zero) children living at home _____

Children living at home:
- youngest under age 6 _____
- youngest age 6 - 12 _____
- youngest age 13 or over _____

10. Approximately how much does a gallon of unleaded, regular gasoline cost in your area?

$1.10 or less	_____	$1.25	_____
$1.15	_____	$1.30	_____
$1.20	_____	$1.35 or more	_____

11. How much do you think a gallon of unleaded, regular gasoline will cost five years from now (in 1985)?

$_____

12. Which of the following products have <u>you</u> bought for your own or your family's use?

microwave oven	_____	waterbed	_____
shower massage	_____	quartz room heater	_____
home table-top computer	_____	water pik	_____
videotape player/recorder	_____	digital watch	_____
food processor	_____	whirlpool bath, spa or hot tub	_____
		none of the above	_____

Thank you very much for your help! Please place your completed questionnaire in the postage paid return envelope and mail it back to us at your earliest convenience.

If you would be interested in the results of this study, just write your name and address in the space below and we will be happy to send them to you when they are available.

Name_____

Street_____

City_____State_____Zip_____

Variable Financial Information

Short Undeterministic

Financial Information

PRICE: The gross price of a solar domestic water heating system would be between $1600 and $2900, or about $2300 for a family of four with average hot water needs. These numbers include materials and installation. However, both the federal government and the state of California offer refunds, paid to you as a lump sum subtracted from your income taxes. The actual cost to you would thus be much lower than the gross price. For an average system the figures would be:

	Low Estimate	Average Estimate	High Estimate
Gross Price	$1600	$2300	$2900
(minus) Tax Rebate	880	1265	1595
Actual Price	$ 720	$1035	$1305

SAVINGS: The solar domestic water heater will begin to save you money as soon as it is installed. However, the savings will grow because while the cost of alternative fuels will increase, the sun remains free. The amount that the average homeowner would save in lower energy costs during the first year of heating water with solar energy varies depending on what fuel is now being used to heat water (see table). The figures shown account for annual system maintenance and upkeep expenses.

Over the past 10 years, overall energy costs have increased at a rate of 12% per year. Rates of increase for individual fuels varied somewhat from the overall rate of increase. The "most likely" projections would have the rate of increase over the next years be about the same over the last 10 years, as shown in the accompanying tables. However, forecasting future energy costs is no easy business. Energy costs could increase at a lower or higher rate than in the past. As a result, the tables show savings calculated using low and high rate increase assumptions as well as the most likely assumption. Under each assumption, the number of years it will take for your total savings to add up to more than the original cost of the system (pay-back) has been calculated, and is also shown in the tables.

California

Solar Water Heating Savings by Fuel Currently Used*

	Oil		
	Low	Most likely	High
Rate of fuel price increase			
Past 10 years - 15%			
Projected	10%	15%	20%
Estimated savings ($)			
First year	131	131	131
Fifth year	196	240	291
Years to payback	6	5 1/2	5

	Electricity		
	Low	Most likely	High
Rate of fuel price increase			
Past 10 years - 10%			
Projected	7%	10%	15%
Estimated savings ($)			
First year	202	202	202
Fifth year	265	300	364
Years to payback	5	4 1/4	4

	Gas		
	Low	Most likely	High
Rate of fuel price increase			
Past 10 years - 12%			
Projected	8%	12%	17%
Estimated savings ($)			
First year	28	28	28
Fifth year	39	51	67
Years to payback	17 1/4	13 1/4	11

*The figures shown take into account
1) energy used to run the solar water heater's pumps, and

THIS PAGE

WAS INTENTIONALLY

LEFT BLANK

Variable Financial Information

Long Deterministic

Financial Information

PRICE: The gross price of a solar domestic water heating system would be about $2300 for a family of four with average hot water needs. These numbers include materials and installation. However, both the federal government and the state of California offer refunds, paid to you as a lump sum subtracted from your income taxes. The actual cost to you would thus be much lower than the gross price.

	Gross Price	$2300
(minus)	Tax Rebate	1265*
	Actual Price	$1035

SAVINGS: The solar domestic water heater will begin to save you money as soon as it is installed. However, the savings will grow because while the cost of alternative fuels will increase, the sun remains free. The amount that the average homeowner would save in lower energy costs during the first year of heating water with solar energy varies depending on what fuel is now being used to heat water (see Appendix 1). The figures shown account for annual system maintenance and upkeep expenses.

Over the past 10 years, overall energy costs have increased at a rate of 12% per year. Rates of increase for individual fuels varied somewhat from the overall rate of increase. (See graph shown in Appendix 2.) The most likely scenario would have the rate of increase over the next years be about the same as over the last 10 years, that is, 12%. Under this assumption, the number of years it will take for your total savings to add up to more than the original cost of the system (payback) has been calculated and is shown in Appendix 1.

* see Appendix 3 for calculation of Tax Credit

PAYING FOR A SYSTEM: You could pay for a solar system in cash -- in that case you would forego the interest that you could earn on the $1035 that you use to purchase the solar system. Instead of buying a solar system, you could put the money in a 10% savings account, but of course you would have to pay income tax on the interest earnings -- how much tax would depend on your tax bracket.

You could also borrow money to pay for the system -- several banks are now giving "energy improvement" loans for 12 - 13 1/2 percent interest. If you were to borrow $1035 for 10 years at, say, 13%, the payments would add up to $185 per year. In this situation, of course, the interest portion of your loan payment would be deductible for federal tax purposes, so your real annual expense would be less -- how much less would depend on your tax bracket.

Appendix 1 presents a comparison of interest earnings, loan payments, and most likely savings from a solar domestic water heater.

INCENTIVES AND REBATES: Both the federal government and the state of California have tax rebates that you can take advantage of if you buy a solar domestic water heating system. See Appendix 3 for further information on federal and state tax rebates.

Appendix 1

California

Comparisons of Solar Domestic Water Heater Savings with Interest Earnings and Loan Payments

Year	Savings			Annual Interest Earnings(1)	Annual L Payment(2)
	Oil	Electricity	Gas		
1	$ 131	$ 202	$ 28	$ 104	$ 185
2	153	223	33	114	185
3	178	246	38	125	185
4	207	272	44	138	185
5	240	300	51	132	185
6	279	331	58	167	185
7	323	365	67	183	185
8	375	402	77	202	185
9	434	442	88	222	185
10	503	489	101	244	185
11	582	540	115		
12	673	595	132		
13	778	656	150		
14	900	723	171		
15	039	798	195		
Totals:	$ 6794	$ 6584	$ 1348	$ 1650	$ 1850
Years to Payback	5 1/2	4 1/4	13 1/4		

The figures shown take into account: a) energy used to run the solar water heater's pumps, and
b) annual maintenance and upkeep expenses estimated at $25/year.

(1) assumes $ 1035, plus all accumulated interest, left in a 10% account for 10 years. (You would have to pay income tax on these earnings, so your actual interest income would be lower than these numbers indicate; how much lower would depend on your income tax bracket.)

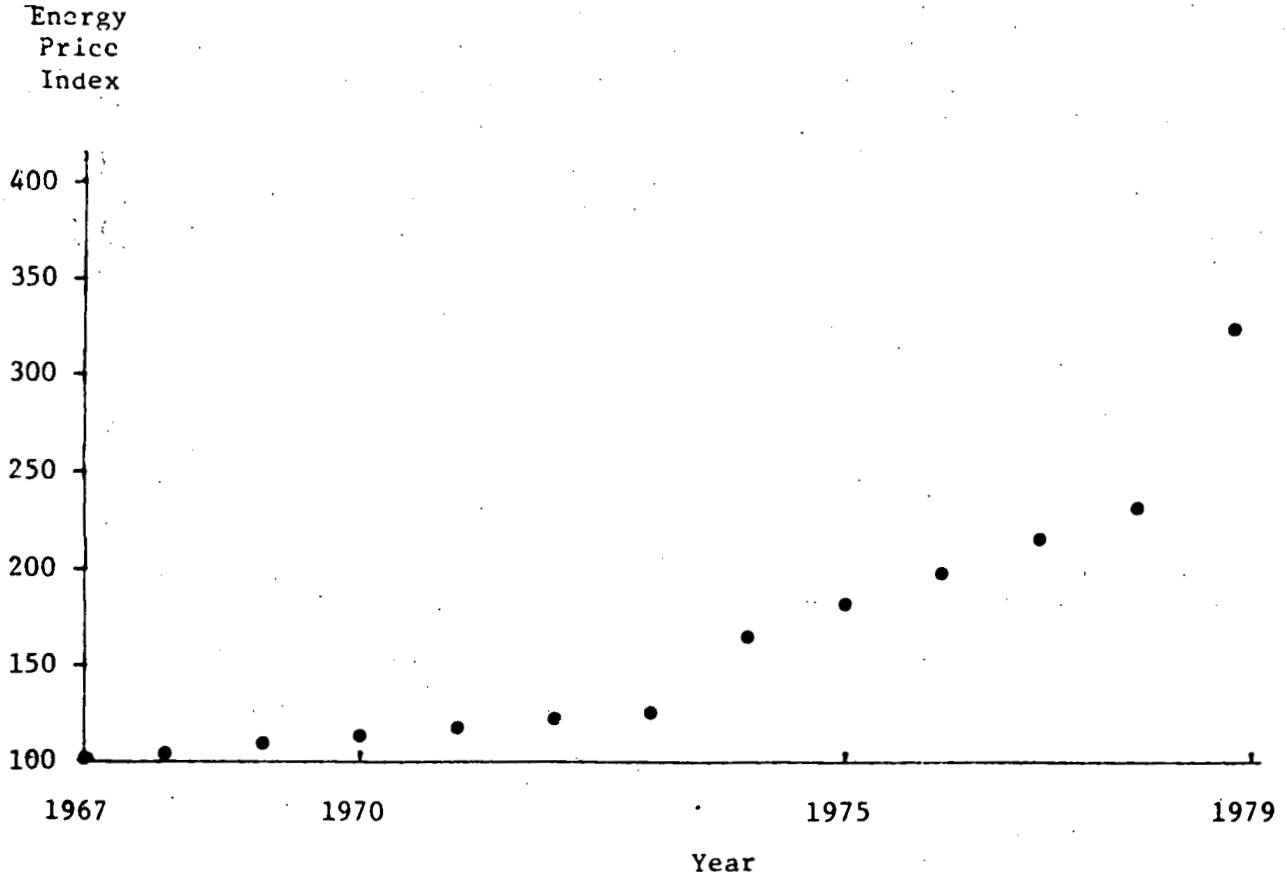
(2) assumes $ 1035 loan for 10 years at 13%. (You would get to deduct the interest portion of these payments from your income before figuring your taxes, so your out-of-pocket expense would actually be lower than these numbers suggest; how much lower would depend on your income tax bracket.)

Appendix 2

Individual Fuel Cost Rates of Increase*

	Overall	Oil	Electricity	Gas
Past 10 years	12%	15%	10%	12%
Projected	12%	15%	10%	12%

Energy Price Index for 12 years*



* Data from Consumer Price Index, U.S. Department of Labor

Appendix 3

Federal and State Income Tax Rebates

Federal Income Tax Rebate

30% of the first $2,000 of gross price (including installation)

20% of the amount over $2,000

Total rebate not to exceed $2,200

California State Income Tax Rebate

55% of system price, retail plus installation, up to a maximum rebate of $3,000, minus the federal rebate

Thus, on a $2,300 system, rebates are calculated as:

Federal

30% of $2,000	=	$ 600
20% of $ 300	=	60
Total Rebate	=	$ 660

California

55% of $2,300	=	$1,265
minus federal rebate	=	660
		$ 605

Total

Federal	=	$ 660
California	=	605
		$1,265

Variable Financial Information

Special New England

Financial Information

PRICE: The gross price of a solar domestic water heating system would be between $2600 and $4100, or about $3300 for a family of four with average hot water needs. These numbers include materials and installation. However, both the federal government and the state of Massachusetts offer refunds, paid to you as a lump sum subtracted from your income taxes. The actual cost to you would thus be much lower than the gross price. For an average system the figures would be:

	Low Estimate	Average Estimate	High Estimate
Gross Price	$2600	$3300	$4100
(minus) Tax Rebate	1378	1714	2020
Actual Price	$1222	$1586	$2080

SAVINGS: The solar domestic water heater will begin to save you money as soon as it is installed. However, the savings will grow because while the cost of alternative fuels will increase, the sun remains free. The amount that the average homeowner would save in lower energy costs during the first year of heating water with solar energy varies depending on what fuel is now being used to heat water (see table). The figures shown account for annual system maintenance and upkeep expenses.

Over the past 10 years, overall energy costs have increased at a rate of 12% per year. However, over the most recent past, some forms of energy have increased at a 40% rate. Forecasting future energy costs, and thus the amount of money a solar water heating system would save, is no easy business. Perhaps the "most likely" event would be for the future rate of increase in energy costs to be the same as it has been over the past 10 years. However, the tables on the following page display savings under "high" and "low" energy cost increases as well. For each of these three possibilities (low, most likely, and high energy cost increases), the number of years it will take for your total savings to add up to more than the original cost of the system has been calculated. This length of time is called "payback".

Massachusetts

Solar Water Heating Savings by Fuel Currently Used*

Oil	Low	Most likely	High
Rate of fuel price increase			
Past 10 years - 15% Projected	10%	15%	40% for 5 years 20% thereafter
Estimated savings ($)			
First year	103	103	103
Fifth year	155	191	459
Years to payback	10	8 1/4	6

Electricity	Low	Most likely	High
Rate of fuel price increase			
Past 10 years - 10% Projected	7%	10%	35% for 5 years 17% thereafter
Estimated savings ($)			
First year	231	231	231
Fifth year	303	342	818
Years to payback	6	5 1/2	4

Gas	Low	Most likely	High
Rate of fuel price increase			
Past 10 years - 12% Projected	8%	12%	30% for 5 years 15% thereafter
Estimated savings ($)			
First year	66	66	66
Fifth year	91	110	227
Years to payback	14	11 1/2	8

*The figures shown take into account
1) energy used to run the solar water heater's pumps, and

THIS PAGE

WAS INTENTIONALLY

LEFT BLANK

Variable Financial Information

Special Concentrating Collector

SOLAR DOMESTIC WATER HEATING SYSTEM FOR FLORIDA HOMES

A typical solar domestic water heating system is composed of a collector, a hot water storage tank, and the piping that connects them. The radiation of the sun heats the water as it passes through the collector. From the collector the warm water flows directly into a storage tank. The tank would be in the basement, or underground; it would be a standard size (about 80-90 gallons), of a type readily available. Controls keep the water circulating through the collector as long as the sun raises the temperature of the water. In general, this means that as long as the sun is out, the water will continue to circulate. At night, or when the weather is cold or cloudy, the water remains in the tank.

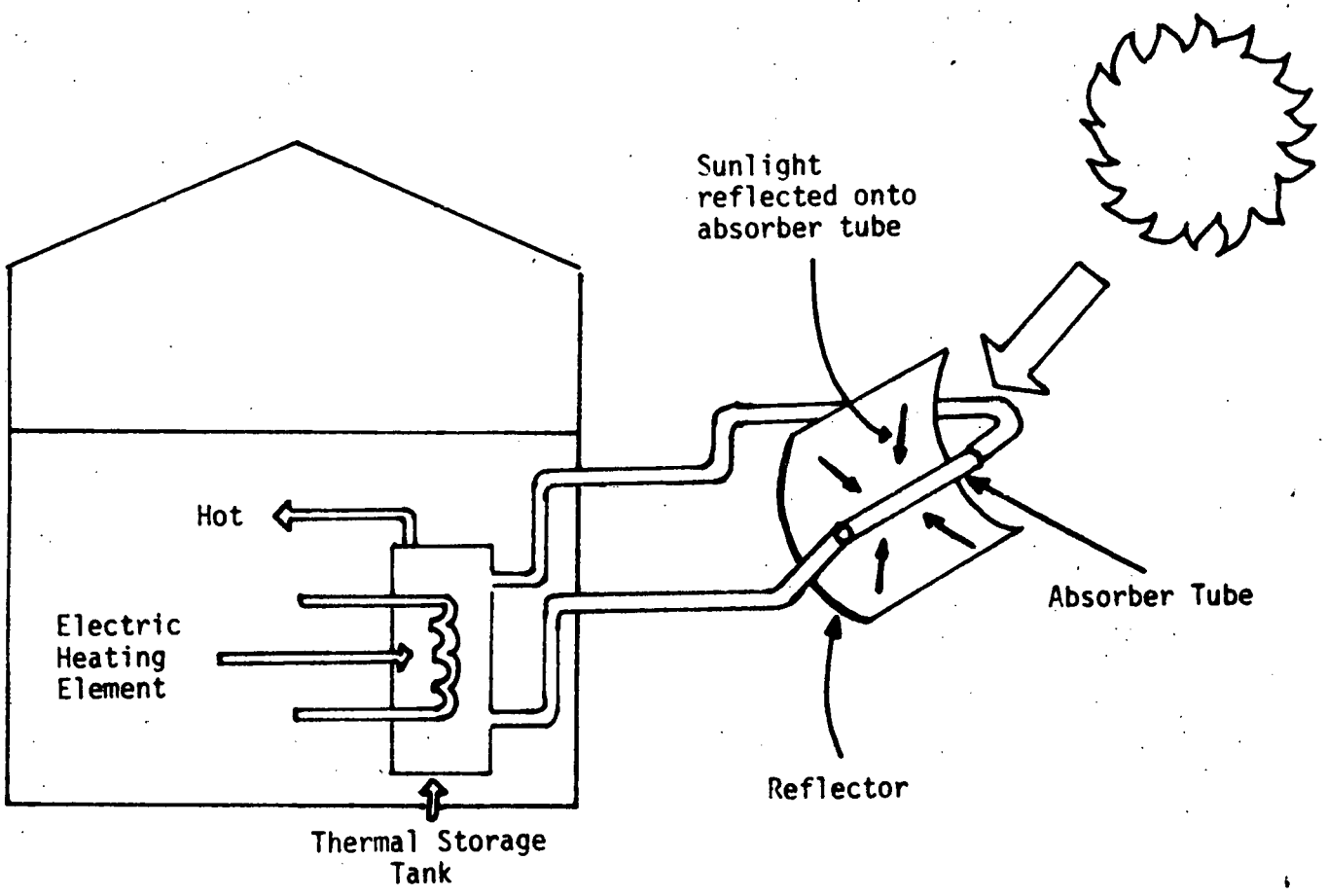
A solar system cannot, by itself, provide enough energy to meet all the hot water needs of an average family of four. In Florida, system manufacturers and dealers say that the system will supply between 70 and 90 percent of those needs. Any additional water heating that is required is provided automatically by a conventional backup system using oil, gas, or electricity.

A concentrating collector array is made of a shiny curved reflector and an "absorber" tube. The curved surface of the collector reflects sunlight onto the absorber tube, thus "concentrating" the solar energy at the tube. Water is pumped through the tube, where it absorbs the concentrated heat. The collector is mounted on a frame which moves so that the collectors remain aimed at the sun thoughout the day. The collector and frame may be mounted on your roof if you have a roof that faces south, or installed in your yard.

A solar domestic water heating system comes with a 5-year manufacturer's warranty. The system has an expected life of 15 years, which is comparable to the expected life of the roof of your home.

A diagram of a typical system is on the next page.

A TYPICAL SOLAR DOMESTIC WATER HEATING SYSTEM WITH CONCENTRATING COLLECTOR



THIS PAGE

WAS INTENTIONALLY

LEFT BLANK

New Homes Segment

or/ms dialogue inc.

763 Massachusetts Avenue
Cambridge, Massachusetts 02139
(617) 661-9797

Dear Study Participant:

This study is being conducted among people who are thinking about buying a newly constructed home, who are building one, or who have recently moved into a newly constructed home. If you are now looking for or building a new home, please answer these questions in terms of the house you would like to buy, or are building. If you now live in your new home, please try to take yourself back to the time when you were thinking about buying or building. Then answer the questions as you would have at that time. In this booklet you will find information about solar water heating and home heating systems. Each description is followed by a series of questions which relate to that particular description. The final section contains questions of a more general nature. Some of the question here ask for information about your current or planned household energy usage. If you can, please use your records to answer these questions as accurately as possible. Otherwise, please make an estimate. Other questions call for you to guess about the future, or ask for your opinions. On these kinds of questions there are no right or wrong answers, so just try to respond in a way that reflects your beliefs as accurately as possible.

We will be calling you back in a few days to answer specific questions you might have about the survey. The time agreed upon is_____. If, in the meantime, you have any questions about any of this material, please call us collect at Dialogue (617-661-9797) and we will try to help. If you don't have any questions, and can complete the survey before we call again, please do so.

Thank you very much for your help!

Sincerely,

Paul E. Johnston
Vice President

D2

SOLAR DOMESTIC WATER HEATING SYSTEM FOR CALIFORNIA HOMES

A typical solar domestic water heating system is composed of a collector, a hot water storage tank, and the piping that connects them. The radiation of the sun heats the water as it passes through the collector. From the collector the warm water flows directly into a storage tank. The tank would be in the basement, or underground; it would be a standard size (about 80-90 gallons), of a type readily available. Controls keep the water circulating through the collector as long as the sun raises the temperature of the water. In general, this means that as long as the sun is out, the water will continue to circulate. At night, or when the weather is cold or cloudy, the water remains in the tank.

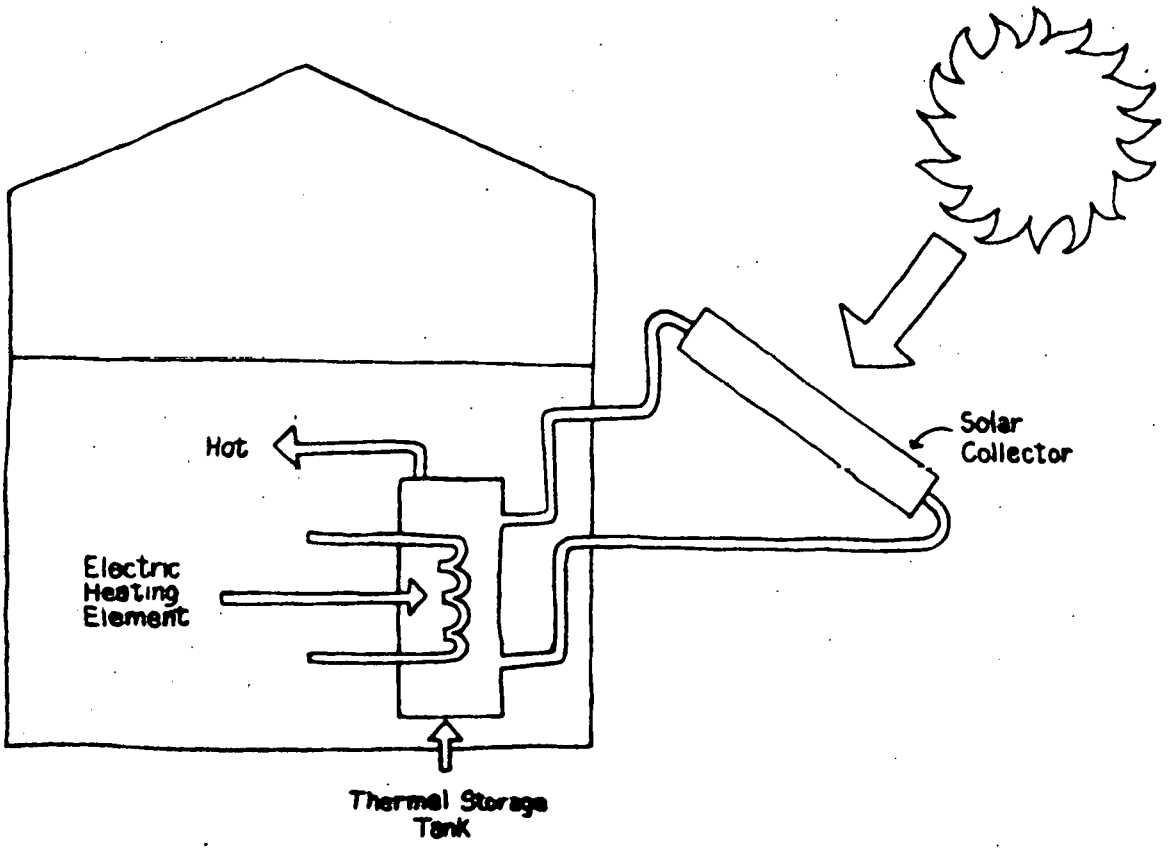
A solar system cannot, by itself, provide enough energy to meet all the hot water needs of an average family of four. In California, system manufacturers and dealers say that the system will supply between 60 and 80 percent of those needs. Any additional water heating that is required is provided automatically by a conventional backup system using oil, gas, or electricity.

Most families would need three solar collectors to trap the sun's heat. These collectors are a little bigger than an average door. They are made of a piece of metal painted black, covered with glass and mounted in a wooden or metal frame. Collectors may be mounted on your roof if you have a roof that faces south, or installed in your yard.

A solar domestic water heating system comes with a 5-year manufacturer's warranty. The system has an expected life of 15 years, which is comparable to the expected life of the roof of your home.

A diagram of a typical system is on the next page.

A TYPICAL SOLAR DOMESTIC WATER HEATING SYSTEM



Financial Information

PRICE: The gross cost of a solar water heating system would be about $2300 for a family of four with average hot water needs. These numbers include materials and installation. However, both the federal government and the state of California offer refunds, paid to you as a lump sum subtracted from your income taxes. The actual cost to you (or increase in the cost of your home) would thus be lower than the gross price.

	Gross Cost	$2300
(minus)	Tax Rebate	1265
	Actual Cost	$1035

PAYING FOR A SYSTEM: You could pay for a system with cash. Alternatively you could finance the system through your mortgage. The following figures are typical of payments if the system is included in a home mortgage: (25 years, current interest rates)

Additional down payment at time of purchase:	$ 210
Increase in monthly mortgage payment:	$ 10

SAVINGS: The solar water heater will begin to save you money as soon as it is installed. However, the savings will grow because while the cost of alternative fuels will increase, the sun remains free. The amount that the average homeowner would save in lower energy costs during the first year of heating the home with solar energy varies depending on the alternative fuel that is used (see below). The figures shown account for annual system maintenance and upkeep expenses.

Over the past 10 years, overall energy costs have increased at a rate of 12% per year. Rates of increase for individual fuels varied somewhat from the overall rate of increase. The most likely projections would have the rates of increase over the next years be about the same as over the last 10 years, as shown in the accompanying table. Under this assumption, the number of years it will take for total savings to add up to more than the original cost of the system (payback) has been calculated and is also shown in the table.

Solar Water Heating Savings by Alternative Fuels

	Oil	Electricity	Gas
Rate of Fuel Price Increase			
Past 10 years	15%	10%	12%
Projected	15%	10%	12%
Estimated Savings			
First year	$131	$202	$ 28
Fifth year	$240	$300	$ 51
Years to Payback	5 1/2	4 1/4	13 1/4

The figures shown take into account:

1) energy used to run the solar water heater's pumps, and
2) annual maintenance and upkeep expenses, estimated at $25/year.

To begin with, are you now living in your new home, are you looking for a new home or building one?

Now living in new home	___	(Please answer the rest of this questionnaire in terms of this home.)
Now looking	___	(Please answer the rest of this questionnaire in terms of the house you would like to buy.)
Now building	___	(Please answer the rest of the questionnaire in terms of the house you are building.)

Questions About Solar Water Heating Systems

1. Please place a check next to the primary fuel that you use or expect to use for heating water (for baths, showers, dishwashing, etc.) in your home. Check only one:

natural gas _____ oil _____
electricity _____ other _____
(please specify)_____

2. Using the fuel indicated in Question 1, approximately how much did you spend for water heating last year? If you do not know approximately, please guess. How much do you expect to pay for water heating next year? How much do you think you will have to pay five years from now (in 1985)?

last year $_____ (answer only if you are now living in the new home) next year $_____ (guess) in 1985 $_____ (guess)

3. The average cost, including installation, of a solar water heating system, as described here, would be about $2300. This figure is for an average family of four with average hot water needs. Your family's needs may be more or less than the average, so you might need a larger or smaller system. Taking into consideration your family's hot water needs and what you know about both solar energy system prices and government incentives, by how much would you expect the cost of your new home to increase if it were to be equipped with a solar water heater? Circle the letter over the column that is closest to this figure.

	A	B	C	D	E
Gross Cost	$1600	$1900	$2300	$2600	$2900
(Minus) Tax Rebate	880	1045	1265	1430	1595
Actual Cost	$ 720	$ 855	$1035	$1170	$1305

4. If your new home had a solar water heating system, how much less do you think you would spend on hot water next year than you would spend using another system?

under $50 _____ $201 - 250 _____
$ 51 - 100 _____ $251 - 300 _____
$101 - 150 _____ $301 - 350 _____
$151 - 200 _____ over $350 _____

Please copy your "Actual Cost" from Question 3 on previous page here: (This is your BASE COST) $_____ BASE COST

Please copy your savings estimate from Question 4 on previous page here: (This is your BASE SAVINGS) $_____ BASE SAVINGS

. Please look at your BASE COST and BASE SAVINGS, above. Thinking about your base figures, how likely are you to try to get a solar water heating system installed in your new home?

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

5b. The description of a solar water heater says that a system usually comes with a 5-year warranty. Suppose now that the warranty is increased to cover the system for 15 years (with the same BASE COST and SAVINGS). How likely would you be to try to get a system installed in your new home, if you could get this longer warranty? Please check the appropriate space:

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

5c. Prices for solar water heating systems may go down. Keeping your BASE SAVINGS (from above) in mind, suppose you could have a system installed in your new home for 25% less than your BASE COST. (The new price of the system would then be 3/4 of your BASE COST.) How likely would you be to try to get a system installed? Please check the appropriate space:

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

5d. Again using your BASE SAVINGS from above, suppose that you could have a system installed in your new home for half of your BASE COST. How likely would you be to try to get a system installed? Please check the appropriate space:

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

5e. Fuel prices may rise faster than we now expect. Go back to your BASE COST from above, but now suppose that your savings are 50% more than your estimated BASE SAVINGS. How likely would you be to try to get a system installed in your new home, if you could get these increased savings? Please check the appropriate space:

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

D5

SOLAR HOME AND WATER HEATING SYSTEM

FOR CALIFORNIA HOMES

A typical residential solar home heating system is composed of a collector, a storage tank and the piping that connects them. The radiation of the sun heats water (or, in some systems, air) as it passes through the collector. The heat is then distributed through the house through its normal set of air ducts, radiators or baseboard units. If the heat is not needed immediately, it is placed in a storage system. Controls keep the circulation going as long as the sun is providing additional heat to either the house or to the storage system. At night, or when the weather is cold or cloudy, the collector circulation shuts down and the distribution system works to draw heat from storage, and to distribute that heat to the living space in the house.

Part of the system would also provide hot water for domestic use.

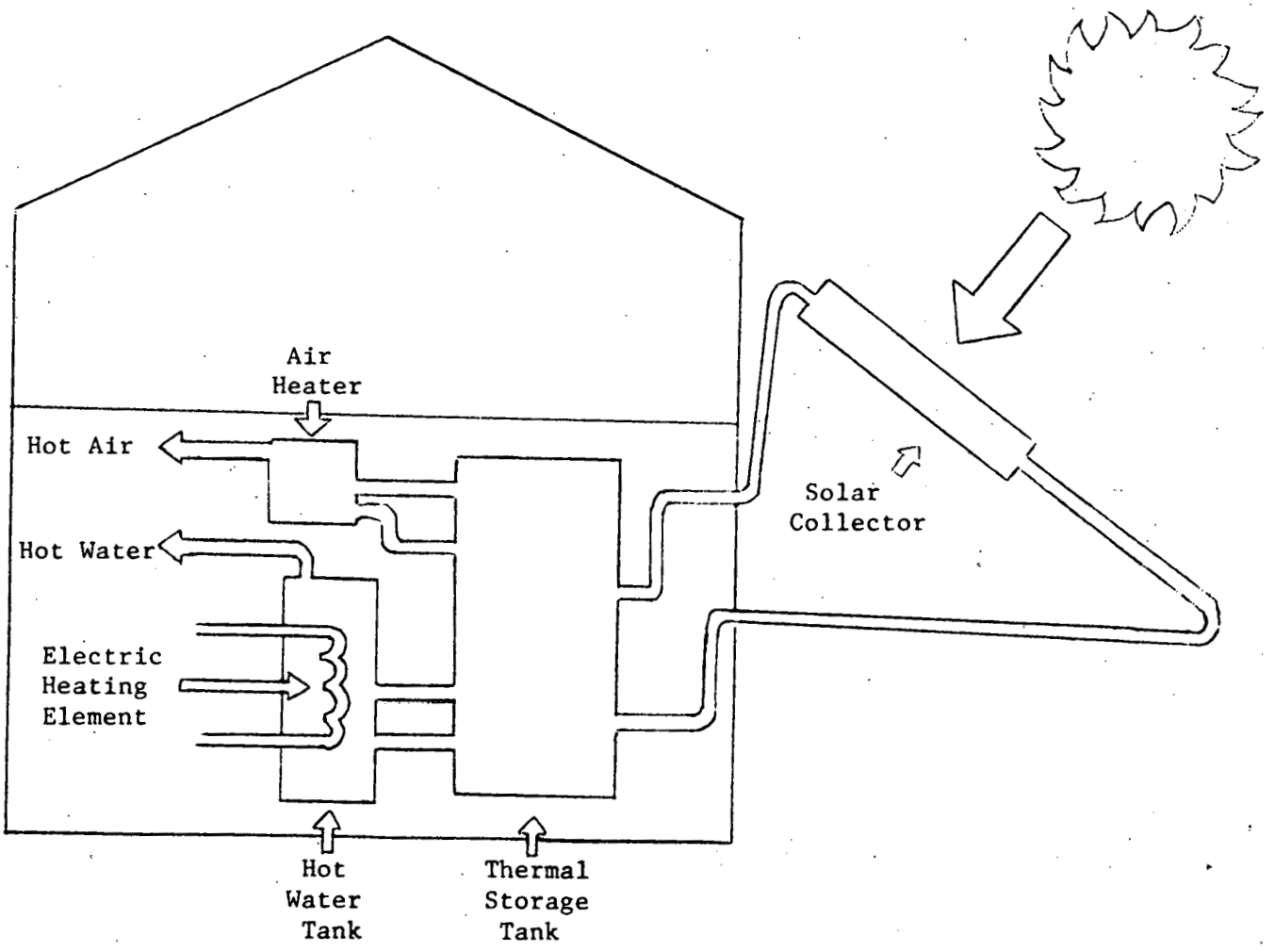
A solar energy system cannot, by itself, provide enough energy to meet all the heating and hot water needs of most families. In California, a typical system will supply between 70 and 90 percent of those needs. Any additional heat that is required is provided automatically by a conventional back-up system, using gas, electricity or oil.

Most families in this area would need 10 collectors to trap the sun's heat. These collectors are a little bigger than an average door. They are made of a piece of metal painted black, covered with glass and mounted in a wooden or metal frame. Collectors are usually mounted on the roof of your home, although they can also be installed in your yard. The storage system consists of a large water tank (about 1000-2000 gallons of water) or a bin of small rocks or pebbles. Storage systems are usually installed in the basement or buried immediately outside if no basement or crawl space is available.

A solar home and water heating system comes with a 5-year manufacturer's warranty. The collectors have an expected life of 15 years, which is comparable to the expected life of your roof.

A diagram of a typical system is shown on the next page.

A TYPICAL SOLAR HOME AND WATER HEATING SYSTEM



Financial Information

PRICE: The gross cost of a solar space and water heating system would be about $6200 for a family of four with average heat and hot water needs. These numbers include materials and installation. However, both the federal government and the state of California offer refunds, paid to you as a lump sum subtracted from your income taxes. The actual cost to you (or increase in the cost of your home) would thus be lower than the gross price.

	Gross Cost	$6200
(minus)	Tax Rebate	3000
	Actual Cost	$3200

PAYING FOR A SYSTEM: You could pay for a system with cash. Alternatively you could finance the system through your mortgage. The following figures are typical of payments if the system is included in a home mortgage: (25 years, current interest rates)

Additional down payment at time of purchase:	$ 640
Increase in monthly mortgage payment:	$ 32

SAVINGS: The solar space and water heating system will begin to save you money as soon as it is installed. However, the savings will grow because while the cost of alternative fuels will increase, the sun remains free. The amount that the average homeowner would save in lower energy costs during the first year of heating the home with solar energy varies depending on the alternative fuel that is used (see below). The figures shown account for annual system maintenance and upkeep expenses.

Over the past 10 years, overall energy costs have increased at a rate of 12% per year. Rates of increase for individual fuels varied somewhat from the overall rate of increase. The most likely projections would have the rates of increase over the next years be about the same as over the last 10 years, as shown in the accompanying table. Under this assumption, the number of years it will take for total savings to add up to more than the original cost of the system (payback) has been calculated and is also shown in the table.

Solar Space and Water Heating Savings by Alternative Fuels

Rate of Fuel Price Increase	Oil	Electricity	Gas
Past 10 years	15%	10%	12%
Projected	15%	10%	12%
Estimated Savings			
First year	$280	$469	$ 84
Fifth year	$512	$694	$145
Years to Payback	7	5 1/2	14

The figures shown take into account:
1) energy used to run the system's pumps, and
2) annual maintenance and upkeep expenses, estimated at $50/year.

Questions About Solar Space and Water Heating Systems

1. What fuel, if any, do you use or plan to use to heat the living space in your home? (If more than one, please check the one that is your primary source of energy.)

electricity_____	other (please specify)_____
natural gas_____	
oil _____	_____
wood _____	none _____

2. Using the fuel indicated in Question 1, approximately how much did you spend for heating your home last year? If you do not know approximately, please guess. How much do you expect to pay for heating your home next year? How much do you think you will have to pay five years from now (in 1985)?

last year $_____ (answer only if you are now living in the new home)	next year $_____ (guess)	in 1985 $_____ (guess)

3. The average cost, including installation, of a solar space and water heating system, as described here, would be about $6200. This figure is for an average family of four with average heat and hot water needs. Your family's needs may be more or less than the average, so you might need a larger or smaller system. Taking into consideration your family's needs and what you know about both solar energy system prices and government incentives, by how much would you expect the cost of your new home to increase if it were to be equipped with a solar space and water heating system? Circle the letter over the column that is closest to this figure.

	A	B	C	D	E
Gross Cost	$4500	$5300	$6200	$7200	$9200
(Minus) Tax Rebate	2475	2915	3000	3000	3000
Actual Cost	$2025	$2385	$3200	$4200	$6200

4. If your new home had a solar space and water heating system, how much less do you think you would spend on heating your home next year than you would spend using another system?

under $100 _____	$400 - 500 _____
$100 - 200 _____	$500 - 750 _____
$200 - 300 _____	$750 -1000 _____
$300 - 400 _____	over $1000 _____

Please copy your "Actual Cost" from Question 3 on previous page here: (This is your BASE COST)

$_____ BASE COST

Please copy your savings estimate from Question 4 on previous page here: (This is your BASE SAVINGS)

$_____ BASE SAVINGS

5a Please look at your BASE COST and BASE SAVINGS, above. Thinking about your base figures, how likely are you to try to get a solar space and water heating system installed in your new home? Please place a check in the appropriate space.

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

5b The description of a solar space and water heating system says that a system usually comes with a 5-year warranty. Suppose now that the warranty is increased to cover the system for 15 years (with the same BASE COST and SAVINGS). How likely would you be to try to get a system installed in your new home, if you could get this longer warranty? Please place a check in the appropriate space.

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

5c Prices for solar space and water heating systems may go down. Keeping your BASE SAVINGS (from above) in mind, suppose you could have a system installed in your new home for 25% less than your BASE COST. (The new price of the system would then be 3/4 of your BASE COST.) How likely would you be to try to get a system installed? Again, please check the appropriate space.

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

5d Again using your BASE SAVINGS from above, suppose that you could have a system installed in your new home for half of your BASE COST. How likely would you be to try to get a system installed? Please check the appropriate space.

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

5e Fuel prices may rise faster than we now expect. Go back to your BASE COST from above, but now suppose that your savings are 50% more than your estimated BASE SAVINGS. How likely would you be to try to get a system installed in your new home, if you could get these increased savings? Please check the appropriate space.

- Certain, practically certain (99 in 100) ____
- Almost sure (9 in 10) ____
- Very probable (8 in 10) ____
- Probable (7 in 10) ____
- Good possibility (6 in 10) ____
- Fairly good possibility (5 in 10) ____
- Fair possibility (4 in 10) ____
- Some possibility (3 in 10) ____
- Slight possibility (2 in 10) ____
- Very slight possibility (1 in 10) ____
- No chance, almost no chance (0 in 10) ____

General Questions

Please answer the following questions concerning the use of solar energy equipment in general.

1. Do you believe that you can currently obtain reliable and dependable solar energy equipment for home use?

   Definitely can ___
   Probably can ___
   Unsure ___
   Probably can not ___
   Definitely can not ___

2. Do you believe that you can currently obtain solar energy equipment that makes economic sense for home use?

   Definitely can ___
   Probably can ___
   Unsure ___
   Probably can not ___
   Definitely can not ___

3. Do you believe that solar energy equipment will be widely used by homeowners in your area within the next five years?

   Definitely will ___
   Probably will ___
   Unsure ___
   Probably will not ___
   Definitely will not ___

4. Please indicate, by circling a number on the scale, how strongly you agree or disagree with each of the following statements:

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a. I understand the financial merits of solar energy systems.	1	2	3	4	5
b. I understand how solar energy systems work.	1	2	3	4	5
c. Solar energy systems can provide a lot of protection from future energy shortages.	1	2	3	4	5

		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
d.	A solar water heating system would greatly increase the resale value of my home.	1	2	3	4	5
e.	If a solar energy system that I installed failed and needed major repairs or replacement, it could mean a financial disaster for my family.	1	2	3	4	5
f.	Solar collectors would be very unattractive on my house.	1	2	3	4	5
g.	It would be very easy to obtain financing for a solar energy system.	1	2	3	4	5
h.	If a solar energy system that I installed gave less savings than I had expected, it could mean a financial disaster for my family.	1	2	3	4	5
i.	Solar equipment would protect me from increasing energy costs.	1	2	3	4	5
j.	I would vote for zoning restrictions to ban solar collectors from the front of houses in my neighborhood.	1	2	3	4	5
k.	Manufacturers of solar systems are mostly little companies that are here today and will probably be gone tomorrow.	1	2	3	4	5
l.	Solar energy equipment will produce maintenance nightmares for me.	1	2	3	4	5
m.	I would admire a neighbor who installed solar equipment.	1	2	3	4	5
n.	A political candidate who supports solar is progressive.	1	2	3	4	5
o.	Technological advances will soon make currently available solar equipment outdated.	1	2	3	4	5
p.	A solar water heating system might save me money in the long run, but the initial cost is just too high for me to consider buying one.	1	2	3	4	5
q.	If more people were aware of the information shown in this questionnaire, more of them would buy solar energy systems.	1	2	3	4	5

5. Please check the one space in each row that best indicates how interested you would be in more information about each of the items listed.

	Not Interested	Slightly Interested	Moderately Interested	Very Interested
cost and savings	____	____	____	____
how system works	____	____	____	____
names of manufacturers	____	____	____	____

6. Do you intend to look for additional information about solar energy systems within the next two or three months?

Yes _____ No _____ (If "NO", please skip to 0.8)

7. About what kinds of solar energy systems will you look for information?

solar water heating ____
solar-assisted heat pump ____
solar home heating ____
other (please specify) _____

8. How likely are you to have a solar home or water heating system installed in your home within the next year? Within the next 5 years?

	within the next year	within the next 5 years
Very likely	_____	_____
Somewhat likely	_____	_____
Unsure	_____	_____
Somewhat unlikely	_____	_____
Very unlikley	_____	_____

9. Which of the following categories best describes your family's composition? (PLEASE CHECK ONLY ONE SPACE)

No (zero) children living at home _____

Children living at home:
- youngest under age 6 _____
- youngest age 6 - 12 _____
- youngest age 13 or over _____

10. Approximately how much does a gallon of unleaded, regular gasoline cost in your area?

$1.10 or less	_____	$1.25	_____
$1.15	_____	$1.30	_____
$1.20	_____	$1.35 or more	_____

11. How much do you think a gallon of unleaded, regular gasoline will cost five years from now (in 1985)?

$_____

12. Which of the following products have you bought for your own or your family's use?

microwave oven	____	waterbed	____
shower massage	____	quartz room heater	____
home table-top computer	____	water pik	____
videotape player/recorder	____	digital watch	____
food processor	____	whirlpool bath, spa or hot tub	____
		none of the above	____

13. If you were to purchase a solar water heating system, how would you be most likely to pay for it? How would you be most likely to pay for a solar space and water heating system?

Solar Water Heating System		Solar Space and Water Heating System	
Personal savings	_____	Personal savings	_____
Included in mortgage	_____	Included in mortgage	_____
Separate bank loan	_____	Separate bank loan	_____
Other (please specify)	_____	Other (please specify)	_____
_____		_____	

14. If you are now building, or planning to build, your new home, who is or will be the general contractors?

Self _____ Builder _____ Other _____

Who is or will be constructing your new home?

Self _____ Builder/ Building Contractors _____ Other _____

Thank you very much for your help! Please place your completed questionnaire in the postage paid return envelope and mail it back to us at your earliest convenience.

If you would be interested in the results of this study, just write your name and address in the space below and we will be happy to send them to you when they are available.

Name _____

Street _____

City _____ State _____ ZIP _____

THIS PAGE

WAS INTENTIONALLY

LEFT BLANK

INDUSTRIAL SEGMENT

TELEPHONE SCREENER QUESTIONNAIRE

SIC_____

ID #_____

TIME START_____ (1-4)

TIME END_____ INDUSTRIAL SCREENER QUESTIONNAIRE

Hello, I'm _____ from Dialogue, an independent market research firm. We are conducting a study about attitudes toward solar energy in the industrial sector. (IF RELEVANT: WE GOT YOUR NAME FROM_____WHO SAID YOU WERE AN APPROPRIATE PERSON TO ANSWER OUR QUESTIONS.)

It is very important for us to get opinions of relevant decision-makers such as yourself in a representative sample of firms. The individuals we need to speak to are those who usually participate in the decision process for the selection and purchase of heating and air conditioning equipment. These individuals should be familiar with the space heating and cooling needs of your organization.

Are you an appropriate individual to work with us on this study?

Yes _____ No _____(IF NO, GO TO Q.A)

Let me explain how the study works. First I'll ask you a few questions over the phone about your firm's energy systems. That will take 20-25 minutes. When we're done, I'll mail you some information about solar energy systems. The material will also contain a questionnaire. We'd like you to read through the material and discuss it, if you wish, with any relevant members of your organization. Then we'd like you to complete the questionnaire and return it in a prepaid return envelope.

I'll call back in 10 days to 2 weeks to answer any questions you may have about the questionnaire.

Since our results will be based on a small sample, it is very important that we get your response. In addition, most organizations that have completed the survey have found it interesting and informative.

I'd like to ask you to agree to take part. Are there any questions you might have about the study? Will you participate?

Yes_____ No_____(GO TO Q.A)

Great! Let me first get your name so I can mail out the package of material.

NAME:_____ TITLE:_____

FIRM NAME:_____

ADDRESS:_____ CITY:_____ STATE:_____ ZIP:_____

PHONE #:_____ INTERVIEWER'S NAME:_____

And when would be a good time to call you back, say within 10 days to 2 weeks?

TIME:_____ DAY:_____

(IF NECESSARY): Of course any information you provide will be combined with all other responses and will be used for statistical analyses only. Your participation will be completely confidential and your name will never be associated with this survey in any way.

Before I go on:

A. Who (besides yourself) in your organization would be appropriate for us to contact? (TRY TO GET FIVE NAMES - RECORD ON CALL RECORD SHEET)

SIC #20 - Food & kindred products
22 - Textile Mill products
26 - Paper & allied products
27 - Printing & publishing
28 - Chemicals
35 - Machinery except electrical
36 - Electrical & electronic machinery & equipment
38 - Measuring, analyzing and controlling instruments
*(ie. Photo, medical & optical equip. Also includes watches and clocks)

* not necessary to read this

INDUSTRIAL QUESTIONNAIRE

1. According to our information your company's SIC code (standard industrial classification code) is _____, which means your company is principally in the _____ industry. Is that correct? RECORD SIC (5-6) ____

7-
Yes ------ (SKIP TO Q.2) ---------- 1
No ---------- 2

(IF NO):
Could you please describe in a few words the industry your organization is in:

_____

_____

- TERMINATE -

2. Prior to this study, have you seen or heard anything about the use of active solar energy equipment for heating water or for space heating or cooling for industrial use?

8-
Yes ---------- 1
No -------- (SKIP TO Q.8) ---------- 2

(IF YES):
3a. Would this be for: (READ LIST AND CIRCLE ALL THAT APPLY)

		YES	NO
domestic water heating ----------	9-	1	2
process water heating ----------	10-	1	2
space heating ----------	11-	1	2
space cooling ----------	12-	1	2

3b. To the best of your knowledge, is your company now using any solar energy systems?

13-
Yes ---------- 1
No ------ (SKIP TO Q.3c) ---------- 2

(IF YES, ASK): Is the system active or passive?

14-
Active ---------- 1
Passive ----- (SKIP TO Q.3c) -------- 2

(IF ACTIVE, ASK): For what purpose does your firm use active solar energy? Is it used for: (READ LIST AND CIRCLE ALL THAT APPLY)

domestic water heating -------- 15- 1
process water heating -------- 16- 1
space heating -------- 17- 1
space cooling -------- 18- 1
> SKIP TO Q.4

3c. Has your firm actively sought information about an active solar energy system from a solar equipment manufacturer or dealer?

19-

Yes ---------- 1
No --------- (GO TO Q.4) ---------- 2

(IF YES):
For what kinds of active solar energy systems have you looked for information?
(READ LIST AND CIRCLE AS MANY AS APPLICABLE)

domestic water heating ------- 20- 1
process water heating ------- 21- 1
space heating ------- 22- 1
space cooling ------- 23- 1

24-
25-
26-

4. Now I'm going to read a few statements to you. After each statement, please tell me on a scale of 1 to 5 if you agree, or disagree with the statement. An answer of 1 would mean you strongly agree, 5 would mean you strongly disagree, 3 would mean you neither agree nor disagree.

	Strongly agree	Moderately agree	Neither agree nor disagree	Moderately disagree	Strongly disagree	
4a. We can currently obtain reliable and dependable solar energy equipment for use in our company.	1	2	3	4	5	27-
4b. We can currently obtain reliable and dependable solar energy equipment that makes economic sense for use in our company.	1	2	3	4	5	28-
4c. Solar energy equipment will be widely used in our industry within the next five years.	1	2	3	4	5	29-
4d. I understand the financial merits of solar energy systems.	1	2	3	4	5	30-
4e. I understand how solar energy systems work.	1	2	3	4	5	31-

(IF 4 OR 5 CIRCLED IN Q.4e, SKIP TO Q.6)

5. What different kinds of collectors do you know about? What others? (DO NOT READ LIST)

flat plate	32-	1
concentrator	33-	1
evacuated tube	34-	1
trickle collectors	35-	1
air collectors	36-	1
selective	37-	1
non-selective	38-	1
other (please specify)		
_____	39-	1
none	40-	(1)

6a. Do you know the names of any suppliers or manufacturers of solar systems? (IF NO, GO TO Q.7) What names come to mind? What others? (PROBE, RECORD BELOW)

6b. (ASK FOR EACH MANUFACTURER MENTIONED IN Q.6a)
Taking these manufacturers and suppliers one at a time, would you say (READ FROM LIST) makes a reliable, or unreliable product? (RECORD BELOW ON RELIABILITY SCALE) (REPEAT FOR EACH MANUFACTURER/SUPPLIER LISTED)

6c. Again, taking these manufacturers and suppliers one at a time, would you say (READ FROM LIST) makes an economical, or uneconomical product? (RECORD BELOW ON ECONOMICAL SCALE, REPEAT FOR EACH MANUFACTURER/SUPPLIER LISTED)

Q.6a manufacturers/ suppliers		Q.6b reliable	unreliable	DK		Q.6c economical	uneconomical	DK	
_____	41-42	1	2	3	-43	1	2	3	-44
_____	45-46	1	2	3	-47	1	2	3	-48
_____	49-50	1	2	3	-51	1	2	3	-52
_____	53-54	1	2	3	-55	1	2	3	-56
_____	57-58	1	2	3	-59	1	2	3	-60

7. Is it likely or unlikely that your company will buy solar heating or cooling equipment for some application in the next (READ LIST)? Is that very or somewhat (likely/unlikely)?

	Very Likely	Somewhat Likely	Unsure	Somewhat Unlikely	Very Unlikely	
six months	1	2	3	4	5	61-
two years	1	2	3	4	5	62-

8. Now suppose that your firm has decided to install a new HVAC system, and has identified several different systems for consideration. I'd like to ask you about the criteria you use to screen out some of these alternatives. For each criteria I mention, I'd first like to know if you use it or not. The first is (READ UNDERLINED WORDS PREFACED BY "DO YOU USE...", IF "NO", CHECK RIGHT HAND COLUMN. READ ENTIRE LIST THEN FOR EACH "YES" GO BACK AND ASK FULL QUESTION AND FILL IN RESPONSE IN APPROPRIATE BLA)

Do you use (READ UNDERLINED WORDING)? NOT USED

o What is the minimum <u>expected life</u> you would consider? _____ years _____ -67
64-66

o <u>For cooling equipment</u>, what is the maximum <u>initial investment cost</u> in dollars per ton that you would consider? _____$/ton _____ -75
68-74

(80) 1
DUP 1-4

o <u>For heating</u>, what is the maximum <u>initial investment cost</u> in dollars per thousand BTU's per hour you would consider? _____$/KBTU/hr _____ -12
5-11

o What is the minimum <u>warranty period</u> that you would consider? _____months _____ -17
13-16

o What is the minimum <u>number of other successful industrial installations</u> you would consider? _____ _____ -25
18-24

o What is the maximum <u>annual maintenance cost</u> as a percentage of initial investment that you would consider? _____% _____ -29
26-28

o **<u>For heating</u>, what is the minimum <u>energy conversion efficiency</u> you would consider?** _____ _____ -33
30-32

o <u>For cooling</u>, what is the minimum <u>coefficient of performance, or COP</u> you would consider? _____ _____ -38
34-37

(NOTE: COP IS A NUMBER, NOT A PERCENTAGE, BETWEEN 0 AND 15. IF RESPONDENT ANSWERS OVER 15, OR X "PERCENT", ASK: Can you tell me how you are defining COP?)

_____

_____

_____

NOT USED

- o What is the minimum energy efficiency ratio, or EER, that you would consider? _____ 39-45 _____ -46
- o What is the minimum seasonal energy efficiency ratio or SEER? _____ 47-53 _____ -54
- o For cooling, what is the maximum cost of a service contract, in dollars per year per ton of cooling, that you would consider? _____ $/yr/ton 55-61 _____ -62
- o What is the minimum coefficient of performance or COP you would consider for heat pumps in the heating mode? _____ 63-66 _____ -67
- o What is the minimum seasonal COP in heating for heat pumps? _____ 68-71 _____ -72

9a. Would you consider an HVAC system if the manufacturer did not have a local presence? ___yes-1 ___no-2 -73

9b. Would you consider an HVAC system if you had no previous experience with the system vendor or the manufacturer? ___yes-1 ___no-2 -74

9c. Now assuming you were considering a retrofit installation, in screening alternatives would you consider the system _____ (READ FOR EACH STATEMENT FOLLOWING)

-- If it was not the same type as the one that was being replaced?

75-
Yes ---------- 1
No ---------- 2

-- If the energy source is not the same as the one you are currently using?

76-
Yes ---------- 1
No ---------- 2

(80) 2
DUP 1-4

10a. In evaluating industrial HVAC equipment, which of the following financial criteria does your company use? Do you use (READ LIST)
(READ ALL METHODS FIRST THEN GO BACK & ASK QUESTION FOR EACH YES)

Payback method - which is a method that estimates the number of years required to recover the initial cash investment and selects equipment for which the recovery time is sufficiently short?

5-
Yes ---------- 1
No ---------- 2

(IF YES, ASK:) What is the length of the payback period you required? _____ years

6-
7-
8-

9-

A Cash Flow Discounting Method - which is a method that estimates yearly cash inflows or savings and cash outflows or costs over the life of the equipment and discounts these flows to account for the time value of money.

Yes ---------- 1
No ---------- 2

10-

(IF YES, ASK:)
Does your company use the Net Present Value Method?

Yes ---------- 1
No ---------- 2

(IF YES, ASK:) What does your company currently use as its discount rate (cost of capital)?

_____% 11- 12- 13-

Does your company use the Internal Rate of Return (that is, the discounted cash flow of return)?

14-

Yes ---------- 1
No ---------- 2

(IF YES, ASK:) What does your company use as its internal rate of return?

_____% 15- 16- 17-

18-

Initial investment cost only, or

Yes ---------- 1
No ---------- 2

Some other financial criteria (SPECIFY)

19-

_____

20-

11. Now I am going to read you a list of six criteria that are often used in evaluating HVAC equipment for new installation. After I read the list, I would like you to tell me which criterion you consider to be the most important in your evaluation of HVAC equipment. (READ LIST, MAKING SURE TO READ X'D CRITERION FIRST, CONTINUING UNTIL ALL CRITERIA ARE READ. RECORD A "1" NEXT TO MOST IMPORTANT.) Which one do you consider the most important in your evaluation of HVAC equipment?

21-

Now, of all the remaining criteria (READ LIST, OMITTING "MOST IMPORTANT CRITERION", AGAIN STARTING WITH X'D FEATURE) which would you consider to be the second most important criterion in evaluating HVAC equipment? (RECORD A "2" NEXT TO SECOND MOST IMPORTANT. REPEAT QUESTION UNTIL ALL SIX CRITERIA HAVE BEEN RANK ORDERED. BE SURE TO READ LIST OF REMAINING CRITERIA EACH TIME AND RECORD RANK ORDER IN THE SPACE NEXT TO THE CRITERIA.)

22-

	Criteria	Rank Order
( )	Initial cost	23- _____
( )	Supplier reputation and service	24- _____
( )	Cost of operating and maintenance	25- _____
( )	System reliability	26- _____
( )	Convenience of installation and operation	27- _____
( )	Life cycle cost	28- _____

12. Between now and 1985, what <u>average</u> annual rate of fuel cost increase do you expect your firm will see? 29-30-

_____% per year (average) 31-

13. Suppose your company chose an HVAC system which did not fully meet its expectations. On a five point scale, where 1 is of little consequence to your company and 5 is potentially catastrophic to your company, how significant would it be for your organization if the system proved: (READ LIST)

	Of little consequence to the organization			Potentially catastrophic to the organization		
a) less economical than projected?	1	2	3	4	5	-32
b) less reliable and dependable than projected?	1	2	3	4	5	-33

14. Suppose you actively supported adoption of an HVAC system which did not fully meet expectations. On a five point scale, where 1 would not affect your position and credibility and 5 would highly endanger your position and credibility, how significant would it be for <u>you personally</u> if the system proved: (READ LIST)

	Would not affect my position and credibility			Would highly endanger my position and credibility		
a) less economical than projected?	1	2	3	4	5	-34
b) less reliable and dependable than projected?	1	2	3	4	5	-35

15. At what level in your organization are final HVAC decisions <u>typically</u> made: (READ LIST)

36-

Corporate level ---------- 1
Divisional level ---------- 2
Individual plant level ---------- 3

16. In the next 2-3 years, do you expect your firm will shift its fuel usage pattern?

37-

Yes ---------- 1
No --- (SKIP TO Q.17) ----------

(IF YES, ASK:)
What fuels do you expect to use less of? What fuels do you expect to use more of? (READ LIST)

		A. use less	B. use more
Oil ----------	38-	1	2
Gas ----------	39-	1	2
Electricity ----------	40-	1	2
Coal ----------	41-	1	2
Wood ----------	42-	1	2
Other (SPECIFY) _____	43-	1	2
_____			

17. About what percent of existing HVAC equipment in the following three areas do you expect your company will replace within the next five years? (READ LIST)

46-
Space heating _____% 47-
48-
49-
Space cooling _____% 50-
51-
52-
Water heating _____% 53-
54-

18a. Which of the following three statements best reflects your company's attitude toward new products and technologies: (READ LIST)

a) We like to be at the frontier of technology and to be the first to experiment with new products and processes. 56- 1

or

b) We carefully monitor test-installation in our industry and, if they work well, we are quick to adopt. 2

or

c) We take a wait-and-see attitude toward new products and processes. 3

18b. In making purchases for your own home, which of the following three statements best reflects your approach: (READ LIST)

a) I find it interesting and exciting to be the first one in my area to try a new product. 57- 1

or

b) I'm interested in new products, but I like to have one or two of my friends try the product first to see if it has "bugs". 2

or

c) If a product is really good, I'll buy it eventually, but not until it has proven itself for a few years. 3

Finally, I would like to get a little more information about you for classification purposes:

19. Which of the following categories correspond most closely to your job responsibilities or if you feel that you are responsible for more than one area what % of time is spent in each category? (READ LIST) (INDICATE %)

Production engineer	_____%	58-59-60-
Plant or maintenance engineer	_____%	61-62-63-
Design engineer	_____%	64-65-66-
Plant or factory manager	_____%	67-68-69-
Financial controller/ accountant	_____%	70-71-72-
Procurement or purchasing officer	_____%	73-74-75-
General manager	_____%	76-77-78-
		80-3 DUP 1-4
Other (SPECIFY)		
_____	_____%	5-6-7-
TOTAL	100%	

20. About how many people report to you in your company, directly or indirectly? (READ LIST)

8-

0	1
1 - 3	2
4 - 10	3
11 - 30	4
over 30	5

21. **How many years have you been working for your present company?** 9-
10-
_____ years 11-

22. In your highest degree, which of the following best describes the area of study you concentrated in? (READ LIST)

12-

	Math/science	1
	Engineering	2
	Business	3
	Liberal arts	4

23. What was the highest level of schooling you completed? (READ LIST)

13-

	High school	1
	College	2
	Post-graduate	3
(DO NOT READ)	Refused	4

24. Into which of the following age groups do you fall? (READ LIST)

14-

	Under 25	1
	25 - 34	2
	35 - 44	3
	45 - 54	4
	Over 55	5
(DO NOT READ)	Refused	6

80-4

(CONFIRM CALLBACK TIME/DATE AND RECORD ON SCREENER)

THANK YOU VERY MUCH FOR YOUR TIME!

INDUSTRIAL SEGMENT

MAIL-OUT QUESTIONNAIRE

QUESTIONNAIRE:

THE SOLAR ENERGY EQUIPMENT PURCHASING PROCESS

In the following questionnaire, we ask you for information about your company and the process you use to purchase heating, ventilating and air conditioning (HVAC) equipment.

Some of the information requested may not be immediately available to you. Please use any sources (people, reports) within your company that you need to complete the questions. Note also that we would prefer to get your best guess about any of the questions than to have the answer left blank.

Section I: Attitudes Toward Alternative Systems

We would like to learn your reaction to two industrial solar HVAC systems. The summary description of each system is followed by a list of statements that you will be asked to agree or disagree with.

We are interested in how you FEEL about these systems, based on their descriptions, rather than your quantitative evaluation of the systems. There are NO RIGHT OR WRONG ANSWERS, so feel free to register your opinion about the product described.

SYSTEM A SOLAR ABSORPTION COOLING

A solar absorption cooling system contains three major components: a solar collector array, storage tanks, and an absorption chiller unit. (See Diagram.)

The *flat plate collector array* consists of a modular set of panels (collectors) installed in a location with maximum exposure to the sun at all times of the year. The collectors are mounted at an angle from the horizontal approximately equal to the installation latitude. Direct attachment to a roof of acceptable slope often produces an esthetically pleasing installation. Each flat plate solar collector is an insulated box, completely glazed on one side enclosing a flat black metal plate which contains closed channels for the passage of heat transfer fluid. In January of 1980 a flat plate collector could be purchased for between $10 and $20 per square foot. The thermal performance of flat plate collectors depends on many factors. However, a rule of thumb is that flat plate collectors will deliver the energy equivalent of 1 to 2 gallons of fuel oil, 1 to 2 thousand cubic feet of natural gas, or 30 to 60 KWH of electricity per square foot of collector per year, at a delivered temperature of 150°F.

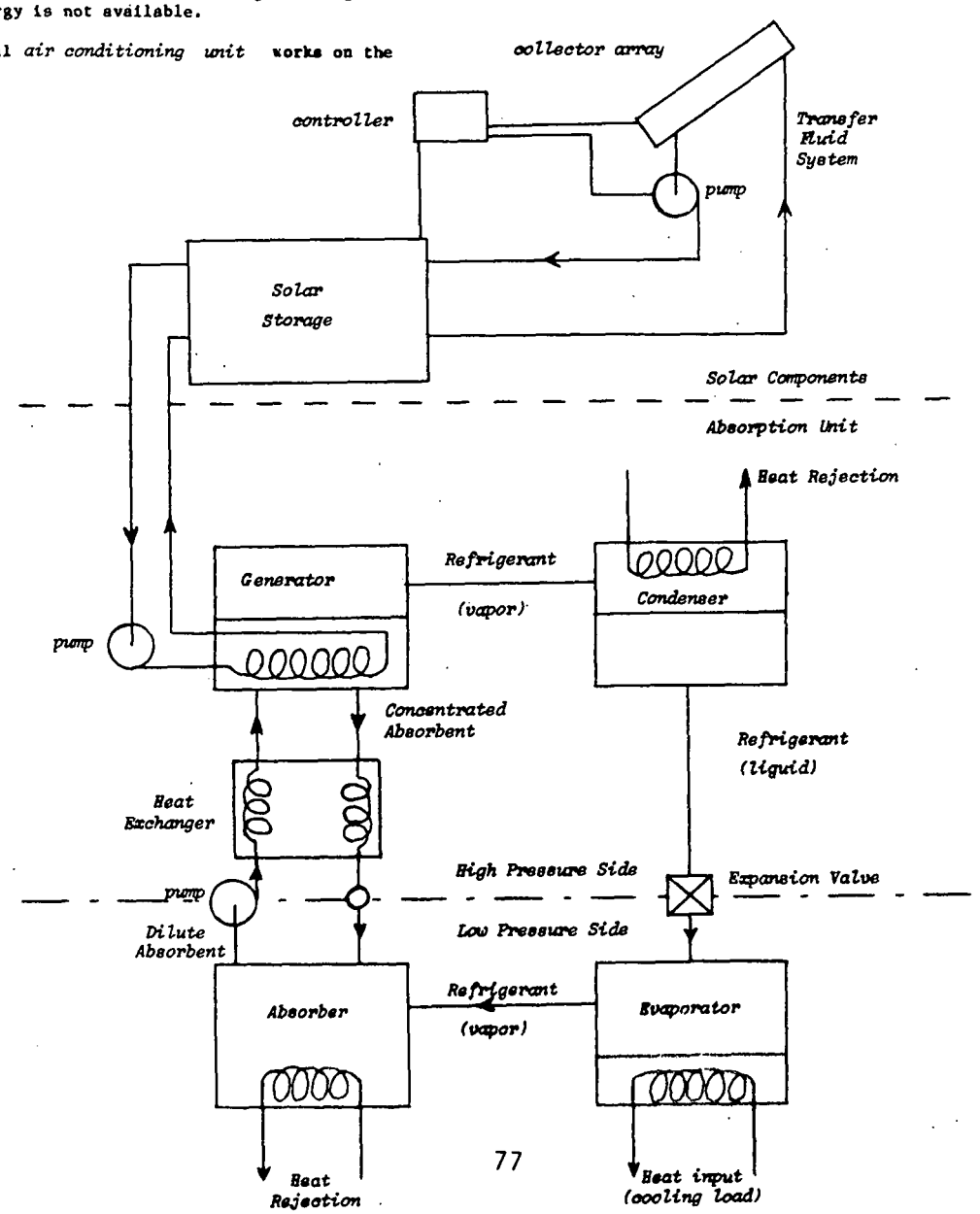
The *insulated hot water storage tank* is used as a method of retaining solar heat for use at night or on days when the sun is obscured by clouds. The storage tank is usually sized to hold two days worth of normal heating requirement. In many installations, a thermostatic mixing valve is used in the delivery line from the tank to keep delivery temperature constant.

In addition to hot water storage, chilled water can be stored for later use in cooling building air when solar energy is not available.

The actual *air conditioning unit* works on the same principal as a gas refrigerator, with the gas flame being replaced by solar heat. In the refrigeration cycle, a chilled liquid (usually water) expands to cool the building supply air. This liquid is then recompressed through a process of absorbing the lower pressure liquid vapor in a concentrated salt solution. The salt solution and water vapor is produced in a generator driven by solar-heated hot water. During sunless days or at night the system uses hot water storage tanks for driving heat, or draws on stored chilled water. One positive element of solar cooling is the strong correlation between available solar energy and cooling requirements.

As can be seen in the system diagram, the process starts in the generator which is filled with the absorber liquid (lithium bromide solution) and is heated by energy from the solar collector. The absorber boils, producing refrigerant vapor and concentrated absorbent. Heat is rejected from the refrigerant vapor by the cooling water, condensing it to a liquid. The liquid refrigerant flows through the expansion valve separating the High and Low pressure side to the evaporator. At the evaporator the drop in pressure boils the refrigerant producing refrigeration, which is applied to the cooling load. The cycle is completed at the absorber where the concentrated lithium bromide solution absorbs the coolant (water) vapor. The heat exchanger for the absorbent serves to preheat dilute absorbent and cool the concentrated absorbent.

The entire absorption system utilizes standard gas fired refrigeration technology with the generator modified to operate on the 200°F solar-heated water.



(Circle one number for each item)

System A: SOLAR ABSORPTION COOLING

	Strongly Disagree			Neither Agree nor Disagree			Strongly Agree	Don't Know
The system produces reliable output.	1	2	3	4	5	6	7	8
Adoption of the system protects against power failures.	1	2	3	4	5	6	7	8
Performance of the system is sensitive to climatic conditions.	1	2	3	4	5	6	7	8
The system is made up of field proven components.	1	2	3	4	5	6	7	8
Adopting the system conveys the image of a modern, innovative company.	1	2	3	4	5	6	7	8
The system requires a major retraining effort.	1	2	3	4	5	6	7	8
The system's initial cost is acceptably low.	1	2	3	4	5	6	7	8
The system protects against fuel rationing.	1	2	3	4	5	6	7	8
In adopting this system, we would do our part in reducing pollution.	1	2	3	4	5	6	7	8
System components produced by several manufacturers can be substituted for one another.	1	2	3	4	5	6	7	8
The system can easily be extended to meet increased HVAC needs.	1	2	3	4	5	6	7	8
The system is easily installed.	1	2	3	4	5	6	7	8
The system has too many concepts that have not been fully tested.	1	2	3	4	5	6	7	8
System components are easily accessible for maintenance and repair.	1	2	3	4	5	6	7	8
The system leads to considerable energy savings.	1	2	3	4	5	6	7	8
The system is easily integrated into an industrial building.	1	2	3	4	5	6	7	8
The system is too complex.	1	2	3	4	5	6	7	8
The system's operating cost is acceptably low.	1	2	3	4	5	6	7	8
The system offers a state-of-the-art solution to HVAC needs.	1	2	3	4	5	6	7	8
The system increases the noise level in the plant.	1	2	3	4	5	6	7	8
The system makes use of currently unproductive areas in industrial buildings.	1	2	3	4	5	6	7	8
Adoption of this system will increase construction delays.	1	2	3	4	5	6	7	8
The system is modular.	1	2	3	4	5	6	7	8
Service for the system will be quick and easy.	1	2	3	4	5	6	7	8

SYSTEM B

SOLAR ASSISTED HEAT PUMP

The major components of a solar assisted heat pump system are the collector array, transfer fluid system, solar storage, solar controller and heat pump. (See Diagram.)

The *flat plate collector array* consists of a modular set of panels (collectors) installed in a location with maximum exposure to the sun at all times of the year. The collectors are mounted at an angle from the horizontal approximately equal to the installation latitude. Direct attachment to a roof of acceptable slope often produces an esthetically pleasing installation. Each flat plate solar collector is an insulated box, completely glazed on one side enclosing a flat black metal plate which contains closed channels for the passage of heat transfer fluid. In January of 1980 a flat plate collector could be purchased for between $10 and $20 per square foot. The thermal performance of flat plate collectors depends on many factors. However, a rule of thumb is that flat plate collectors will deliver the energy equivalent of 1 to 2 gallons of fuel oil, 1 to 2 thousand cubic feet of natural gas, or 30 to 60 KWH of electricity per square foot of collector per year, at a delivered temperature of 150°F.

The *transfer fluid system* consists of a pump, heat exchanger and associated piping. To avoid problems of freezing and corrosion, glycol solutions are usually used as the transfer fluid. The transfer fluid pump is activated by the solar system controller and circulates the fluid across the collectors and through a heat exchanger at the storage tank.

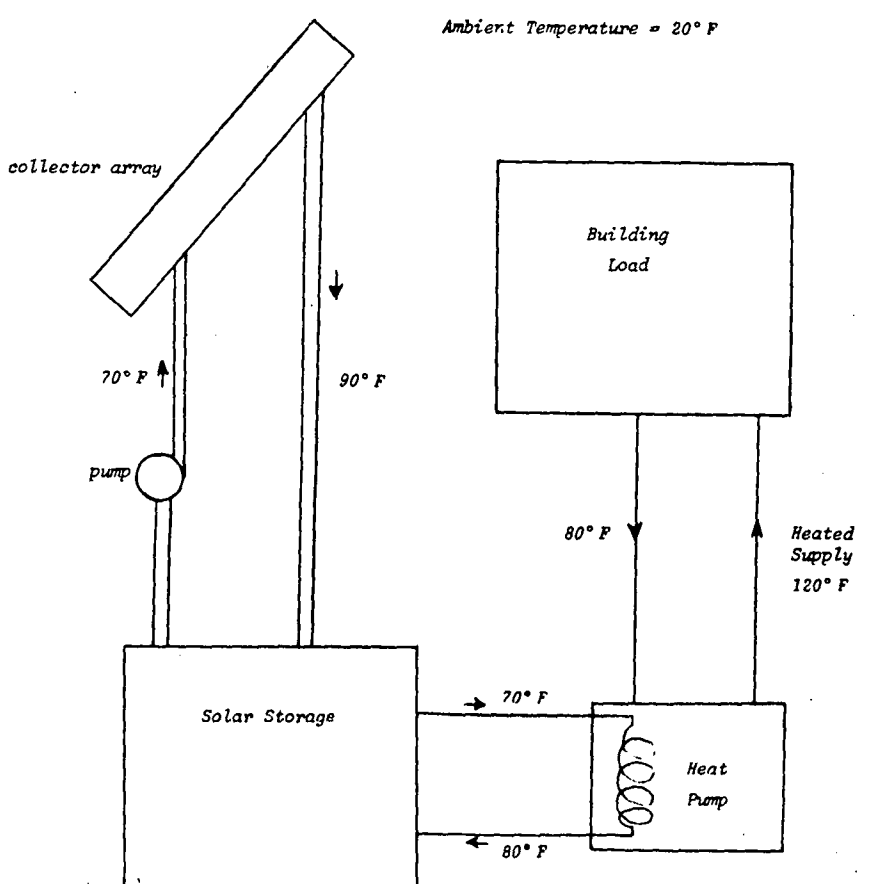
The *system controller* operates the transfer fluid pump in response to thermostatic sensors. The controller measures the difference between collector and storage temperatures and starts the operation of the pump when a positive difference is measured.

The *insulated hot water storage tank* is used as a method of retaining solar heat for use at night or on days when the sun is obscured by clouds. The storage tank is usually sized to hold two days worth of normal heating requirements. In many installations, a thermostatic mixing valve is used in the delivery line from the tank to keep delivery temperature constant.

A *heat pump* uses the same three components as an air conditioner - an evaporator, compressor, and condenser. However, the cycle is reversed. In effect, a heat pump attempts to cool the outside, and in the process "pumps" heat to the indoor air. In a normal heat pump installation the indoor air absorbs heat from the refrigerant which obtains the heat from the outside air. In a solar-assisted unit the heat is obtained from the stored solar-heated fluid. The higher the temperature of the source fluid, the more efficient the heat transfer. This efficiency is measured by the COP (coefficient of performance). A COP of 2 means that one unit of electrical energy applied to the unit will move 2 units of heat across the unit.

When the temperatures of the solar storage and collector return line are lower than that which can be efficiently used for direct building heating, the solar-assisted heat pump is an effective heating system. In the hypothetical example shown in the system diagram, the heat pump alone would have a low COP (coefficient of performance) because the ambient temperature below freezing decreases the heat source and causes freezing problems on the outdoor coil. The solar system alone, as shown in the schematic, cannot produce transfer fluid temperatures high enough to provide useful heat to the building. However, when coupled in a system as shown in the schematic, the efficiency of both systems is improved.

The heat pump operates on a fluid which has a temperature elevated well above freezing. Even if the solar storage is kept as little as 20°F above ambient, the heat pump COP is improved (as long as the storage temperature is above 35°F). The solar collector efficiency is also improved over a direct solar heating scheme. Since a lower temperature transfer fluid is in use, the collector cover losses are less, increasing efficiency. The collectors can be used during periods of otherwise marginal sunshine such as at the beginning and end of the day and on partly cloudy days, which also increases solar system efficiency.



(Circle one number for each item)

System B: SOLAR ASSISTED HEAT PUMP	Strongly Disagree			Neither Agree nor Disagree			Strongly Agree	Don't Know
The system produces reliable output.	1	2	3	4	5	6	7	8
Adoption of the system protects against power failures.	1	2	3	4	5	6	7	8
Performance of the system is sensitive to climatic conditions.	1	2	3	4	5	6	7	8
The system is made up of field proven components.	1	2	3	4	5	6	7	8
Adopting the system conveys the image of a modern, innovative company.	1	2	3	4	5	6	7	8
The system requires a major retraining effort.	1	2	3	4	5	6	7	8
The system's initial cost is acceptably low.	1	2	3	4	5	6	7	8
The system protects against fuel rationing.	1	2	3	4	5	6	7	8
In adopting this system, we would do our part in reducing pollution.	1	2	3	4	5	6	7	8
System components produced by several manufacturers can be substituted for one another.	1	2	3	4	5	6	7	8
The system can easily be extended to meet increased HVAC needs.	1	2	3	4	5	6	7	8
The system is easily installed.	1	2	3	4	5	6	7	8
The system has too many concepts that have not been fully tested.	1	2	3	4	5	6	7	8
System components are easily accessible for maintenance and repair.	1	2	3	4	5	6	7	8
The system leads to considerable energy savings.	1	2	3	4	5	6	7	8
The system is easily integrated into an industrial building.	1	2	3	4	5	6	7	8
The system is too complex.	1	2	3	4	5	6	7	8
The system's operating cost is acceptably low.	1	2	3	4	5	6	7	8
The system offers a state-of-the-art solution to HVAC needs.	1	2	3	4	5	6	7	8
The system increases the noise level in the plant.	1	2	3	4	5	6	7	8
The system makes use of currently unproductive areas in industrial buildings.	1	2	3	4	5	6	7	8
Adoption of this system will increase construction delays.	1	2	3	4	5	6	7	8
The system is modular.	1	2	3	4	5	6	7	8
Service for the system will be quick and easy.	1	2	3	4	5	6	7	8

Next, we'd like to get your feelings about solar:

Section II: Preference Analysis

In the questions below, remember that *SYSTEM A IS A SPACE COOLING SYSTEM* and *SYSTEM B IS A SOLAR ASSISTED HEAT PUMP SYSTEM*.

1. Assuming that each system met all of the operating and financial requirements of your firm (as we discussed over the phone), what is the likelihood that you would recommend that your firm purchase each system for a new installation? (Check one line in each column.)

	System A	System B
Certain, practically certain (99 in 100)	_____	_____
Almost sure (9 in 10)	_____	_____
Very probable (8 in 10)	_____	_____
Probable (7 in 10)	_____	_____
Good possibility (6 in 10)	_____	_____
Fairly good possibility (5 in 10)	_____	_____
Fair possibility (4 in 10)	_____	_____
Some possibility (3 in 10)	_____	_____
Slight possibility (2 in 10)	_____	_____
Very slight possibility (1 in 10)	_____	_____
No chance, almost no chance (0 in 10)	_____	_____

2. In financial analysis, many companies use the payback period method for evaluating HVAC equipment. It determines the number of years required to recover an initial cash investment.
Now, considering your feeling about fuel escalation, how long would you require that an investment in each HVAC system payback to:

		System A	System B
(a)	Be 100% certain to recommend it over a conventional alternative. (Please answer to the nearest tenth of a year.)	_____ years	_____ years
(b)	Be indifferent between it and a conventional alternative (a 50% chance of recommending it).	_____ years	_____ years
(c)	Be just willing to consider it for recommendation (a 10-20% chance of recommending it).	_____ years	_____ years

3. Again, *SYSTEM A IS A SPACE COOLING SYSTEM AND SYSTEM B IS A HEAT PUMP SYSTEM*. Please circle the number which shows how much you agree or disagree with each of the following statements:

	Strongly agree	Moderately agree	Neither agree nor disagree	Moderately disagree	Strongly disagree
a) We can currently obtain a System A that makes economic sense for use in our company.	1	2	3	4	5
b) We can currently obtain a reliable and dependable System A for use in our company.	1	2	3	4	5
c) We can currently obtain a System B that makes economic sense for use in our company.	1	2	3	4	5
d) We can currently obtain a reliable and dependable System B for use in our company.	1	2	3	4	5
e) Solar energy equipment will be widely used in our industry within the next five years.	1	2	3	4	5
f) I understand the financial mertis of solar energy systems.	1	2	3	4	5
g) I understand how solar energy systems work.	1	2	3	4	5

Section III: Decision Process Information

4. The purchase of an industrial HVAC system typically involves several participants. In this question, we would like to know more about who would be involved in the important phases of the decision-making process -- both company personnel and people external to the firm.

For each of the "decision phases" in the following chart, please indicate approximately what percentage of the task-responsibilities is that of each category of participants. For instance, Phase I may be the responsibility of the architect (25%), the HVAC consulting firm (25%), and top management (50%).

Of course, a given decision-making phase might be the responsibility of only one category of participants, in which case, you should write 100% in the appropriate box and leave all of the other boxes in that column blank.

		1		2	3
	Decision Phases / Decision Participants	Identification of HVAC alternatives		Financial and technical evaluation*	Final equipment and source selection**
		New Installation	Retrofit Installation		
INTERNAL COMPANY PERSONNEL	Production engineer	%	%	%	%
	Plant or maintenance engineer	%	%	%	%
	Design engineer	%	%	%	%
	Plant or factory manager	%	%	%	%
	Financial controller or accountant	%	%	%	%
	Procurement or purchasing officer	%	%	%	%
	General management	%	%	%	%
	Other (specify)	%	%	%	%
EXTERNAL PERSONNEL	HVAC/Engineering firm	%	%	%	%
	Architects	%	%	%	%
	HVAC equipment manufacturers/vendors	%	%	%	%
	COLUMN TOTAL	100%	100%	100%	100%

*Decision phase 2 generally involves evaluation of all alternative HVAC systems that meet your company's needs, while

**Decision phase 3 involves only the alternatives (generally 2-3) retained for final selection.

Section IV: Company Information

5. At what level in your organization are final HVAC decisions typically made? (CHECK ONE)

corporate level _____

divisional level _____

individual plant level _____

Call the level noted above the HVAC "decision unit", and answer the following questions in terms of that decision unit.

6. About how many separate plants does your decision unit have?

_____

7a. About how many total sq. ft. of plant area does your decision unit have?

_____thousand sq. ft.

b. About what percent of this space is owned by the decision unit (not rented or leased)?

_____%

c. Of the area in (a), how is it distributed geographically (see map)?

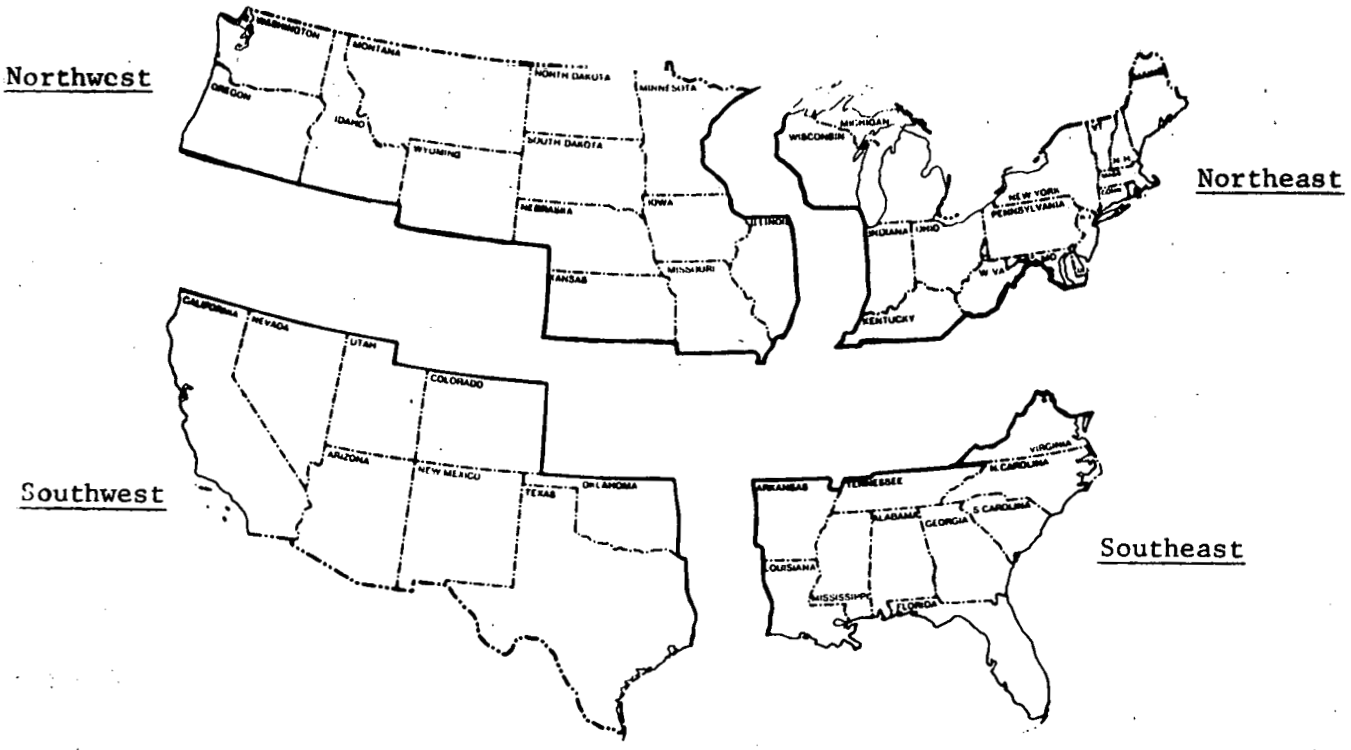
Northeast _____%

Northwest _____%

Southeast _____%

Southwest _____%

100 %



8a. Where is the headquarters of your decision unit located?

ZIP _____

b. Where is the plant you are associated with located?

ZIP _____

9. What is your expected growth rate in new plant area as a percent of your current plant floor area (do not subtract plant area currently being vacated)?

_____% annual growth rate

10. What were the sales for your decision unit last year (± 10%)?

$ _____million

11. About how many employees does your decision unit have?

_____

12a. Please estimate your decision unit's annual HVAC energy usage of each of the following fuels. What is your company's unit energy cost of each of these fuels?

	Oil	Gas	Elec.	Coal	Wood	Other (specify)	
Annual usage (thousands of dollars)	_____	_____	_____	_____	_____	_____	_____
per unit energy cost	_____ $/gal	_____ $/M ft^3	_____ $/KWH	_____ $/ton	_____ $/cord	_____	

b. Please check the primary fuel your company uses for each of the following HVAC applications. (Please place only one check in each row.)

	Oil	Gas	Elec.	Coal	Wood	Other (specify)	
Space heating	_____	_____	_____	_____	_____	_____	_____
Space cooling	_____	_____	_____	_____	_____	_____	_____
Water heating	_____	_____	_____	_____	_____	_____	_____

Thank you very much for your cooperation! If you would like a copy of the results, please write your name and address below, and we will be happy to send you a copy when they are available.

Name _____

Company _____

Address _____

_____

_____

If you would like to comment on this questionnaire or solar products in general, please use the space below to do so.

Variable System Descriptions

SYSTEM A

SOLAR DOMESTIC WATER HEATING

A solar domestic water heating system is composed of five elements: a collector array; hot water storage tank, transfer fluid circulating system (a pump, pipes and a heat exchanger), system controller and auxilliary heating source. (See Diagram.)

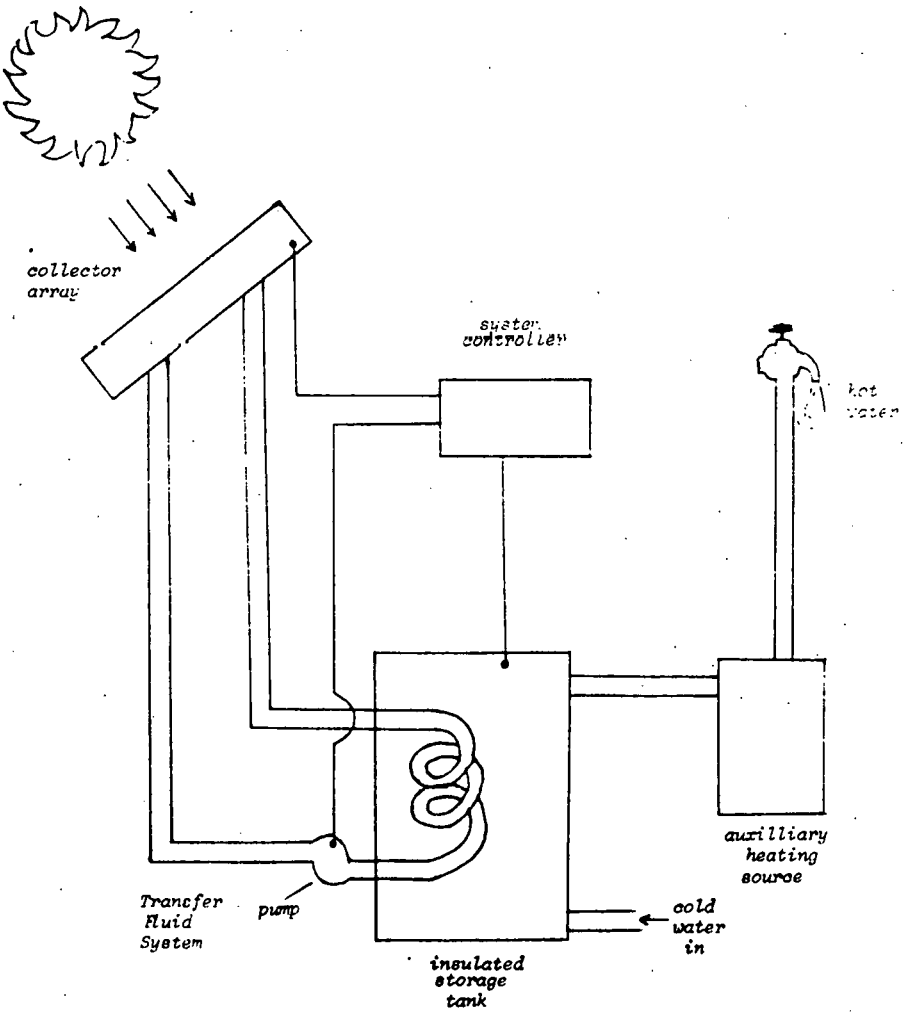
The *flat plate collector array* consists of a modular set of panels (collectors) installed in a location with maximum exposure to the sun at all times of the year. The collectors are mounted at an angle from the horizontal approximately equal to the installation latitude. Direct attachment to a roof of acceptable slope often produces an esthetically pleasing installation. Each flat plate solar collector is an insulated box, completely glazed on one side enclosing a flat black metal plate which contains closed channels for the passage of heat transfer fluid. In January of 1980 a flat plate collector could be purchased for between $10 and $20 per square foot. The thermal performance of flat plate collectors depends on many factors. However, a rule of thumb is that flat plate collectors will deliver the energy equivalent of 1 to 2 gallons of fuel oil, 1 to 2 thousand cubic feet of natural gas, or 30 to 60 KWH of electricity per square foot of collector per year, at a delivered temperature of 150°F.

The *insulated hot water storage tank* is used as a method of retaining solar heat for use at night or on days when the sun is obscured by clouds. The storage tank is usually sized to hold two days worth of normal heating requirement. In many installations, a thermostatic mixing valve is used in the delivery line from the tank to keep delivery temperature constant.

The *transfer fluid system* consists of a pump, heat exchanger and associated piping. To avoid problems of freezing and corrosion, glycol solutions are usually used as the transfer fluid. The transfer fluid pump is activated by the solar system controller and circulates the fluid across the collectors and through a heat exchanger at the storage tank.

The *system controller* operates the transfer fluid pump in response to thermostatic sensors. The controller measures the difference between collector and storage temperatures and starts the operation of the pump when a positive difference is measured.

The *auxilliary heating source* is placed down stream of the solar storage tank, and it is essentially a standard hot water heating system. This auxilliary source could be any type of water heater, from steam converter to electric resistance. The auxilliary heating system operates in response to the temperature of the water delivered from the solar storage tank.



SYSTEM B

SOLAR SPACE HEATING

A solar space heating system is composed of six elements. These are a collector array, hot water storage tank, transfer fluid circulating system, heat delivery system, solar system controller, and auxilliary heat source. (See Diagram.)

The *concentrating collector array* consists of collector units mounted on a framework which moves to track the sun, keeping the collectors perpendicular to the sun throughout the day. A single concentrating collector consists of a linear absorber through which the transfer fluid is pumped. This can be as simple as a black pipe. The unit is insulated by one of two methods: either glazing across the outside edges of the reflector and providing foam insulation on the external surface of the reflector, or insulating only the absorber pipe with an evacuated glass tube to produce a Thermos effect. In January of 1980, a concentrating collector array could be purchased for approximately $30 to $50 per square foot. This same array will deliver the energy equivalent of 1 to 2 gallons of fuel oil, 1 to 2 thousand cubic feet of natural gas, or 30 to 60 KWH of electricity per square foot of collector per year, at a delivered temperature of approximately 250°F.

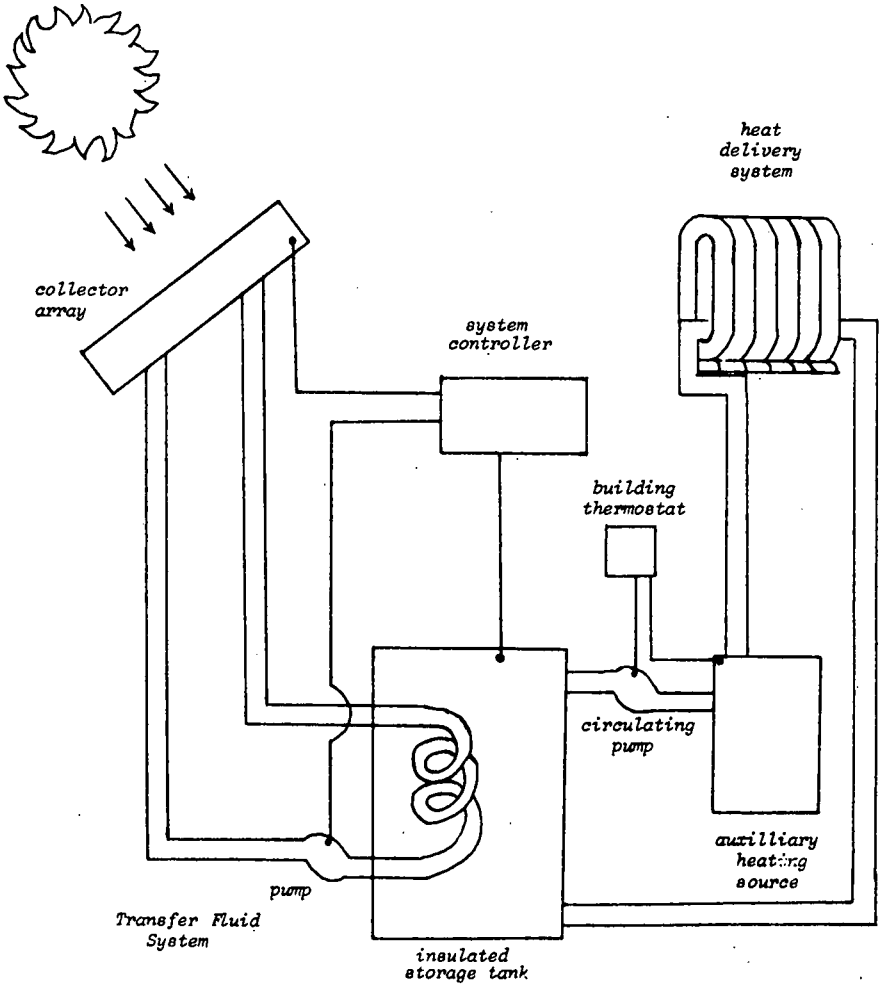
The *insulated hot water storage tank* is used as a method of retaining solar heat for use at night or on days when the sun is obscured by clouds. The storage tank is usually sized to hold two days worth of normal heating requirement. In many installations, a thermostatic mixing valve is used in the delivery line from the tank to keep delivery temperature constant.

The *transfer fluid system* consists of a pump, heat exchanger and associated piping. To avoid problems of freezing and corrosion, glycol solutions are usually used as the transfer fluid. The transfer fluid pump is activated by the solar system controller and circulates the fluid across the collectors and through a heat exchanger at the storage tank.

The *heat delivery system* in a hot water based solar space heating system can consist of any standard hot water unit. Fin tube convectors, fan coil units or reheat coils could be supplied by the solar heated waters. Standard circulating pumps and temperature controls are also used in solar heating systems. The only special requirements with a solar heating system is that the sizing of unit coils be matched to the temperature of the delivered hot water.

The *system controller* operates the transfer fluid pump in response to thermostatic sensors. The controller measures the difference between collector and storage temperatures and starts the operation of the pump when a positive difference is measured.

The *auxilliary heating source* is placed down stream of the solar storage tank, and it is essentially a standard hot water heat system. This auxilliary source could be any type of water heater, from steam converter to electric resistance. The auxilliary heating system operates in response to the temperature of the water delivered from the solar storage tank.



THIS PAGE

WAS INTENTIONALLY

LEFT BLANK

HVAC PROFESSIONALS SEGMENT

TELEPHONE QUESTIONNAIRE

HVAC Questionnaire
April, 1980

Hello, I'm from Dialogue, an independent market research firm. We are conducting a study about solar energy. (IF RELEVANT: we got your name from_____.) It is very important for us to get attitudes of individuals such as you who influence purchase decisions for heating and air conditioning equipment. Do you, personally, work directly with clients in the selection or evaluation of heating or air conditioning equipment?

yes_____-1 no_____-2 (IF NO, GO TO (A)) -7

I'd like to ask you to agree to take part in the study. Our questions will only take a few minutes of your time. Of course, any information you provide will be combined with all other responses and will be used for statistical analyses only. Your participation will be completely confidential and your name will never be associated with this survey in any way. In addition, we will make available to you results of the study.

I'd like to ask you to agree to take part. Are there any questions you might have about the study? Will you participate?

yes_____-1 Great! (GO TO Q.1) no_____-2 (GO TO (A)) [Not Now (GO TO B)] -8

B. When would be a good time to call you back?_____Day_____Time.

(A.) Who in your organization would be an appropriate individual for us to contact?

Name_____

Telephone_____

Who Else? (PROBE)

Name_____

Telephone_____

Name_____

Telephone_____

(TRY TO GET ONE INDIVIDUAL FROM AN ORGANIZATION)

1a. Are you aware of how active solar energy systems work?

yes_____-1 no_____-2 -9

1b. Has your firm actively sought information about solar energy from a solar equipment manufacturer or dealer?

yes_____-1 no_____-2(IF NO, GO TO Q. 2a) -10

(IF YES, ASK:)

1c. For what kinds of active solar energy systems have you looked for information?

domestic water heating	_____-1	-11
process water heating	_____-2	-12
space heating	_____-3	-13
space cooling	_____-4	-14

2a. Has your firm considered the use of active solar energy equipment for: (READ LIST)

2b. Has your firm specified the use of solar energy for: (ASK ONLY THOSE ITEMS CONSIDERED AND ENTER IN Col. Q.2b) (IF THERE IS A SYSTEM CONSIDERED BUT NOT SPECIFIED, ASK 2c. OTHERWISE, GO TO 2d.)

	(Q.2a) Considered	(Q.2b) Specified
any domestic water heating application?	_____-1-15	_____-1-19
any process water heating application?	_____-1-16	_____-1-20
any space heating application?	_____-1-17	_____-1-21
any space cooling application?	_____-1-18	_____

(IF NOT CONSIDERED ALL OF THE ABOVE, GO TO 3)

(ASK FOR TYPE NOT SPECIFIED IN Q.2b)

2c. What are the reasons for not specifying solar when it was considered? (DO NOT READ LIST: CHECK ANY BOXES THAT APPLY. NOTE: USE "GENERAL" BOX HERE AND IN Q.2e. WHEN RESPONDENT DOES NOT SPECIFY ANY DIFFERENCE BY SYSTEM-TYPE.)

	General	Water Heating	Process Heating	Space Heating	Space Cooling
cost	_____-1-23	_____-1-24	_____-1-25	_____-1-26	_____-1-27
reliability	_____-1-28	_____-1-29	_____-1-30	_____-1-31	_____-1-32
manufacturer reputation	_____-1-33	_____-1-34	_____-1-35	_____-1-36	_____-1-37
client decided against	_____-1-38	_____-1-39	_____-1-40	_____-1-41	_____-1-42
other (specify)_____	_____-1-43	_____-1-44	_____-1-45	_____-1-46	_____-1-47

2d. (IF ANY TYPE OF EQUIPMENT SPECIFIED IN Q.2b, ASK Q.2d; IF NONE, GO TO Q.3)
How much of your company's business is active solar related?

-50

_____	-1	less than 5%
_____	-2	5% - 25%
_____	-3	over 25%

2e. Would you say your clients have been satisfied or dissatisfied with their solar energy experience? (IF NECESSARY:) Would that be moderately satisfied/dissatisifed or very satisfied/dissatisfied?

	General	Water Heating	Process Heating	Space Heating	Space Cooling
Very satisfied	____-1	____-1	____-1	____-1	____-1
Moderately satisfied	____-2	____-2	____-2	____-2	____-2
Unsure	____-3	____-3	____-3	____-3	____-3
Moderately dissatisfied	____-4	____-4	____-4	____-4	____-4
Very Dissatisfied	____-5	____-5	____-5	____-5	____-5
	51	52	53	54	55

3. What types of solar collectors do you know about? What others? (DO NOT READ LIST)

flat plate	____-1	-56
concentrator	____-1	-57
evacuated tubes	____-1	-58
trickle collectors	____-1	-59
air collectors	____-1	-60
selective	____-1	-61
non-selective	____-1	-62
other (specify)	____-1	-63
none	____-1	-64

4. Are you aware of suppliers or manufacturers of any solar systems? (IF NO, GO TO Q.6) If so, what names come to mind? Others? (PROBE AND RECORD BELOW.)

5a. Taking these manufacturers and suppliers one at a time, would you say (READ FROM LIST) makes a reliable or unreliable product? (RECORD BELOW ON RELIABILITY SCALE.) (REPEAT FOR EACH MANUFACTURER/SUPPLIER LISTED.)

5b. Again, taking these manufacturers and suppliers one at a time, would you say (READ FROM LIST) makes economical or uneconomical products? (RECORD BELOW ON ECONOMICAL SCALE. REPEAT FOR EACH MANUFACTURER/SUPPLIER LISTED.)

4. manufacturers/ suppliers	5a. reliable	5a. unreliable		5b. economical	5b. uneconomical	
_____ -65-66	1	2	-67	1	2	-68
_____ -69-70	1	2	-71	1	2	-72
_____ -73-74	1	2	-75	1	2	-76
_____ -77-78	1	2	-05	1	2	-06
_____ -07-08	1	2	-09	1	2	-10

cc 80-1
dup 1-4

Not Aware of Suppliers ☐ SKIP TO Q.6

(ASK EVERYONE):

6. Do you believe that solar energy equipment will or will not be widely used within the next five years? (AS NECESSARY, ASK:) Is that definitely will/will not, or probably will/will not? (IF DEFINITELY WILL, ASK:) Do you feel fairly certain about that, or are you just pretty sure?

Definitely will _____ → Fairly certain _____-1
Definitely will _____ → Pretty sure _____-2
Probably will _____-3
Unsure _____-4
Probably will not _____-5
Definitely will not _____-6

-11

7a. Is it likely or unlikely that your firm will specify active solar heating or cooling equipment for some application in the next year? (AS NECESSARY, ASK:) Is that very likely/unlikely, or somewhat likely/unlikely? (IF VERY LIKELY, ASK:) Are you 100% certain or just pretty sure?

How about in the next five years?

Next Year		Five Years	
Very Likely ___ 100% certain ___ -1		Very Likely ___ 100% certain ___ -1	
Very Likely ___ pretty sure ___ -2		Very Likely ___ pretty sure ___ -2	
Somewhat Likely ___ -3		Somewhat Likely ___ -3	
Unsure ___ -4		Unsure ___ -4	
Somewhat Unlikely ___ -5		Somewhat Unlikely ___ -5	
Very Unlikely ___ -6	-12	Very Unlikely ___ -6	-13

(IF EITHER 1 YEAR OR 5 YEAR, OR BOTH, ARE "VERY LIKELY", THEN ASK Q. 8, 9a AND 9b. IF NEITHER ARE "VERY LIKELY", THEN SKIP TO Q. 10.)

8. (IF"VERY LIKELY"):

What application/technology do you expect to specify active solar heating or cooling equipment for: (IF NECESSARY, READ LIST)

Solar domestic water heating	___ -1	-15
Solar space heating	___ -1	-16
Solar absorption cooling	___ -1	-17
Solar assisted heat pumps and cooling systems	___ -1	-18

9a. Would this be for:

Residential use	____-1	-19
Industrial use	____-1	-20
Commercial use	____-1	-21
Municipal/government buildings	____-1	-22
Hospitals	____-1	-23
Other (please specify)	____-1	-24

_____

9b. Are these likely to be new or retrofit installations?

new	____-1	-25
retrofit	____-1	-26

(ASK EVERYONE):

10. Now I'm going to read a few statements to you. After each statement, please tell me on a scale of 1 to 5 if you agree, or disagree with the statement. An answer of 1 would mean you strongly agree, 5 would mean you strongly disagree, 3 would mean neither agree nor disagree. Remember that we are talking about only ACTIVE solar energy products.

		Strongly agree	Moderately agree	Neither agree nor disagree	Moderately disagree	Strongly disagree	
)	a. HVAC manufacturers can currently produce cost effective solar energy systems.	1	2	3	4	5	-27
)	b. HVAC manufacturers can currently produce reliable and dependable solar energy systems.	1	2	3	4	5	-28
)	c. If my firm recommended a solar HVAC system that proved less economical than we expected, it could harm our reputation.	1	2	3	4	5	-29
)	d. If I, personally, recommended a solar HVAC system that proved less economical than projected, it could ruin my career.	1	2	3	4	5	-30
( )	e. If my firm recommended a solar HVAC that proved less reliable and dependable than projected, it could harm our reputation.	1	2	3	4	5	-31
)	f. If I, personally, recommended a solar HVAC that proved less reliable and dependable than projected, it could ruin my career.	1	2	3	4	5	-32

10. (continued)

			Strongly agree	Moderately agree	Neither agree nor disagree	Moderately disagree	Strongly disagree	
( )	g.	I find it interesting and exciting to be the first one in my area to try a new product.	1	2	3	4	5	-33
( )	h.	My firm is known in the industry as one that only specifies or recommends systems that are "tried and true".	1	2	3	4	5	-34
( )	i.	The federal government should finance the development of markets for solar energy.	1	2	3	4	5	-35
( )	j.	Day in and day out, solar energy systems can provide a significant fraction of a building's HVAC needs.	1	2	3	4	5	-36
( )	k.	Solar HVAC systems are too complex.	1	2	3	4	5	-37
( )	l.	Specifications of solar HVAC systems will lead to construction delays.	1	2	3	4	5	-38
( )	m.	The widespread adoption of solar energy systems would be the best way for the nation to achieve energy independence.	1	2	3	4	5	-39
( )	n.	A solar HVAC system user conveys a modern, innovative image.	1	2	3	4	5	-40
( )	o.	Solar HVAC systems incorporate too many concepts that have not been fully tested.	1	2	3	4	5	-41
)	p.	I like the concept of using solar energy for HVAC applications.	1	2	3	4	5	-42
)	q.	Solar HVAC systems protect against fuel rationing.	1	2	3	4	5	-43
)	r.	Solar HVAC systems are difficult to service.	1	2	3	4	5	-44

11. Now I'd like to review with you the criteria you use in evaluating HVAC systems in general for recommendation to your clients.

First, when you perform an economic evaluation of alternative HVAC systems, which one of the following criteria do you emphasize most:

(READ LIST, CHECK ONLY ONE: THE MOST EMPHASIZED)

(1) Payback period, balancing differences in investment cost with differences in operating and maintenance costs. _____-1 -45

(2) Net present value of the investment and future operating and maintenance costs. _____-2

(3) Initial investment cost only _____-3

or some other criterion (please specify):

_____ _____-4

12a. Suppose you were retained to recommend an HVAC system for a client. There may be criteria that you use to screen out alternatives that you wouldn't consider recommending. Is there a minimum overall economic life, less than which you wouldn't consider a system?

_____-1 YES _____-2 NO -46

(IF YES): How many years? _____years -47-48

12b. Is there a minimum factory warranty on HVAC equipment that you require?

_____-1 YES _____-2 NO -49

(IF YES): How many months? _____months -50-51

12c. Is there a certain minimum number of prior successful installations for a system that you require before you will recommend a system?

_____-1 YES _____-2 NO -52

(IF YES): How many prior installations? _____ -53-54

12d. Will you consider recommending a system if you or your firm have had no previous experience with the system's vendor or manufacturer?

_____-1 YES _____-2 NO -55

12e. For a heating system, is there a minimum % energy conversion efficiency that you require?

_____-1 YES _____-2 NO -56

(IF YES): What %? _____% -57-58

12f. For a cooling system, is there a minimum coefficient of performance that you require?

_____-1 YES _____-2 NO -59

(IF YES): What coefficient of performance? _____ --60-62

12g. Is there a minimum profit margin, or fee for your firm that you require?

_____-1 YES _____-2 NO -63

(DO NOT READ): Refused _____-3

(IF YES): What % of the system's price to the client would that be?

_____% -64-66

13. When your firm evaluates new HVAC systems introduced to the market, how important is _____(READ EACH ITEM FROM LIST BELOW. IS IT OF HIGHEST IMPORTANCE, MODERATELY IMPORTANT, OR NOT IMPORTANT?)

ROTATE		Of highest importance	Moderately important	Not important	
( ) a.	the system's expected life?	1	2	3	-67
( ) b.	the reputation of the system's producers?	1	2	3	-68
( ) c.	previous experience with the system's producers?	1	2	3	-69
( ) d.	ease of installation?	1	2	3	-70
( ) f.	the system's ease of maintenance?	1	2	3	-71
( ) g.	the modularity of the system's components?	1	2	3	-72
( ) h.	the initial investment cost?	1	2	3	-73
( ) i.	the warranty period?	1	2	3	-74
( ) j.	the system's maintenance costs?	1	2	3	-75
( ) k.	client's availability of primary fuel?	1	2	3	-76
( ) l.	future costs of client's primary fuel?	1	2	3	-77

cc 80-2
dup 1-4

Next, I'd like to get some information about your firm.

14. In what city is the principal office of your firm located?

_____ 7-13

15. What is your firm's main activity? Is it: (READ LIST)

architecture or design	_____-1	-11
contracting	_____-2	
HVAC consulting	_____-3	
both HVAC consulting and contracting	_____-4	
other	_____-5	

16. About how many architects or engineering professionals does your firm employ?

_____-12-14

17. About how many separate HVAC installation recommendations was your firm involved in last year?

_____-15-19

18. About what percentage of these installations were for: (READ LIST)

municipal or government buildings	_____-20-22	
hospitals	_____-23-25	
industrial buildings	_____-26-28	
commercial buildings	_____-29-31	
multiple family residences	_____-32-34	
single family residences	_____-35-37	
other (Please specify)	_____-38-40	

_____ _____

(CHECK TO SEE THAT TOTAL IS EQUAL TO 100%)

19. About what percent of your firm's dollar business is located in the:

Northeast	_____%	-41-43
Southeast	_____%	-44-46
Southwest	_____%	-47-49
Northwest	_____%	-50-52

20. Does your firm represent a manufacturer of HVAC equipment?

_____-1 YES _____-2 NO -53

(IF YES): Which manufacturer? _____ -54-55

(IF MORE THAN ONE MENTIONED, ASK: "Which is the primary manufacturer?")

21. What was your firm's average growth rate in total revenue during the last five years?

_____ -56-58

Finally, I would like to get a little information about you for classification purposes:

22. What is your job title?

_____ _____ -59-60

23. Which of the following categories most closely corresponds to your current job responsibility?

architecture	_____-1	-61
system specification and engineering	_____-2	
sales and customer contact	-3 _____	
customer service and maintenance	_____-4	
company management	_____-5	
other (specify)	_____-6	

_____

24. About how many people report to you in your company, directly or indirectly?

0	_____-1	-62
1 - 3	_____-2	
4 - 10	_____-3	
11 - 30	_____-4	
over 30	_____-5	

25. In your highest degree, which of the following best describes the area of study you concentrated in?

Architecture	_____-1	-63
Math/Science	_____-2	
Engineering	_____-3	
Business	_____-4	
Liberal Arts	_____-5	

26. What was the highest level of schooling you completed?

-64

less than college	_____ -1
college	_____ -2
post-graduate	_____ -3
(DO NOT READ) refused	_____ -4

27. Into which of the following age groups do you fall?

-65

Under 25	_____ -1
25 - 34	_____ -2
35 - 44	_____ -3
45 - 54	_____ -4
Over 55	_____ -5
(DO NOT READ) refused	_____ -6

If your would like a copy of the results of this study, please give me your full name and address:

NAME_____

ADDRESS_____

_____

PHONE #:_____

Thank you very much for your time and cooperation!

INTERVIEWER'S NAME:_____ DATE:_____

THIS PAGE

WAS INTENTIONALLY

LEFT BLANK

BUILDER/DEVELOPER SEGMENT

PERSONAL QUESTIONNAIRE

Builder's Questionnaire

Hello, I'm _____ from Dialogue, a marketing consulting firm. We're conducting a study for the Department of Energy about marketing active solar energy products. The survey is being done among several different groups, one of which is home builders, and I'd like to ask you to participate. Does your firm build single family residential houses on speculation, that is, build first and find a buyer as the house gets finished?

YES ____ NO ____ (TERMINATE)

And does your firm build only mobile homes?

YES ____ (TERMINATE) NO ____

I'd like to ask you to participate in our study. The interview will take only a short while.

(IF INDIVIDUAL AGREES): Thank you very much. (SEAT RESPONDENT WITH RESPONSE CARD.) In the study we are trying to find out what home builders think about active solar energy systems and also to get their views of home buyers' attitudes about solar energy. This survey will only take a short while. We will be glad to send you the results of the study when it is complete if you stamp this form. (HAND FORM TO RESPONDENT.)

1a. To begin with, how many single family residential units, both spec and custom, and excluding mobile homes, did your company build in 1979?

_____ units 5- 9

1b. And about what percentage of your detached, single-family residential construction is spec built? What percentage is custom built?

spec built	_____%	10-12
custom built	_____%	13-15
(MUST ADD TO 100%)	100 %	

2. Approximately what was the residential construction volume for your company in 1979, in thousands of dollars?

_____M dollars 16-21

3. (HAND MAP TO RESPONDENT) What percentage of the single-family residential homes that your firm built in 1979 fall into each of these regions? (SHOW MAP, READ LIST)

Northeast	_____%	22-24
Southeast	_____%	25-27
Northwest	_____%	28-30
Southwest	_____%	31-33
(MUST ADD TO 100%)	100 %	

4a. Approximately what percentage of the homes that you build are: (READ LIST)

entry level houses	_____%	34-36
middle price houses	_____%	37-39
luxury houses	_____%	40-42
(MUST ADD TO 100%)	100 %	

4b. Consider a typical house you build on speculation. Looking at Scale A on your response card, which of the ranges most closely reflects the selling price of that house?

$30-50	_____-1	110-130	_____-5	
50-70	_____-2	130-150	_____-6	43-
70-90	_____-3	150 & up	_____-7	
90-110	_____-4			

5. Next, I'd like to get some information about the kinds of heating, cooling and hot water systems you install when you build a home. First let's talk about the primary fuel used for home heating.

a) What percentage of spec homes that you build use gas as the primary heating fuel? (REPEAT FOR EACH OF THE FOLLOWING):

gas	_____%	44-46
electricity	_____%	47-49
oil	_____%	50-52
solar	_____%	53-55
other	_____%	56-58
no heating system	_____%	59-61

(COLUMNS MUST ADD TO 100%: TOTAL = 100%)

b) What percentage of spec homes that you build use gas as the primary fuel to heat water? (REPEAT FOR EACH OF THE FOLLOWING):

gas	_____%	62-64
electricity	_____%	65-67
oil	_____%	68-70
solar	_____%	71-73
other	_____%	74-76

(COLUMNS MUST ADD TO 100%: TOTAL = 100%)

80- 1
Card 2 Dup 1-4

c) In about what percentage of the homes that you build do you install a central air conditioning system?

_____% 5- 7

d) Have you ever installed a heat pump in a home?

_____YES -1 _____NO -2 8-

6. Active solar energy systems are systems with a collector that use a fluid, or air, to move the trapped heat from the collector to where it will be used. Have you included any kinds of <u>active</u> solar devices in any of the homes you've built?

_____YES -1 _____NO -2 (SKIP TO Q. 15) 9-

In all of the following questions when we are talking about solar energy systems, we are only talking about <u>active</u> solar energy systems.

7. What kinds of active solar energy systems have you installed? (READ LIST) (PROBE FOR OTHER KINDS OF SYSTEMS) (IF "YES" ASK FOLLOW-UP QUESTION): In how many houses have you installed this kind of system? (RECORD)

	yes	no		Number of houses	
water heating	____-1	____-2	-10	____	11-13
pool heating	____-1	____-2	-14	____	15-17
home heating (and water)	____-1	____-2	-18	____	19-21
solar-assisted heat pump	____-1	____-2	-22	____	23-24
other_____				____	25-26

8. Who manufactured the systems that you installed? (PROBE) (ASK FOR EACH SYSTEM MARKED "YES" IN Q.7)

water heater names: _____
_____
_____
_____ -1 27-

don't remember _____ -2

site built _____ -3

pool heater names: _____
_____
_____
_____ -1 28-

don't remember _____ -2

site built _____ -3

home heating
(and water) _____
_____
_____
_____ -1 29-

don't remember _____ -2

site built _____ -3

solar-assisted
heat pump _____
_____
_____
_____ -1 30-

don't remember _____ -2

site built _____ -3

other type manufacturer

_____
_____
_____ 31-1
_____

9. Looking at Scale B (HAND SCALE CARD TO RESPONDENT), please tell me the number that best shows how satisfied you are with the _____ (READ EACH SYSTEM TYPE INSTALLED FROM Q. 7), you have installed?

	very satisfied	moderately satisfied	neither satisfied nor dissatisfied	moderately dissatisfied	very dissatisfied	
solar water heaters	1	2	3	4	5	33-
solar home heating systems	1	2	3	4	5	34-
solar assisted heat pumps	1	2	3	4	5	35-
other: _____	1	2	3	4	5	36-
_____	1	2	3	4	5	37-

10. **Were there any specific solar related problems that developed either during or after your installation of any system? What were they?**

NO____-1

_____ 38-
_____
_____ -2

11. Do you plan to install any kinds of active solar energy systems in the future?

_____YES -1 _____NO -2 39

12. Have you used any federal or state incentives to reduce your own cost of installing active solar energy equipment?

_____YES -1 _____NO -2(SKIP TO Q.13a) 40-

What incentives did you use?

_____

_____

_____

13a. Did the homebuyer(s) use any federal or state incentives to reduce the cost of purchasing the solar systems that you installed?

_____YES -1 _____NO -2 _____DON'T KNOW -3

(IF "NO" OR "DON'T KNOW", SKIP TO Q.14) 41-

13b. How important were the incentives in getting the purchaser to buy the house? Where they: (READ LIST)

Very important	_____	-1
Moderately important	_____	-2
Unimportant	_____	-3
Don't know	_____	-4
Custom designed house	_____	-5

42-

14a. Using your most recent spec solar home as an example, did you perform any analysis of fuel savings, compared to the cost of the solar energy system?

_____YES -1 _____NO -2 (SKIP TO Q18) _____NO SPEC SOLAR -3 (SKIP TO Q.18) 43-

14b. In what form was the analysis done? (READ LIST) (CHECK ALL MENTIONED)

was it: fuel savings per year	_____	44-1
payback analysis or years to payback	_____	45-1
cash flow analysis	_____	46-1
other (please specify)	_____	47-1

_____

(SKIP TO Q. 18)

15a. Have you ever considered installing a solar energy system in one of your spec houses?

YES _____ -1 NO _____ -2 (SKIP TO Q. 16) 48-

15b. What prompted you to consider installing solar? (CHECK ALL MENTIONED)

demonstration	_____	49-1
manufacturer/vendor	_____	50-1
another builder	_____	51-1
just went out looking	_____	52-1
other (please specify)	_____	53-1

_____ _____

16a. What kinds of active solar energy systems for home use are available in your area?

solar water heating	___	55-1
solar home and water heating	___	56-1
solar-assisted heat pump	___	57-1
other (please specify)	___	58-1 _____
none mentioned	___	59-1 (SKIP TO Q. 17)

16b. (FOR EACH "YES" IN Q. 16a, ASK:) Please look at Scale C. Which number on the scale best describes how much you agree or disagree with the statement: "I know a lot about how a _____ system works."

	Strongly agree		Neither		Strongly Disagree	
solar water heating	1	2	3	4	5	60-
solar home and water heating	1	2	3	4	5	61-
solar-assisted heat pump	1	2	3	4	5	62-
other (please specify) _____	1	2	3	4	5	63-

17. What manufacturers of active solar energy systems do you know of? What others?

_____
_____
_____ } 64-1

18. Looking at Scale D, which number best describes how likely you are to install a solar energy system in a spec home during 1980?

Certain, practically certain (99 in 100)	____ -10	
Almost sure (9 in 10)	____ -09	
Very Probable (8 in 10)	____ -08	
Probable (7 in 10)	____ -07	
Good possibility (6 in 10)	____ -06	
Fairly good possibility (5 in 10)	____ -05	66-67
Fair possibility (4 in 10)	____ -04	
Some possibility (3 in 10)	____ -03	
Slight possibility (2 in 10)	____ -02	
Very slight possibility (1 in 10)	____ -01	
No chance, almost no chance (0 in 10)	____ -88	

19. Using Scale E, do you believe that a manufacturer or supplier can or cannot currently provide <u>reliable</u> and <u>dependable</u> solar energy equipment for home use?

Definitely can	____ -1	
Probably can	____ -2	
Unsure	____ -3	68-
Probably can not	____ -4	
Definitely can not	____ -5	

20. Again, using Scale E, do you believe that a manufacturer or supplier can or cannot provide solar energy that <u>makes</u> <u>economic</u> sense for home use?

Definitely can	____ -1	
Probably can	____ -2	
Unsure	____ -3	69-
Probably can not	____ -4	
Definitely can not	____ -5	

21. Now look back at Scale C. Please tell me the number on the scale that best describes how much you agree or disagree with the statement "It is easy to obtain financing for a solar energy system".

Strongly agree	____ -1	
Moderately agree	____ -2	
Neither agree nor disagree	____ -3	70-
Moderately disagree	____ -4	
Strongly disagree	-5	

22. What number on Scale C best describes how much you agree or disagree with the statement: "Manufacturers of solar systems are mostly little companies that are here today and will probably be gone tomorrow"?

Strongly agree	____ -1	
Moderately agree	____ -2	
Neither agree nor disagree	____ -3	71-
Moderately disagree	____ -4	
Strongly disagree	____ -5	

23. What number on Scale C best describes how much you agree or disagree that solar energy equipment will be widely used by homeowners within the next five years?

Strongly agree	____ -1	
Moderately agree	____ -2	
Neither agree nor disagree	____ -3	72-
Moderately disagree	____ -4	
Strongly disagree	-5	

24. Now I'd like to ask you some questions about home buyers in your area. Using Scale F, would you tell me how much demand there is among home buyers for solar energy heating systems?
(REPEAT QUESTION FOR SOLAR WATER HEATING SYSTEMS.)

	strong demand	moderate demand	slight demand	no demand	
solar heating systems	____-1	____-2	____-3	____-4	73-
solar water heating systems	____-1	____-2	____-3	____-4	74-

Next, I'm going to give you three lists of criteria that people use to evaluate solar energy systems. (HAND FORMS TO RESPONDENT.) With the first list, I'll ask you to tell me the importance of each criterion as it affects you, in your own business. Then, with the second list, I'll ask you to tell me about your customers. Finally, I'll ask you how a solar manufacturer should evaluate the criteria.

25. On the first list, the criteria are ones that you might consider when thinking about using a solar energy system on a spec house. I'd like you to circle the number in the column indicating how much priority you'd assign to each criterion. Please try to place about three circles in each column.

(ALLOW SUFFICIENT TIME FOR RESPONDENT TO COMPLETE THIS QUESTION.)

26a. If you'll now turn the page, you'll see a list of criteria that are often mentioned as ways in which general consumers evaluate solar equipment. Please look at this page and circle the number in the column that indicates how much priority one of your customers would give to each of the criteria in deciding to adopt a solar energy system in a new home. Once again, please try to place three circles in each column.

(ALLOW SUFFICIENT TIME FOR RESPONDENT TO COMPLETE THIS QUESTION.)

26b. What other high priority criteria do you think your customers use?

_____

_____

_____

_____ 75-1

27a. Please turn to the next page. Now, I'd like you to place yourself in the position of a solar product manufacturer. You want to increase sales of your products. Unfortunately, you also have a fixed budget, so you can't do everything that you might like to. Keeping both these goals in mind, I'd like you to look at the list of marketing actions and circle the numbers in the columns to indicate how you'd place your marketing priorities in order to increase your business. This time, please try to place about four circles in each column.

(ALLOW SUFFICIENT TIME FOR RESPONDENT TO COMPLETE THIS QUESTION.)

27b. What other actions would you take if you were a solar manufacturer or vendor?

_____

_____

_____

_____ 77-1

28. Please turn to the final page. This question is about the various job responsibilities you have. During a typical week, what fraction of your job responsibilities are associated with each of the categories listed on the page? Please place the appropriate percentages in the spaces provided, and note that the total must add to 100%.

(ALLOW SUFFICIENT TIME FOR RESPONDENT TO COMPLETE THIS QUESTION.)

80- 2

Card 3 Dup 1-4

29. Who designs the spec single-family houses that you build? (CHECK ALL MENTIONED)

me	_____	5-1
staff architect/design	_____	6-1
outside architect/design	_____	7-1
other (please specify)_____		8-1

_____

30. Who chooses the energy system that you install? (CHECK ALL MENTIONED)

me	_____	9-1
staff engineer	_____	10-1
outside engineer	_____	11-1
HVAC contractor	_____	12-1
other (please specify)_____		13-1

_____

31. Who else would be involved in making decisions about which kinds of energy systems to install in the houses you build? Who else is involved? (DO NOT READ LIST) (CHECK ALL MENTIONED)

no one	_____	14-1	firm's owner/officers	_____	19-1
staff architect	_____	15-1	legal/financial staff	_____	20-1
outside architect	_____	16-1	contractors	_____	21-1
staff engineer	_____	17-1	other (please specify)	_____	22-1
outside engineer	_____	18-1	_____		

32. Suppose that after installing solar water heating equipment you had to increase the price of a typical house by $3500 to cover costs and profit. Using Scale G, please tell me how the marketability of that house would be affected.

no demand - unable to sell		demand unaffected			large demand - sell immediately		
1	2	3	4	5	6	7	23-

don't know_____ -8

33. Suppose that after installing solar home heating equipment you had to increase the price of a typical house by $8500 to cover costs and profit. Using Scale G, please tell me how the marketability of that house would be affected.

no demand - unable to sell			demand unaffected			large demand - sell immediately	
1	2	3	4	5	6	7	24-

don't know_____ -8

34. In your business, would it be worth your while to keep abreast of research developments in solar assisted heat pump technology? Please look at Scale H and tell me the number that best describes how worthwhile this information would be to you: (REPEAT FOR SOLAR COOLING TECHNOLOGY.)

	would definitely be worthwhile	would be moderately worthwhile	would be slightly worthwhile	would not be worthwhile	
solar assisted heat pump technology	1	2	3	4	25-
solar cooling technology	1	2	3	4	26-

35. What two or three technical or trade publications do you read most regularly? (IF OTHER THAN ONES LISTED, LIST IN BLANKS)

Professional Builder	_____ 27-1	_____	
Commercial Building	_____ 28-1	_____	
Home Building	_____ 29-1	_____	_____ 31-32
Housing.	_____ 30-1	_____	

36. Company Name:_____

Another portion of this study will involve our interviewing people who are either looking to buy a newly-built spec house or who are building custom - designed homes, or have recently bought a newly-built spec home or custom-built home. In order to do this, we need lists of such people. Would your company be willing to provide us with names of people who have contacted you about buying a newly-built home or who have recently bought a newly-built home?

(IF YES SAY:)

Thank you very much. We will be contacting you in a week or so to get the list of names (MAKE SURE COMPANY NAME, ADDRESS, AND PHONE # ARE RECORDED.) We really appreciate your help.

Name_____

Company Name_____

Address_____

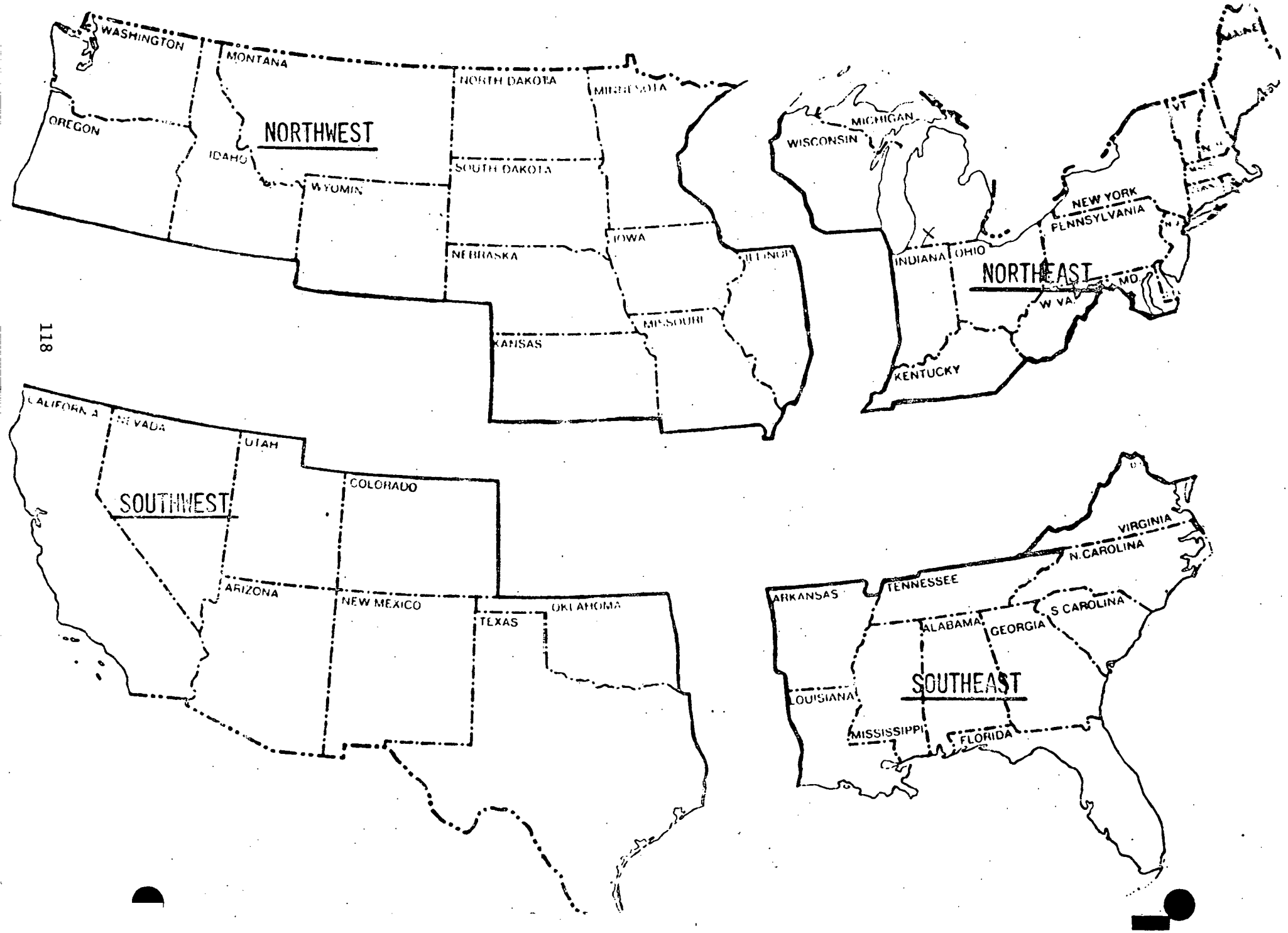
_____

Phone #_____

36	37	38	39	40	41	42	43	44

45	46	47	48	49	50	51	52	53

80-3


WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
OREGON
NORTHWEST
IDAHO
WYOMIN
SOUTH DAKOTA
NEBRASKA
IOWA
ILLINOIS
KANSAS
MISSOURI
MICHIGAN
WISCONSIN
INDIANA
OHIO
NEW YORK
PENNSYLVANIA
NORTHEAST
W VA.
MD
KENTUCKY
VT
CALIFORNIA
NEVADA
UTAH
SOUTHWEST
COLORADO
ARIZONA
NEW MEXICO
TEXAS
OKLAHOMA
VIRGINIA
N.CAROLINA
ARKANSAS
TENNESSEE
S CAROLINA
ALABAMA
GEORGIA
SOUTHEAST
LOUISIANA
MISSISSIPPI
FLORIDA

SCALE A

$30 - 50	50 - 70	70 - 90	90 - 110
110 - 130	130 - 150	Over 150	

SCALE B

VERY SATISFIED	MODERATELY SATISFIED	NEITHER SATISFIED NOR DISSATISFIED	MODERATELY DISSATISFIED	VERY DISSATISFIED
1	2	3	4	5

SCALE C

STRONGLY AGREE	MODERATELY AGREE	NEITHER AGREE NOR DISAGREE	MODERATELY DISAGREE	STRONGLY DISAGREE
1	2	3	4	5

SCALE D

Certain, practically certain (99 in 100)
Almost sure (9 in 10)
Very probably (8 in 10)
Probable (7 in 10)
Good Possibility (6 in 10)
Fairly good possibility (5 in 10)
Fair possibility (4 in 10)
Some possibility (3 in 10)
Slight possibility (2 in 10)
Very slight possibility (1 in 10)
No chance, almost no chance (0 in 10)

SCALE E

DEFINITELY CAN	PROBABLY CAN	UNSURE	PROBABLY CAN NOT	DEFINITELY CAN NOT
1	2	3	4	5

SCALE F

STRONG DEMAND	MODERATE DEMAND	SLIGHT DEMAND	NO DEMAND
1	2	3	4

SCALE G

No demand -- Unable to sell			Demand unaffected			Large demand -- Sell immediately
1	2	3	4	5	6	7

SCALE H

WOULD DEFINITELY BE WORTHWHILE	WOULD BE MODERATELY WORTHWHILE	WOULD BE SLIGHTLY WORTHWHILE	WOULD NOT BE WORTHWHILE
1	2	3	4

Builder's Criteria

		top priority	high priority	medium priority	low priority
1.	Profit margin on solar equipment	1	2	3	4
2.	Performance reliability of solar equipment	1	2	3	4
3.	Ease of installation	1	2	3	4
4.	Amount of change from usual building schedules	1	2	3	4
5.	Likely customer demand for solar equipped houses	1	2	3	4
6.	Installation of solar equipment by other builders in the area	1	2	3	4
7.	Building regulations	1	2	3	4
8.	Availability of solar equipment	1	2	3	4
9.	Willingness of subcontractors to participate in solar installation	1	2	3	4
10.	Reliability of suppliers	1	2	3	4
11.	Availability of fully integrated solar equipment	1	2	3	4
12.	Government certification of solar equipment	1	2	3	4

Customers' Criteria

		top priority	high priority	medium priority	low priority
1.	System's expected life	1	2	3	4
2.	Initial cost	1	2	3	4
3.	Warranty period	1	2	3	4
4.	Operating and maintenance cost	1	2	3	4
5.	Number of successful installations	1	2	3	4
6.	Payback period	1	2	3	4
7.	Effect on home appearance	1	2	3	4
8.	Yearly savings on energy costs	1	2	3	4
9.	Effect on the environment	1	2	3	4
10.	Good citizenship	1	2	3	4
11.	Protection from fuel shortages	1	2	3	4

Solar Product Manufacturer

		would definitely do	would probably do	might or might not do	would not do
1.	Install demonstration units	1	2	3	4
2.	Advertise non-financial benefits (energy independence, etc.)	1	2	3	4
3.	Sell components only	1	2	3	4
4.	Advertise financial benefits	1	2	3	4
5.	Reduce price	1	2	3	4
6.	Lengthen warranty	1	2	3	4
7.	Sell integrated systems	1	2	3	4
8.	Provide how-to workshops for installers	1	2	3	4
9.	Sell directly to the builder or end-user	1	2	3	4
10.	Build sturdier collectors	1	2	3	4
11.	Improve system performance	1	2	3	4
12.	Sell through local distributors	1	2	3	4
13.	Advertise in trade publications	1	2	3	4
14.	Have my product certified by the appropriate agencies	1	2	3	4
15.	Advertise to the general public	1	2	3	4

Job Responsibilities

Construction management _____ %

Sales/Marketing management _____ %

Technical management/engineering _____ %

Financial responsibilities _____ %

Procurement or purchasing _____ %

General management _____ %

Other _____ _____ %

_____ _____ %

(Total must equal = 100 %)

COMMERCIAL SEGMENT

PERSONAL PROTOCAL

COMMERCIAL QUESTIONNAIRE

1. Name _____

   Address _____

   _____

   Owner (Manager) _____

   Title (if applicable) _____

2. Description of facility: number of units, machines, rooms, total sq. feet

   _____

   _____

   _____

   _____

3. What system do you currently use for heating water (and space heating if applic.)? (manufacturer, size, fuel) How satisfied are you with the present system?

   _____

   _____

   _____

   _____

   _____

4. How much do you currently pay for heating hot water? How much hot water do you use? (gal/room/time, $/room/time, gal & $/month, gal & $/operation)

   _____

   _____

5. What fuel do you expect to be using to heat water a year from now? What would you expect the cost of that fuel to be a year from now?

   fuel _____ cost _____

   Five years from now?

   fuel _____ cost _____

6. Does your hot water usage (heating) vary seasonally?

_____

_____

7. Do you currently have any plans for expansion of (business) ? Renovation? What kinds of systems for hot water (heating) are under consideration?

_____

_____

_____

8a. Prior to this survey, had you seen or heard anything about the use of solar energy equipment for water heating or home/business heating?

yes ___ no ___

b. Other than in a picture, have you ever seen a home or business equipped with solar collectors or solar panels?

yes ___ no ___

c. Do you know anyone who is now using solar energy for home or business heating or water heating?

yes ___ no ___

d. Have you actually gone looking for information about solar home/business or water heating equipment from a solar equipment manufacturer or dealer, a builder, or an architect?

yes ___ no ___

9. Have you heard of any kinds of government-sponsored financial incentives for installation of solar energy equipment in businesses?

Incentive	Federal	State	Percent of cost
_____	___	___	_____
_____	___	___	_____
_____	___	___	_____
_____	___	___	_____

(SHOW DESCRIPTION)

10. Attitudinal questions - Separate sheet

Please read the statements on this sheet, and circle the number on the scale that tells how you feel about that statement; first, as it applies to home use, and second, as it applies to business use

11. The decision to purchase an energy system can be broken down into three major steps: 1) identification of alternatives, 2) financial and technical evaluation, and 3) final equipment and source selection.

For each stage:

Who in your company would be involved in stage _____?
(Probe: staff/outside architect, staff/outside engineer, firm's owner/ officers, legal/financial staff, contractors)

Who would be the most influential in decision process? Second? .....

Identification of of Alternatives		Financial and Technical Evaluation		Final Equipment and Source Selection	
rank		rank		rank	
____	_____	____	_____	____	_____
____	_____	____	_____	____	_____
____	_____	____	_____	____	_____
____	_____	____	_____	____	_____
____	_____	____	_____	____	_____

12. Under what conditions would you personally consider solar? (Importance rankings)

_____

_____

_____

13. What specific data would you want before you would purchase? (financial, other working installations, someone's seal of approval, guarantees) (Prompt, if no response initially) Importance rankings.

_____

_____

_____

_____

14. How would you evaluate a solar purchase? What financial criteria? How use? What other criteria?

_____

_____

_____

_____

_____

15. Put yourself in the place of a solar manufacturer. What actions would you take now, and over the next few years to get people in (specific business) to buy your product? (demos, advertise non-financial benefits, reduce price, warranty, improve system performance, have product certified)

_____

_____

_____

_____

_____

16. Size of operation:

Number of employees _____

Gross revenues _____

17. Personal:

Person's age _____

Education _____

Years with business _____

A. Do you believe that you can currently obtain reliable and dependable solar energy equipment for:

home use?		business use?	
Definitely can	_____	Definitely can	_____
Probably can	_____	Probably can	_____
Unsure	_____	Unsure	_____
Probably can not	_____	Probably can not	_____
Definitely can not	_____	Definitely can not	_____

B. Do you believe that you can currently obtain solar energy equipment that makes economic sense for:

home use?		business use?	
Definitely can	_____	Definitely can	_____
Probably can	_____	Probably can	_____
Unsure	_____	Unsure	_____
Probably can not	_____	Probably can not	_____
Definitely can not	_____	Definitely can not	_____

C. Do you believe that solar energy equipment will be widely used by homeowners/businesses in your area within the next five years?

homeowners:		businesses:	
Definitely will	_____	Definitely will	_____
Probably will	_____	Probably will	_____
Unsure	_____	Unsure	_____
Probably will not	_____	Probably will not	_____
Definitely will not	_____	Definitely will not	_____

Please circle the number on the scale that indicates how you feel about each of the following statements, first for "home use" and then for "business use".

		Strongly agree	Moderately agree	Unsure	Moderately disagree	Strongly disagree
D.	I know a lot about the financial aspects of solar energy systems					
	for home use:	1	2	3	4	5
	for business use:	1	2	3	4	5
E.	I know a lot about how solar energy systems work					
	for home use:	1	2	3	4	5
	for business use:	1	2	3	4	5
F.	If several of my neighbors/ other businesses installed solar equipment, I would think much more seriously about installing it myself					
	for home use:	1	2	3	4	5
	for business use:	1	2	3	4	5