

47
7/22/80
M.S.

Rn. 1509

solar market studies

REVIEW AND COMMENT

MASTER



SERI 

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

Printed in the United States of America

Available from:

National Technical Information Service

U.S. Department of Commerce

5285 Port Royal Road

Springfield, VA 22161

Price:

Microfiche \$3.00

Printed Copy \$5.25

**Also available from: Superintendent of Government Documents, U.S. Government Printing Office
Washington, D.C. 20402
Stock number 061-000-00417-3**

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

SERI/SP-434-475
UC CATEGORY: UC-58b

SOLAR MARKET STUDIES:
REVIEW AND COMMENT

REBECCA VORIES
HAROLD STRONG

MAY 1980

DISCLAIMER

This book was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PREPARED UNDER TASK NO. 6721.20

Solar Energy Research Institute

1536 Cole Boulevard
Golden, Colorado 80401

A Division of Midwest Research Institute

Prepared for the
U.S. Department of Energy
Contract No. EG-77-C-01-4042

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

PREFACE

In the absence of current national studies that probe the market characteristics of present and potential users of solar energy, this report presents the results of a literature review of selected solar market surveys and related studies and provides summaries of all reports reviewed. An attempt is made to characterize the current solar consumer and potential solar consumer on the basis of these scattered studies. An attempt is also made to present potential market penetrations and possible constraints and incentives to the development of markets for solar energy systems.

Many of the studies covered additional elements that are not reported here. Only those elements that might have a bearing on the marketing of solar concepts were selected for inclusion in this report.

It is hoped that this summary will be useful to industry and to others in their marketing and educational strategies. It was prepared as part of Task Number 6721.20 of the Solar Energy Research Institute (SERI).



Rebecca Vories
Senior Consumer Specialist

Approved for:

SOLAR ENERGY RESEARCH INSTITUTE



David Feasby, Chief
Market Development Branch



Jon Veigel, Director
Commercialization Division

DISCLAIMER

This book was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

TABLE OF CONTENTS

	<u>Page</u>
1.0 Introduction	1
2.0 Overall Findings and General Conclusions.....	3
2.1 Solar Consumers (Present and Potential).....	3
2.2 Manufacturers and Product Delivery Network	4
2.3 Government	5
2.4 Constraints.....	5
2.5 Incentives	5
2.6 Market (Present and Future)	6
3.0 Summaries of Reviewed Studies	7
3.1 What Home Shoppers Seek in Six Major Markets (Walker and Lee, a California Realty Firm for Housing Magazine, October 1978).....	7
3.2 Solar Energy Study (Research Department of Architectural Record, November 1978).....	8
3.3 The Montana Solar Public Opinion Survey (Jan Konigsberg, Montana Energy Office, May 1978).....	9
3.4 Socio-Economic Factors Affecting the Adoption of Household Solar Technology: Preliminary Findings (Sparrow, Warkov & Cass, 1978)	10
3.5 Solar Energy Incentives Analysis: Psycho-Economic Factors Affecting the Decision Making of Consumers and the Technology Delivery System (The Department of Energy, January 1978)	11
3.6 Survey of Customer Attitudes Toward Home Solar Systems (Southern California Edison (SCE), December 1977).....	12
3.7 An Attitudinal Study of the Home Market for Solar Devices (Decisions and Designs, Inc. for the Federal Energy Administration, September 1977)	13
3.8 SDG&E's Solar Water Heating System: A Concept Study (Marylander Marketing Research, Inc. for San Diego Gas and Electric Company, April 1977).....	14
3.9 Solar Water Heating Economic Feasibility, Capture Potential, and Incentives (Jerome Scott, University of Delaware for the National Science Foundation, February 1977).....	15
3.10 Solar, Background Attitude and Awareness Study (Marketing Research Department, San Diego Gas and Electric Company, October 1976)	17
3.11 Early Market Experience of Solar Energy in the United States (Alan Hirshberg, Booz-Allen and Hamilton, Inc., May 1979)	18

TABLE OF CONTENTS (continued)

	<u>Page</u>
3.12 The Diffusion and Adoption of Solar Equipment Among California Homeowners: Report on a Pretest Study (Dorothy Leonard-Barton, Institute for Communication Research, Stanford University, December 1977)	19
3.13 Selling the Solar Home: Some Preliminary Findings (Real Estate Research Corp., 1978)	21
3.14 Solar Energy and Today's Consumer (Report by the Subcommittee on Oversight and Investigations of the House Committee on Interstate and Foreign Commerce, December 1978)	22
3.15 Solar Commercialization—The Consumer Experience (Yarosh & Litka, Florida Solar Energy Center, 1978) Solar Commercialization—In Need of Help (Marvin M. Yarosh, Florida Solar Energy Center, 1978)	24
3.16 SHAC Evaluation: A Feasibility Study (Booz-Allen and Hamilton, August 1978).....	25
3.17 SDG&E Solar Water Heating Initial Purchaser Analysis (Marylander Marketing Research, Inc. for San Diego Gas & Electric Company, October 1978).....	26
3.18 Solar Consumers: An Investigation Toward Commercialization (Jeffery Cook, Connelly, Garrett for the Arizona Solar Energy Research Commission, June 1977)	27
3.19 Attitudes, Usage Patterns, and System Characteristics Among Owners of Solar Pool Heaters and Owners of Solar Water Heaters (Marylander Marketing Research, Inc., 1976)	28
3.20 Project Payback: Preliminary Results of Pre-Test Survey of Homeowners Regarding Personal Energy Conservation (National Demographics Inc. for the Department of Energy, November 1978).....	29
3.21 Evaluation of a Marketing Program Designed to Increase Consumer Consideration of Energy-Efficient Products in Denver, Colorado (National Demographics Ltd. for the Department of Energy 1978)	30
3.22 Federal Incentives for Solar Homes, An Assessment of Program Options (Epstein and Barrett, Regional and Urban Planning Implementation, Inc. for the Department of Housing and Urban Development, July 1977)	31
3.23 Financing the Solar Home: Understanding and Improving Mortgage-Market Receptivity to Energy Conservation and Housing Innovation (Barrett, Epstein and Haar: Lexington Books, June 1977)	33

TABLE OF CONTENTS (concluded)

	<u>Page</u>
3.24 Colder . . . Darker: The Energy Crisis and Low-Income Americans, An Analysis of Impact and Options (Eunice S. Grier, Washington Center for Metropolitan Studies for the Community Services Administration, June 1977)	35
3.25 Photovoltaic Power Systems Market Identification and Analysis (The BDM Corporation for the Department of Energy, November 1978)	36
3.26 Embryo Windmill Market Probed in Pioneer Research Effort (Don Morris, Marketing News, March 1978)	37
3.27 A Review of Selected Solar Market Studies and Techniques, Progress Report (Berliner, Christmas, Costello & Fellhauer, Solar Energy Research Institute, October 1978)	38
3.28 Solar Heating and Cooling of Buildings (SHACOB) Commercialization Report: Part B—Analysis of Market Development (Arthur D. Little, Inc. for the Department of Energy, September 1977)	39
3.29 Residential Solar Heating and Cooling Constraints and Incentives, A Review of the Literature (Arthur D. Little, Inc. for the Department of Housing and Urban Development, May 1976)	42
3.30 Solar Heating and Cooling of Buildings, Phase O Feasibility and Planning Study, Final Report (General Electric for the National Science Foundation RANN, May 1974)	43
3.31 Solar Home Heating in Canada: Problems and Prospects (Foster & Sewell, Office of the Science Advisor, Canadian Department of Fisheries and Environment, 1977)	44
3.32 Canadian Perspective on United States Solar Policies (Foster and Sewell, University of Victoria for the Canadian Department of Energy, Mines and Resources, December 1977)	45
Appendix A Bibliography	47

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

LIST OF TABLES

	<u>Page</u>
3-1. Percentage of Potential Home Buyers Wanting Solar Systems at Approximate Cost Levels.....	7
3-2. Interviews Conducted for this Report	21
3-3. Solar Incentive Comparisons Summary Table	40

SECTION 1.0

INTRODUCTION

The objective of this report is to summarize and analyze relevant solar energy market surveys and related studies to provide a basis for determining areas requiring additional research, and for formulating policies and actions that would aid in rapid adoption and use of solar technologies.

There is a growing though scattered body of research on various aspects of the market for solar energy products. The research covers a wide variety of technologies, regions, samples, objectives, and methodologies. The credibility of the results is directly related to the professional quality of the research, which is highly variable. Regardless of any shortcomings in the individual studies, there appears to be enough consistency in the findings of the research as a whole that a great deal can be learned about the market for solar energy applications.

Most of the studies to date have concentrated on the residential users of solar heating systems.* Others have dealt with the manufacturers and product delivery network, the constraints and incentives to the development of the solar industry, the Federal Government's role in that development, and other issues that influence the use of solar energy systems. A limited number of studies have also dealt with the "other solar technologies."**

Thirty-two studies are discussed in this report. The first 19 directly assess the market for residential use of solar domestic hot water, space, and pool heating. Studies 20 and 21 inspect energy conservation surveys. Studies 22 and 23 examine the financial incentives and financial institutions in the expanding solar market. Study 24 considers energy and low-income people. Studies 25 and 26 assess market sizes for photovoltaic systems and wind machines. Studies 27-30 are not surveys per se, but represent secondary source and modeling efforts to gain understanding of the solar marketplace. Studies 31 and 32 present the Canadian perspective on the market feasibility of solar energy systems.

Many of the studies had flaws of concept and/or method to a degree that would bring into question the credibility of individual findings. The primary faults that made the studies nonrepresentative of the total market are: small sample size, nonrandom samples, self-selected samples, geographic limitations, and lack of questions that examined non-economic motivating factors. Because a majority of the studies were not meant to be national surveys, national market generalizations of geographically restricted studies would be misleading. However, the results of geographically limited studies taken as an aggregate can provide a useful compendium of opinion. A lack of consensus within the studies concerning a particular issue does not necessarily mean that a finding is not valid; it may only suggest the need for further study, a difference in the manner a question was phrased, or different research approaches or objectives.

*Solar pool heaters, solar water heaters for domestic hot water, solar space heaters and combinations of those uses.

**Solar thermal for process heat, solar thermal electric generation, photovoltaics, wind, ocean thermal energy conversion, etc.

A number of the studies have been reviewed in greater depth and from different perspectives by other researchers at SERI. Those are: Public Opinion About Energy: A Literature Review (June 1979) by Farhar, Weis, Unseld, and Burns; and A Review of Empirical Studies of Residential Solar Energy Users (January 1980) by Unseld and Crews.

Microfiche copies of these reports are available through SERI, 1617 Cole Boulevard, Golden, Colorado 80401. Hardcover copies are available through NTIS, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

In addition, SERI is undertaking national surveys of homeowners and solar users to gain an in-depth perspective of attitudes, knowledge, financing preferences, etc., of both solar users and nonusers. This study, The National Survey of the Residential Solar Energy User: Decision Factors and Experiences, should have preliminary information available in the fall of 1980.

SECTION 2.0

OVERALL FINDINGS AND GENERAL CONCLUSIONS

This section presents the findings and conclusions that appeared frequently in the studies reviewed. Findings that appeared infrequently but which nevertheless are particularly credible or relevant are also presented. Note that these findings and conclusions are representative of the relatively small and scattered samples surveyed in various individual studies, however.

According to these studies, present solar consumers are relatively young, well educated, politically conservative, and express a high degree of satisfaction with their solar systems. Most fall into the category of innovators or early adopters in the market diffusion continuum. As the market diffusion process continues, it is assumed that the "typical" consumer will represent a cross section of the American homeowner. Potential solar consumers are generally uninformed about the potential of solar systems, and feel that more information is needed.

Solar manufacturers, dealers, and installers have evolved into a conventional distribution network. While some technological/organizational problems exist, they probably will not be a major barrier to industrial development, although their slow rate of development may be undesirable for an accelerated strategy.

The institutional/financial constraints that have been the concern of many researchers have not proven to be major barriers. Continuous monitoring will prevent these constraints from becoming problems. However, early concern and awareness have moderated their potential effect.

The consensus of those who have studied the effect of various incentives on solar development is that strong government support consisting of an education program, demonstration programs, and financial incentives can have a very marked effect in accelerating solar development.

There is a great deal of public interest in and acceptance of solar energy systems, which would seem to predict a very healthy future market. However, the realization of that potential market depends upon a multitude of variables. Most significant among those variables is whether or not a reduction of high initial system costs can be achieved through a technological breakthrough or by providing adequate financial incentives.

The general conclusions set forth in the preceding paragraphs are based on the overall findings described in the following paragraphs. The findings are grouped according to what they indicate about present and potential solar consumers, solar equipment manufacturers and the solar product delivery network, the government's perceived role in the development of the solar industry, constraints and incentives to solar energy development, and the present and future solar market.

2.1 SOLAR CONSUMERS (Present and Potential)

- Most early solar users surveyed had a family income and educational level well above the national average, though this appears to be less true of newer users.

- Most solar users surveyed to date have been relatively young to middle-aged (25-50) professionals, managers, or white collar workers, with small families. A high percentage categorize themselves as Republicans or conservatives.
- Most present users surveyed indicated a high degree of satisfaction with their solar systems; they feel a commitment toward solar energy and conservation and are willing to make allowances for problems encountered. Most, however, had no idea how well their systems were working or how much money/energy they might be saving.
- The most frequently mentioned reasons for adopting or considering purchasing solar energy systems in the future were savings on utility bills, conserving energy, and protecting the environment.
- The most frequently mentioned reasons for not adopting or not considering purchasing solar energy systems in the future were high initial costs and concern about being at the mercy of the weather.
- Newspapers, television and radio, magazine articles, and present solar users appear to be the dominant sources of information for learning about solar energy applications for both the present and potential users surveyed.
- A significantly greater number of potential customers surveyed would consider purchasing a new home with a solar energy system rather than retrofitting their present home.
- Those surveyed generally showed high levels of interest in and acceptance of solar energy, but seemed to be misinformed about it. An overwhelming majority of the potential solar users surveyed felt they needed more information about solar energy.
- Most of the consumers surveyed said they were willing to pay more for energy-efficient products and homes (including solar energy systems).

2.2 MANUFACTURERS AND PRODUCT DELIVERY NETWORK

- Most manufacturers surveyed have shifted their selling strategies away from consumers and toward distributors and dealers.
- Builders and developers surveyed showed a growing interest in solar homes, although they are not yet ready to commit themselves fully. However, they do appear to be emerging as increasingly important figures in the development of the industry.
- A large percentage of architects surveyed have specified or are planning to specify a solar energy system of one kind or another and generally report that they are supportive of the use of solar energy when asked by clients.
- In many of the regions surveyed, utilities appear to be respected and considered a logical supplier of solar energy systems, information, maintenance, and possibly financing.
- Of the manufacturers of solar flat-plate collectors surveyed, 45% account for 90% of the sales.
- Mortgage lenders surveyed generally report that they consider loans for solar homes using the same criteria as they would for a conventional home.

- Most system operational problems can be traced to installation—most installers reportedly fix those problems promptly.

2.3 GOVERNMENT

Many people surveyed in several studies felt that:

- Government agencies tend to stress high technology and have neglected simpler, more cost-effective "passive systems."
- The government should assume a major role in promoting solar energy applications through education, financial incentives, and serving as an example.
- The government should institute a solar energy system and component certification program and establish industry standards.
- The government's efforts to collect and disseminate information about solar energy are redundant and disorganized.
- The government is not presently supporting the development of solar energy at the level that is necessary to assure a significant market penetration and energy savings in the near future.

2.4 CONSTRAINTS

- The major barriers to the development of the solar industry are the uncertainties about market and technology development for the product delivery system and the systems' high initial cost.
- Manufacturers and installers have not yet produced a foolproof system design or installation method and many operational problems result in owner dissatisfaction.
- A lack of information exists with regard to true costs and performance of solar energy systems.
- Economic/financial constraints will have a major effect on the rate of solar development, although many other factors also play a significant role in a decision to purchase a system.

2.5 INCENTIVES

- A substantial portion of potential home buyers surveyed expressed a willingness to shift to solar heating. Economic incentives would influence them to make that decision.
- Rebate programs or tax credits appear to be the favored financial incentives.
- Promotional and regulatory/legal incentives will be necessary to ensure full realization of the market potential.

- Economic/financial incentives will have the greatest effect on the rate of solar development.⁴
- There is a need to explore alternative financing arrangements.

2.6 MARKET (Present and Future)

- To date, there are an estimated 90 to 100,000 solar installations in the United States. Of these, 50 to 60,000 are water and/or space heaters.
- The primary market based on those surveyed is made up of "first on the block" innovators and "tinkerers" who derive personal satisfaction from having a solar system. However, the market could be expanded significantly by suitable economic and educational incentives.
- Builders'/developers' decisions to install solar systems on new speculative-built homes will have a significant effect on the growth of the market.
- According to one computer projection, approximately 39 million buildings will be candidates for solar systems by the year 2000. Of these buildings, the most cost effective will be newly constructed.
- The same study estimating market penetration projected that approximately 4.4 million buildings will have solar systems by the year 2000.

A great deal of information concerning the solar industry and market has been derived from the studies discussed in this report. However, it is evident that there is a need for further study in specific areas. To prevent unnecessary duplication and to ensure the validity of the findings, the scope of the studies should be limited and care should be taken to follow appropriate scientific methodology. Some of the questions that need to be addressed in depth are:

- How will the future users of solar energy systems differ from present users in their motivation to adopt solar energy?
- What incentives (both economic and noneconomic) would be necessary to realize a larger market penetration in the retrofit and new home solar field, which combination of incentives would accomplish that end in the shortest time frame, and to whom should these incentives apply?
- What would be the most efficient method of collecting and disseminating solar information to the public without redundancy?
- What is the best and quickest method of promoting passive systems?
- What specific studies need to be done concerning the market development of the "other solar technologies," and when should these studies be done in order to provide timely input into the development of those technologies?

*It should be noted that most of the surveys explored only economic and financial incentives and not psychological or sociological incentives, and, therefore, may have overlooked many equally motivating factors.

SECTION 3.0

SUMMARIES OF REVIEW STUDIES

3.1 WHAT HOME SHOPPERS SEEK IN SIX MAJOR MARKETS (Walker and Lee, A California Realty Firm for Housing Magazine, October 1978)

Study Description

This consumer preference survey consisted of interviews of new home shoppers who visited model homes in Washington, D.C., Miami, Chicago, Phoenix, San Francisco, and San Diego. The answers to the questions asked in the survey were tabulated to show pertinent demographic information and preferences for different styles of homes and available options.

Objective

The objective was to provide the readers of Housing Magazine with answers regarding new home shoppers and the styles and features of housing and options they would buy.

Findings and Conclusions

- Most potential home buyers surveyed were young (26 to 35) with above-average incomes and small families.
- Approximately two-thirds of all buyers desiring detached houses (not sharing any wall with another building), and half of those wanting attached dwellings (e.g., apartments, condominiums, townhouses) already owned homes.
- Preferences for exterior designs varied greatly between cities.
- Fireplaces were the most desired option, with French doors, bay windows, and skylights mentioned frequently.
- Upgraded insulation was the most requested energy conservation option with double-glazed windows ranking high in the cold weather areas. Solar systems that received a high rating by shoppers in Phoenix and Miami only can be seen in Table 3-1.
- Potential home buyers throughout the United States have a great deal in common, but are affected by many regional and local preferences.

Table 3-1. PERCENTAGE OF POTENTIAL HOME BUYERS WANTING SOLAR SYSTEMS AT APPROXIMATE COST LEVELS

	Solar Water Heat		Solar Space & Water Heat	
Washington, D.C.	34%	\$2,000	32%	\$13,000
Miami	58%	\$1,200	48%	\$ 7,000
Chicago	25%	\$2,000	21%	\$13,000
Phoenix	77%	\$1,700	N.A.	
San Francisco	41%	\$1,800	42%	\$ 7,000
San Diego	36%	\$1,800	24%	\$ 7,000

Comments

This survey is useful only as a representation of the present potential market in the named cities and to illustrate that there are many regional differences. The reasons for those differences are not identified in the magazine article.

3.2 SOLAR ENERGY STUDY (Research Department of Architectural Record, November 1978)

Study Description

This report presents the tabulated results of 272 questionnaires completed and returned by architectural firms nationwide.

Objective

To learn more about architectural practices, preferences, and opinions with regard to active solar energy systems.

Findings and Conclusions

- Of the architects surveyed, 62% had specified an active solar system in the last two years or planned to specify such a system in the future.
- Eighty-eight percent had specified or planned to specify a system for water heating, and 65%, a space heating system.
- Fuel cost savings and unavailability of conventional fuels were the primary reasons for using solar energy, followed by energy conservation.
- Sixty-three percent of the architects' clients evaluated a solar system on the basis of the payback period; most of the remainder evaluated a system by return on investment.
- Half of the respondents indicated that they would prefer to specify a pre-designed total system, 26% indicated that they would rather design their own system, and 24% expressed no preference.
- Product literature/catalogs were mentioned most often as the source of knowledge about solar systems, followed closely by articles and/or advertising in professional magazines.
- Various types of cost information and assistance were commonly mentioned as the most important service a manufacturer could provide.

Comments

No analysis or conclusions were offered in this report, simply a tabulation of the responses.

3.3 THE MONTANA SOLAR PUBLIC OPINION SURVEY (Jan Konigsberg, Montana Energy Office, May 1978)

Study Description

This study consists of the results and analysis of a solar energy questionnaire that was sent to 150 state legislators and 2,850 Montana residents selected using a scientific random sample from the motor vehicle registration list. Sixty-five legislators and 649 residents responded.

Objective

The objective was to gauge the current attitudes and perceptions of the people of Montana and their legislators about the following:

- willingness to support state legislation to facilitate the development of solar in the state;
- attitudes about future state energy policies;
- sophistication of the public's knowledge of solar energy;
- perceptions of incentives and obstacles to solar development; and
- the public's willingness to become personally involved in the application of solar energy.

Findings and Conclusions

- Almost half of the respondents felt that installation of solar energy systems was within their capabilities.
- The majority believed that technology for solar heating is feasible in less than 20 years.
- A majority of those polled indicated that they lack knowledge of the various types of solar systems. They were most knowledgeable about wind, followed in order by hydro, biomass, solar water heating, geothermal, and active and passive solar space heating.
- Montanans perceived a lack of information about the feasibility of solar energy in Montana as the main hindrance to solar development, followed by the high cost of solar conversion.
- A public education program about solar energy would be the most important factor to facilitate its development.
- Both the public and the state legislators favored concentrating their efforts in developing wind energy and domestic hot water systems first, followed in order by active space heating, geothermal, biomass, passive systems, and wood stoves.
- Seventy-three percent of the public and 65% of the legislators said they would consider installing a solar device in their home sometime in the future.

Comments

This report provides good general information for use in and about Montana. The preference for developing wind energy systems probably is a result of climatological conditions

and Montana's rural character. While the state legislators were slightly more knowledgeable (by their own estimate) than the general public, they appeared to have additional misconceptions and reservations about the development of solar technologies.

3.4 SOCIO-ECONOMIC FACTORS AFFECTING THE ADOPTION OF HOUSEHOLD SOLAR TECHNOLOGY: PRELIMINARY FINDINGS (Sparrow, Warkov & Cass, 1978)

Study Description

This study is a preliminary report based on interviews of 45 households utilizing solar systems.

Objective

The objective was to identify barriers and incentives affecting the widespread utilization of household solar technology.

Findings and Conclusions

- The median family income of those households surveyed (\$30,000) is above the national average, but is lowering with time.
- Those with lower incomes experienced more difficulty in obtaining financing than those with higher incomes, but did not perceive high initial cost to be as great a barrier to adoption as did those with higher incomes.
- There appeared to be a high degree of trust in the technology of solar systems and in the warranties provided by manufacturers and installers.
- There was a greater geographic concentration of those adopting solar energy after 1975.
- The overall educational level of early adopters was well above average, and most of those surveyed had occupations that dealt with science and/or solar energy in some way.
- Over 60% were likely to discuss incorporating solar energy with architects and financiers before making a decision. Solar equipment distributors and solar engineers were the next most likely to be consulted, followed in order by solar manufacturers, utilities, real estate sales representatives, and developer/contractors.
- Since 1975, the developer/contractor and solar engineers are emerging as more prominent figures in the decision-making process, while solar manufacturers and financiers seem to be receding in importance.
- Architects tended to encourage the homeowner to incorporate solar energy, but real estate sales people, financiers, and local utilities tended to discourage its use.

Comments

The relatively small sample of solar user/owners probably would not permit generalizing many of these findings to the entire public.

3.5 SOLAR ENERGY INCENTIVES ANALYSIS: PSYCHO-ECONOMIC FACTORS AFFECTING THE DECISION MAKING OF CONSUMERS AND THE TECHNOLOGY DELIVERY SYSTEM (The Department of Energy, January 1978)

Study Description

This analysis was prepared for the U.S. Department of Energy (DOE) by George Washington University, and is based upon data collected during 21 decision analysis panel meetings with groups of individuals from the Technology Delivery System (TDS) and potential user groups in four regions of the United States: the Far West, Southeast, Middle Atlantic, and Northeast. Individual interviews and literature searches were also utilized to a minor degree.

Objective

The objective was to assess the combined economic and behavioral processes that are involved in decisions to invest in solar heating, ventilating, and air conditioning (HVAC) systems by segments of the solar TDS and by consumers.

Findings and Conclusions

- Interest in solar energy is generally high; however, some individuals from the TDS (e.g., financiers and corporate owners of residential and commercial buildings) indicated that they were not ready to make major commitments to solar applications.
- The major barriers to market and industry development appear to be perceived market risks, time factors involved, and authority and peer validation.
- Americans seem to prefer a "technological fix" for the energy problem and are still very unsure about the technological and economic performance of solar systems.
- There does not appear to be the necessary level of social support for widespread acceptance at this time, with the TDS in general being very cautious and waiting for the demand to develop and the homeowner not ready to sacrifice comfort, spend to conserve energy, tolerate a payback period as long as five years, or be at the mercy of changing weather.

Some regional differences of opinion existed, but there was a consensus on the following:

- The primary market today is for a custom-built, individually designed system.
- The federal government is not adequately utilizing solar energy to develop a market and continues to give the impression that solar is a "future technology," which discourages the market.
- Fear is the single greatest deterrent to private investment.
- The government should encourage the use of solar systems by utilizing them to a significant degree and by providing subsidies, tax credits, loan incentives, etc., where appropriate.
- The government should establish industry standards to protect the public and establish confidence in the technology.

- Further research and development (R&D) and the establishment of an energy extension service to disseminate information and provide feedback is necessary.
- The present market is made up primarily of "first on the block" people and "tinkerers" who derive personal satisfaction from having a solar system. The market could be expanded significantly with suitable economic and educational incentives.

Comments

No attempt was made to generalize the findings to the public. While the study does show some consensus among different regions of the country, the panels were composed mainly of individuals from within the industry, an inherent bias.

3.6 SURVEY OF CUSTOMER ATTITUDES TOWARD HOME SOLAR SYSTEMS (Southern California Edison (SCE), December 1977)

Study Description

A random sample of 406 SCE customers were interviewed by telephone. All respondents were adult heads of household with certain quotas being used to ensure that the sample would reflect a cross section of the residential customer population.

Objective

The primary purpose was to determine how SCE customers felt about the use of solar home energy sources and how SCE should assist customers in the use of these systems in their homes.

Findings and Conclusions

- Of those surveyed, 66% mentioned solar energy first as an energy source to meet the increasing demand for power, and 97% claimed they had heard something about solar power.
- Newspapers, television, radio, and magazine articles were the dominant sources of information for learning about solar energy.
- Of the SCE customers, 18% felt the use of solar power was not a good idea for a home energy source; but 78% felt it was a good, very good, or excellent idea. Renters were significantly more likely to feel it was a good idea than homeowners.
- Space and water heating were the two uses associated with solar power most often; approximately 20% expected solar to provide electrical power.
- Respondents indicated that savings on utility bills and conserving natural resources were the major advantages of a solar system, and that the dependence on sunshine and cost of solar systems were the major disadvantages.
- In general, those surveyed did not expect widespread residential solar usage in less than 5 years.
- Twenty-five percent of the SCE customers did not know or wish to estimate how much a solar water heating system would cost. Of those who estimated, the median expected price was \$2,190.

- Fifty-three percent were aware of the California tax incentive for solar installation, and 43% indicated their interest would increase because of the tax credit.
- Only 6% of SCE customers said they definitely would purchase a solar system, 20% said they probably would, 29% said they might or might not, 21% said they probably would not, and 24% said they definitely would not.
- A significantly higher percentage of customers indicated an interest in having a new solar home rather than their present conventional home, with 32% saying they definitely would, 33% probably would, and 24% might have a solar energy system installed in a new home.
- Those surveyed would expect solar equipment to last from 11-14 years.
- Renters (52%) expressed a great deal of interest in renting an apartment with solar heating and hot water.
- Ninety-two percent of all SCE customers felt they should have more information about solar energy. Government agencies were cited most often as the preferred source, followed by SCE and other utilities.
- Southern California Edison in particular and utilities in general, along with HVAC contractors, were the preferred places to buy solar equipment.
- An overwhelming majority felt that SCE should be involved in public education and R&D. Other areas mentioned were guidance in purchasing a system, rate incentives for solar installation, service contracts for maintenance and repair, incentives to solar builders, checking the work of independent contractors, selling and installing solar systems, and possibly financing the systems.

Comments

This was a scientifically sound sample, geographically limited to Southern California Edison's service area. There were no findings that were inconsistent with other research reviewed here.

3.7 AN ATTITUDINAL STUDY OF THE HOME MARKET FOR SOLAR DEVICES (Decisions and Designs, Inc., for The Federal Energy Administration, September 1977)

Study Description

A telephone survey of 379 homes in New York City; Nobles County, Minnesota; Santa Clara County, California; and Washington, D.C., was conducted to assess the potential home solar market. A review of previous studies was also used as background information and to establish certain survey criteria.

Objective

The objective was to estimate the potential penetration of solar devices into the residential market, assuming various financial incentives.

Findings and Conclusions

- Assuming that solar space heating would cost \$20 per month more, but \$5 more for water heating only, the authors estimated that 1.3% of all homes would have solar space and water heating by 1985 and 8.5% would have a solar water heater.

- Assuming conventional and solar costs were equal, 2% of all homes would have both systems by 1985 and 14% would have a retrofitted solar water heater.
- Assuming \$20 and \$5 per month savings, 2.2% of all homes would have both systems and 18% would have a retrofitted solar water heater by 1985.
- "Potential home buyers said they would be willing to pay an average of \$12 per month more for the next 20 years to have a solar home rather than a conventional home."
- Conservation of energy was the most frequently given reason for considering the purchase of solar energy, followed by saving money.
- High initial and operation costs were the reasons most frequently given for not buying solar.
- Seventy-eight percent of the respondents said they were for federal financial assistance for installing solar; 10% were against it.
- A substantial portion of potential home buyers expressed a willingness to shift to solar heating. Economic incentives would influence them to make that decision.
- Developer and builder decisions to install solar systems in noncustom-built homes will also have a significant effect on the growth of the market.
- Further study of the possibility of economic incentives directed toward developers/builders to stimulate their interest would seem to be in order.

Comments

This study is somewhat limited in the range of information collected, but does not appear to have any major faults in methodology other than focusing only on economic incentives. Apparently there were no substantial differences concerning major points in the different regions surveyed, and the conclusions reached would seem to be substantiated by other studies summarized in this report. The only marginally significant difference was that respondents in this survey mentioned conservation of energy more times than saving money as the primary reason for considering solar, the opposite of the findings in most studies.

3.8 SDG&E's SOLAR WATER HEATING SYSTEM: A CONCEPT STUDY (Marylander Marketing Research, Inc., for San Diego Gas and Electric Company, April 1977)

Study Description

This study consists of personal interviews with 304 San Diego County heads of household who either presently own their single-family residences or are planning on moving to one within the next five years.

Objective

The objective was to determine the level of acceptance of an SDG&E solar water heating system for single-family residences and the relative preferences of homeowners for leasing or purchasing such a system.

Findings and Conclusions

- Seventy-five percent of those surveyed stated that they would "definitely" or "probably" buy a solar water heating system if they were to buy a new home, but only 27% expressed a desire to retrofit such a system on their existing home.
- Saving money and conserving energy were given as the greatest benefits to be realized from solar energy; initial costs and the availability of adequate sunlight were the primary concerns.
- SDG&E was the source most preferred by the respondents for purchasing a solar water heater.
- Including the cost of the solar system in the mortgage of a new home was preferred by over half of those surveyed.
- The lease with an option to buy was selected by about 40% of those interested in retrofitting a solar water heater. However, among those seriously interested in a retrofit, the lease option was less popular.
- An aggressive marketing program that would target the home builder might achieve significant market penetration. However, the builder must be convinced that adopting solar would help to reach the new home buyer.
- There is a need to provide alternative financing arrangements, especially in the case of retrofits.

Comments

The geographical limitations of the sample again restrict the usefulness of specific findings. It is interesting to note that SDG&E was preferred as the supplier of solar systems with the possibility of also providing financing. In addition, a marketing program aimed at the builder was mentioned.

3.9 SOLAR WATER HEATING ECONOMIC FEASIBILITY, CAPTURE POTENTIAL, AND INCENTIVES (Jerome Scott, University of Delaware for the National Science Foundation, February 1977)

Study Description

This is a five-part report investigating the technical and economic characteristics of solar water heating in residential applications through computer simulation and surveys of homeowners. Each part can be considered separately and is capsulized below.

- Part I—Systems Definition and Economic Feasibility. The technical and economic characteristics of residential solar water heating are developed, including designs for different regions, optimum system size calculations, and analysis of costs, contributions, payback, and budget effects.
- Part II—Incentives and Research Design. Various economic incentives for the use of solar water heaters and the likely effects of each are considered. The research design used to estimate homeowner attitudes and demand functions that are the basis for estimating market penetration is also discussed (results in Parts III and V).

- Part III—Consumer Acceptance. Results of personal interviews with 300 male head-of-household homeowners in Denver, Colorado, and Wilmington, Delaware, are analyzed. Early adopters are characterized and motivations, barriers, and the impact of a federal tax credit are assessed.
- Part IV—Market Penetration Model. A quantitative model for projecting solar water heating market penetration through the year 2000 is developed.
- Part V—Market Penetration and Incentive Analysis. Market penetration estimates through the year 2000 considering region, fuel type, and tax credits are presented.

Objective

The objective was to determine the optimum size and type of residential solar water heaters for several regions of the country, considering technical and economic factors. The market penetration of these systems through the year 2000, considering various economic and attitudinal factors along with different types and levels of incentives, was estimated.

Findings and Conclusions

There is a great deal of interesting information presented in this study, but in the interest of brevity only the relevant major findings will be presented.

- Regional differences in optimum size, type, technical and economic performance presently exist and will continue as a result of differences in climate and conventional fuel costs.
- A significant number (15% of the Denver sample and 22% of the Wilmington sample) had no previous exposure to articles on solar energy.
- The information most frequently desired by homeowners before making a purchase decision was data on performance and reliability. Initial cost followed.
- The probability of purchasing a solar hot water heater decreases rapidly with increasing first costs, but almost 30% indicated a probability of purchase assuming approximately \$1,500 initial cost. There was also more acceptability for installation in new homes than for retrofitting existing homes.
- Some homeowners surveyed seemed to accept life-cycle cost arguments, but most preferred to compare monthly payments against anticipated monthly savings.
- Over 90% of the respondents believed it should take 10 years or less to pay for a system in fuel savings.
- A vast majority of homeowners believed the Federal Government should provide incentives for the adoption of solar energy, with a strong preference for a tax credit over a tax deduction.
- Initial cost was mentioned as the most important reason not to buy a solar water heater.
- The primary motivations for purchasing a system appear to be fuel cost savings, followed by fuel conservation.

- There is evidence to indicate that those with higher education, higher income, home value, and smaller families have more favorable attitudes toward purchasing solar hot water heaters. Those who are flexible in their thinking also are more likely to purchase.
- Assuming a \$350 tax credit and a state-of-the-art marketing effort by responsible firms, approximately 20% of all single-family residences should have solar water heaters by the year 2000.
- By 1985, approximately 12.7% of all homes should have solar energy, with slightly more than three times as many new homes having it as existing homes being retrofitted.
- Homes in the low-priced category (under \$20,000) are expected to have fewer systems, with an estimated 2.7% having solar energy by 1985 without a tax credit and only 7.9% with one. By the year 2000, this segment market penetration is only 10.7% without a tax credit and nearly 15% with one.

Comments

This is a very detailed study using sophisticated computer simulations and interview procedures. The results are not directly applicable to all parts of the country. However, the cities used are representative of several major areas.

3.10 SOLAR, BACKGROUND ATTITUDE AND AWARENESS STUDY (Marketing Research Department, San Diego Gas and Electric Company, October 1976)

Study Description

This survey consisted of interviews with 400 single-family homeowners who were customers of SDG&E. The sponsor of the research was not revealed, in order to avoid bias. Respondents were randomly selected with some limitations, none of which should have any major effect on the findings' applicability when generalized to the potential market area under study.

Objective

This research was conducted to determine San Diego consumers' knowledge and perceptions of, attitudes toward, and readiness to own a solar system at the time of the study.

Findings and Conclusions

- A very high percentage (85%) of people were already aware of solar energy as a source for heating homes.
- Awareness of the various ways that solar energy can be used other than space heating "revealed room for meaningful consumer education."
- Of the respondents, 55% felt that solar energy was available at the time of the study; another 25% believed it would take from 1-10 years before it was available.
- A large percentage (85%) reacted very favorably to the idea of using solar systems, with almost no negative reactions.

- The most frequently expressed advantage of solar systems was lower utility bills (76%), followed by its being a clean energy (46%).
- The cost of purchase and installation was the most frequently stated disadvantage (59%), and weather problems were second (41%).
- A majority underestimated the cost of a solar space and hot water heating system by a significant amount.
- Over half (59%) said that they would "probably" or "definitely" buy solar in a new home, but only 21% indicated that they "probably" or "definitely" would retrofit a solar system on their home.
- Ninety-five percent responded "yes" when asked if they felt the public needs more information about solar. A majority (72%) stated that the first or second place they would go for more information would be federal energy agencies, and 53% said that they would go to their utility.
- There appeared to be little difference in the appeal of solar energy among different income or age groups.
- Some consumer education is needed to familiarize the public as to the different ways solar energy can be used in the home, and to give the public a better perspective on its availability, cost, and potential for retrofit.

Comments

The major restrictions of this study appear to be its limited geographic scope and the fact that it was conducted in southern California where there are fewer weather-related obstacles to widespread acceptance. Therefore, the findings are probably more optimistic than might be expected for the national market.

3.11 EARLY MARKET EXPERIENCE OF SOLAR ENERGY IN THE UNITED STATES (Alan Hirschberg, Booz-Allen and Hamilton, Inc., May 1979)

Study Description

This paper draws heavily from the information gathered in five metropolitan areas around the country and the state of Florida for the SHAC evaluation study done by Booz-Allen.

Objective

The purpose was to summarize the barriers to future growth and the early market experience of the solar industry.

Findings and Conclusions

- The high initial cost of SHAC systems is a major barrier to solar energy growth. Consumers feel that long payback periods are unacceptable and have not yet accepted life-cycle costing.
- The building industry's traditionally slow acceptance of technological innovations, regional differences in practices, and the multiplicity of building code authorities are examples of some institutional barriers.

- Another institutional barrier is the practice of "rolling in" the cost of the new fuel supplies with the lower cost of existing supplies, hiding the true price of new fuel from the consumer.
- Financial constraints such as lenders requiring a higher down payment on solar homes, high interest rates, and difficulty in obtaining construction loans also retard solar development.
- A lack of information available to the consumer on the cost and performance of SHAC systems and the impact of solar tax incentives constitutes another barrier.
- Owners of SHAC systems reported that any minor installation problems were quickly repaired by the installers and that manufacturers were helpful in providing information.
- Most solar system owners have higher than average incomes and education and are installing their systems for economic reasons, not for the environmental or conservation reasons of earlier buyers.
- Most manufacturers now sell to distributors and dealers as opposed to selling directly to consumers as in earlier years.
- The growth of the photovoltaic industry is slowed by industry uncertainty due to rapid technological development and confusing market projections. The industry is presently dominated by a handful of firms, but the situation could change with heavy government funding in the next 10 years.

3.12 THE DIFFUSION AND ADOPTION OF SOLAR EQUIPMENT AMONG CALIFORNIA HOMEOWNERS: REPORT ON A PRETEST STUDY (Dorothy Leonard-Barton, Institute for Communication Research, Stanford University, December 1977)

Study Description

Twenty-five homeowners in the Palo Alto/Mt. View area were interviewed in this sample, which was taken from the sales lists of a solar equipment company and attendance records of a solar workshop conducted by the city of Palo Alto. Nineteen of those interviewed had solar equipment installed in their homes, three were in the process of having it installed, and three had obtained cost estimates but had not yet purchased the equipment. Many were members of environmental organizations.

Objective

This is a report on a pretest study to determine the answers to the following questions:

- What sources of information initially brought solar energy to the attention of the users?
- What considerations entered into the decision to buy or not to buy?
- What motivated adopters to consider using solar?
- How satisfied are they with their solar equipment?
- Do adopters also "spread the word" personally?
- What is the role of government in the diffusion process?

Findings and Conclusions

- Over two-thirds of those surveyed considered themselves "handy around the house."
- Over three-fourths had made at least one major alteration to their home in addition to solar energy.
- All were well above the national average income, with 96% earning over \$25,000 annually and almost one-fourth over \$50,000.
- Most were also young professionals (under 55).
- The "do-it-yourselfers" tended to get their initial information about solar from technical books and articles; most of the others were made aware of and persuaded to use solar energy by their peers. Solar equipment dealers, alternative technology groups, workshops, and seminars also rated highly along with magazines such as Sunset and Popular Mechanics.
- Fifteen out of twenty-five respondents listed environmental and conservation concerns as the primary consideration in their decision to adopt solar energy.
- None of the institutional barriers to the adoption of solar energy such as solar access, rapid obsolescence of equipment, financing problems, or tax and insurance problems, were rated in the top five considerations.
- The author of this study divided the sample into four "types".
 - Ecologists—active in environmental groups, adopt solar energy for idealistic reasons.
 - "Tinkerers"—intrigued by innovative technology and like to get their hands on the solar hardware.
 - Comfort/Convenience—adopt solar equipment to keep their water/pools as warm as they want without feeling guilty about using energy.
 - Economy Minded—put economic considerations ahead of noneconomic in deciding on solar energy.
- All respondents were generally satisfied with their solar equipment and would install it in a different home if they moved.
- Twice as many said the decision to buy solar equipment could be compared to the decision to buy a household appliance as those who said the decision to buy solar equipment could be compared to buying a home.
- Adopters of solar technology appear to be "spreading the word" to others, aiding in the diffusion process.
- Nearly all (23 of 25) felt the government should "assume a major role" in promoting solar by offering education, financial incentives, and an example by retrofitting government buildings.
- Solar adopters will play a significant role in the diffusion process of solar equipment and technology.
- There appears to be a shift occurring — away from an attempt to dominate nature and toward an effort to live with it, and a general acceptance of renewable and environmentally benign energy sources (solar, wind, biomass, etc.).

Comments

Although the conceptual methodology was more rigorous than that of most studies, the restricted nature of the sample size and geographic area, combined with the bias of those surveyed, make this a study in which findings cannot be projected to the total population.

3.13 SELLING THE SOLAR HOME: SOME PRELIMINARY FINDINGS (Real Estate Research Corp., 1978)

Study Description

This report was prepared for the U.S. Department of Housing and Urban Development (HUD) as part of the Residential Solar Heating and Cooling Demonstration Program, based upon interviews of participating builders, purchasers, lenders, utility officials, local government officials, and nonparticipants as a basis for comparison. The number of each type is indicated in Table 3-2.

Table 3-2. INTERVIEWS CONDUCTED FOR THIS REPORT

Participant Groups	Number of Cases
Builder (Grantee)	40
Comparative Builder	98
Purchaser	22
Comparative Purchaser	29
Construction Lender	17
Permanent Lender	19
Comparative Lender	26
Auxiliary Utility	18
Alternative Utility	13
Planning and Zoning Official	22
Building Code Official	25
Tax Assessor	23

Objective

The objective was to "serve as a guide to marketing approaches utilized and market experiences to date in the HUD demonstration program; . . . to summarize some . . . findings emerging from interviews of actual participants," and to assess the market acceptance of solar homes.

Findings and Conclusions

- Participating builders are typically small- to medium-sized contracting firms, most of which work only in their local market areas and almost all specializing in residential construction.
- Sellers of solar homes have found utilizing traditional marketing techniques such as newspaper advertisements, open houses, and individual referrals to lead

successfully to sales. Special media exposure such as feature articles or TV news spots tend to increase traffic to solar and adjacent housing units.

- Solar homes must meet the potential buyer's basic housing need before the solar unit becomes a consideration.
- The profile of solar home buyers does not vary significantly from that of buyers purchasing similarly priced conventional homes in the same areas. The majority are young, well educated, with higher-than-average incomes and small families. Eighty percent are previous homeowners.
- Builders and purchasers have experienced very little difficulty with or resistance from local financial institutions, utilities that provide the backup service, and local government authorities. These institutions are treating solar homes like conventional homes with few exceptions.
- Builders show a growing interest in solar homes, but they are not yet ready to commit themselves fully.
- Buyers find out about solar homes and purchase them in much the same way as they would a conventional home. They want energy savings, value, quality construction, and resale potential at a price they can afford. A solar system itself will not sell a home. There are, however, some variances in what was important to solar purchasers and nonpurchasers.

<u>Solar Purchasers</u>		<u>Nonpurchasers</u>	
House Value	59%	Resale Value	63%
Energy-Saving		Construction	
Material	53%	Quality	49%
Resale Value	51%	House Value	42%
Construction		Bullder	
Quality	49%	Reputation	31%
Solar System	45%	House Price	29%

- Financial institutions, utilities, and local governments have not posed any major obstacles to the development of solar housing to date, although the potential exists for conflict in certain areas as solar utilization becomes more widespread.

Comments

The statistical sample used for this study was very small, and the preliminary findings make it difficult to generalize any of the conclusions to the market as a whole. The research is continuing and periodic reports will be available.

3.14 SOLAR ENERGY AND TODAY'S CONSUMER (Report by the Subcommittee on Oversight and Investigations of the House Committee on Interstate and Foreign Commerce, December 1978)

Study Description

This report presents the findings and conclusions of four different surveys that were presented to a congressional committee along with the conclusions and recommendations of the subcommittee.

Objective

The purpose was to inform a congressional committee about active and passive solar technologies and how they relate to today's consumer.

Findings and Conclusions

A summary of findings from each survey follows.

- Summary of performance problems of 100 residential solar water heaters installed by New England Electric Company subsidiaries in 1976 and 1977 (Robert O. Smith & Associates, October 1977).
 - "Results are still undetermined about demand peak effects because so much difficulty was encountered in the mechanical functioning of the solar water heaters," with 77% of the systems experiencing at least one major stoppage or failing to function properly. "Most of the troubles . . . are due mainly to flaws in installation . . . selection of component sizes and types, (and) to a lack of inspections and adjustments . . . after installation."
- Survey of solar consumer problems (Florida Solar Energy Center for the Department of Energy, May 1978).
 - Of the 522 solar users surveyed, 67% said they were satisfied with their systems, 21% had mixed feelings, and 12% were unsatisfied. Nearly half (46%) reported some problems with their solar systems, with 80% of the problems occurring within one year of purchase.
- Summary of problems in DOE-funded solar energy systems (September 1978).
 - Forty operating solar systems were reviewed, showing a high percentage of operating problems: 55% experienced collector malfunctions; 27.5%, controller malfunctions; 37.5%, leaks; and 29.7%, freezing problems.
- Questionnaire on Solar Energy, Subcommittee on Oversight and Investigations of the Committee on Interstate and Foreign Commerce.

Valid responses (336) were returned to the subcommittee from Michigan, Wisconsin, and California. Selected findings are as follows:

- Of the owners, 86.1% indicated they were either satisfied or very satisfied with the operation of their equipment.
- Nearly half (43.1%) said that the most rewarding aspect of owning solar equipment was the money they were saving.
- A large majority (81.6%) said they rarely or never experienced problems with their equipment.
- The most utilized source of information about solar systems was a dealer in solar equipment (61.8%), next were magazine or journal articles (56.5%), followed in order by solar exhibitions (37.6%), a friend or neighbor (26.1%), and any other advertisements (20.9%).
- Of the owner families, 89.9% earned more than \$12,000/yr, and 70.4% earned more than \$20,000/yr.

- When asked what the federal government should do to improve the climate for the use of solar energy, etc., 56.6% suggested tax incentives, 13.5% suggested loans or financial aid, 13.1% recommended publicity/demonstration programs, and 11.2% suggested more R&D. All other suggestions were mentioned by fewer than 10% of the respondents.

The conclusions and recommendations by the subcommittee after evaluating all available information are as follows:

- Many solar technologies are now mechanically and economically feasible; however, users are experiencing an unacceptable number of operational problems. If the problems are not significantly reduced, the popularization of solar energy could be greatly retarded. Presently, there are no workable consumer protection plans, uniform equipment standards, or certification procedures.
- DOE's solar budget and demonstration efforts overemphasize large, centralized technologies and active solar systems at the expense of more cost-effective and less troublesome passive technologies.
- The solar bureaucracy is disorganized in its R&D and commercialization efforts and in its efforts to collect and disseminate timely information to prevent recurrence of many past problems with solar systems.
- A federal consumer protection plan that aids the establishment of industry standards, requires minimal warranties in order to be eligible for federal tax credits, and informs the industry and consumers of potential and past problems should be established.
- Information about passive solar technology should be developed and widely disseminated, while federal solar tax incentives and possible innovative mortgage instruments should also be extended to passive systems.
- The organization of federal solar programs should be improved to provide a more efficient flow of information and prevent further fragmentation.

Comments

The committee's broad base of information allowed it to reach valid conclusions, even though the individual surveys suffered from size, geographical, and nonrandom sample limitations. In general, the findings are consistent with those of other studies.

3.15 SOLAR COMMERCIALIZATION—THE CONSUMER EXPERIENCE (Yarosh & Litka, Florida Solar Energy Center, 1978) SOLAR COMMERCIALIZATION—IN NEED OF HELP (Marvin M. Yarosh, Florida Solar Energy Center, 1978)

Study Description

These two papers were written by the same principal investigator, based upon identical basic research, and are summarized jointly. The data were collected from telephone interviews, questionnaires, and site visits of approximately 1500 solar users in Florida.

Objective

The purpose was to determine perceptions of solar users with regard to their experience and the need for consumer protection in the solar field.

Findings and Conclusions

- The present solar user is concerned about our energy problems, actively interested in solar energy, often interested in new or novel solutions to problems, and has an above-average income.
- A high percentage of users are very satisfied with their systems, feel a sense of commitment toward solar energy, and are willing to make allowances for problems encountered in their solar experience.
- Site visits by investigators showed a startling contrast between the high levels of satisfaction expressed by the solar owners and the actual operating and installation conditions of their systems. Many owners did not know how well their systems were performing or if they were performing at all.
- Many users had problems with their systems, with 60% occurring in the first six months. Research data suggest that only 25% of the systems being installed are free of present or potential problems.
- There is an urgent need for training of manufacturers, dealers, and installers who make design and sizing decisions.
- Most owners received inadequate operating and maintenance instructions or warranties for their systems.
- There was no evidence of widespread intent to defraud or deceive consumers concerning solar systems. A great deal of inaccurate information, and design and installation inadequacies, resulted from participants' inexperience in the solar field.

Comments

A vast majority of those surveyed owned solar domestic hot water systems or pool heaters, due to the very low requirement for space heating in Florida. Florida has a great deal more experience with solar water heating (since the 1920s), and the significant number of problems they have may well be an area of concern for the solar industry nationwide.

3.16 SHAC EVALUATION: A FEASIBILITY STUDY (Booz-Allen and Hamilton, August 1978)

Study Description

Information was gathered in six geographically representative Standard Metropolitan Statistical Areas (SMSAs) primarily by local contacts, solar manufacturer data, remote site data, on-site inspection data, and sensitivity analysis. The data collection efforts took place in Boston, Denver, Los Angeles, Miami, Phoenix, and Washington, D.C.

Objective

The purpose of this study was "to design, test, and implement a system of data collection and analysis capable of reporting routinely on the number, cost, performance, and related infrastructure experience of nonfederal solar heating and cooling (SHAC) installations throughout the nation."

Findings and Conclusions

- The load a SHAC system must carry is the most significant performance variable and is one of the hardest types of data to obtain.
- The solar collector industry has evolved into a diverse industry with distribution channels similar to the normal HVAC industry.
- Forty-five percent of the manufacturers of solar flat-plate collectors account for 90% of the sales.
- There are an estimated 90,000 solar installations in the United States, of which 50-60,000 are water and/or space heaters.
- There are presently between 5 and 20 SHAC installations for every 10,000 single-family units.
- Solar water heaters cost between \$30-\$50/ft².
- The levelized cost ranges from \$13-\$30/MBtu, which will compete on a life-cycle basis with 4.5¢/kWh electricity in all areas, assuming 2% real escalation in fuel prices for 20 years.
- Most owners were motivated to purchase a solar system by a desire to reduce utility bills and a commitment to the conservation of energy and the protection of the environment.
- Most systems were properly designed, with only 1 of 30 showing significant design problems. Most minor problems were quickly fixed by the installers.
- Most hydronic systems used the drain-down method of freeze protection.

Comments

This study was designed to test a data-gathering method and was apparently very successful. However, it provides limited market information.

3.17 SDG&E SOLAR WATER HEATING INITIAL PURCHASER ANALYSIS (Marylander Marketing Research, Inc., for San Diego Gas & Electric Company, October 1978)

Study Description

Seventeen individuals who purchased solar water heaters from SDG&E and 72 non-purchasers, all of whom had received an SDG&E sales presentation, were interviewed by telephone.

Objective

The objective was to determine the factors involved in the decision to buy, and to identify any sales and installation problems in order to maximize further sales efforts.

Findings and Conclusions

- SDG&E bill inserts (direct mail) were the principal source of awareness for the SDG&E solar system.
- The primary motivation of purchasers requesting an SDG&E presentation was the company's reputation and perceived expertise in solar. Nonpurchasers contacted SDG&E to educate themselves or to compare prices.
- The major reason for not purchasing was the initial cost of the system, while the major reason for purchasing was SDG&E's image of expertise.
- Purchasers were generally satisfied with their systems. However, there were comments regarding poor workmanship and inexperience of the subcontractors.
- The views of the purchasers and nonpurchasers were similar concerning the energy crisis and conservation. Both groups also were similar in most demographic characteristics, although the purchasers had slightly higher incomes than the nonpurchasers and the general public.
- SDG&E pricing was considered very competitive by both groups.
- Almost 60% of the purchasers could find nothing to criticize, with only 2 mentioning the temperature of the water.
- Those who purchased seemed slightly more interested in conservation than cost savings; nonpurchasers were primarily interested in cost savings.

Comments

The small sample size, geographic limitation, and self-selection of the respondents (who had to make the initial contact to be included), limits the usefulness of these findings.

3.18 SOLAR CONSUMERS: AN INVESTIGATION TOWARD COMMERCIALIZATION (Jeffery Cook, Connelly, Garrett for the Arizona Solar Energy Research Commission, June 1977)

Study Description

This report presents the results and analysis of face-to-face interviews with 26 solar equipment users selected on a judgmental basis in Maricopa County, Arizona.

Objective

The objective was to characterize the behavior and attitudes of solar consumers.

Findings and Conclusions

- Most solar users surveyed were middle-aged, conservative professionals with relatively high incomes and educational levels, contrary to the stereotypical young, liberal environmentalists with minimal budgets.
- Most consumers surveyed had strong economic reasons for adopting solar systems, and most expected their solar systems to pay for themselves in fuel cost savings in less than eight years.

- Nearly all users stated that they received additional satisfaction (psychic income) because their solar systems conserved energy, were innovative, technically ingenious, and showed the owners' social responsibility.
- Solar users were ranked second on the list of information sources used by potential consumers and were generally encouraging to them, but frequently gave inaccurate information.
- Potential solar consumers surveyed were mainly interested in the following types of information: monthly fuel savings, equipment reliability, equipment costs, and equipment sources. Their information was obtained most frequently from public libraries and present solar users, followed by relatives, friends, and helpful professionals in the field. Advertisements, sales people, government agencies, special interest groups, and paid professionals were characterized as having marginal influence or limited value.
- Solar consumers surveyed were generally satisfied with the company that sold and installed their equipment. However, some criticized salesmen ignorant of their products who exaggerated claims and distributors who sold solar systems as a sideline and were not experts in the field.
- The most immediate markets appear to be for solar pool heaters and domestic water heaters, especially for those respondents with all-electric homes. Most respondents also expressed an interest in efficient solar cooling in the future.
- The statements of those surveyed indicated that, in general, respondents regarded solar systems as a reasonable investment. This inference is supported by the dramatic decrease in decision time over the last two years, the growth in the amount of business done by those in the industry, and the high level of satisfaction of solar consumers.

Comments

Care should be exercised in any attempt to generalize the findings of this study, as the sample used was not chosen on a random basis, was relatively small, and was geographically limited. While the sample may have been representative of solar consumers in the limited survey area, some regional bias is also evident.

3.19 ATTITUDES, USAGE PATTERNS, AND SYSTEM CHARACTERISTICS AMONG OWNERS OF SOLAR POOL HEATERS AND OWNERS OF SOLAR WATER HEATERS (Marylander Marketing Research, Inc., 1976)

Study Description

This study is a summary of two focus group sessions conducted for San Diego Gas and Electric Company. One group consisted of 10 owners of solar pool heaters and the other of 5 solar water heater owners.

Objective

The purpose was to provide an understanding of the types of solar pool and water heating systems in use and how their owners felt about the systems.

Findings and Conclusions

- The owners of the solar water heaters had occupations that permitted them to understand their systems.
- The owners of the solar water heaters had some degree of "emotional/creative" involvement with their systems.
- The primary motivation for purchasing solar water heaters was financial, either to reduce their present utility bills or to hedge against future fuel costs.
- The owners of the water heaters expressed some complaints, but all felt their systems were good investments and were generally satisfied with them.
- The owners were perceived by friends and neighbors to be pioneers.
- The owners of the solar pool heaters were much less technically and emotionally involved with their systems.
- The main reason for installing solar pool heaters was to reduce fuel costs.
- Overall, the owners of the pool systems were happy with their systems. Two were not very satisfied, but both had purchased their homes with the systems already installed.
- There was no evidence that the purchasers of such systems go through any type of cost/benefit analysis prior to buying.

Comments

The extremely limited number of people involved in this study, along with the method of gathering the data (allowing interaction among the respondents) and geographical restrictions severely limit the usefulness of this study.

3.20 PROJECT PAYBACK: PRELIMINARY RESULTS OF PRETEST SURVEY OF HOMEOWNERS REGARDING PERSONAL ENERGY CONSERVATION (National Demographics, Inc., for the U.S. Department of Energy, November 1978)

Study Description

The results of a nationwide survey in which 916 homeowners were interviewed are compared with the results of surveys in five major metropolitan areas (425 were surveyed in Denver, 374 in Atlanta, 403 in Portland, 437 in Syracuse, and 388 in Minneapolis). No analysis or conclusions were given; the data were simply presented in the form of 51 tables.

Objective

The purpose was to obtain baseline data on attitudes toward energy conservation.

Findings and Conclusions

- A majority of those surveyed in all cities and the national sample felt they could do a great deal or at least something to contribute to the solution of the energy problem.

- Most felt that energy-efficient appliances would be more expensive than conventional appliances.
- Those surveyed thought that installing storm windows/doors would result in the greatest energy savings. Installing a solar water heater was next, but was also perceived as having the highest initial cost.
- The median estimates of the percentage of present utility costs that could be saved by installing energy-efficient products and practicing energy conservation was 7-9%.
- Of those surveyed, 64-74% felt their standard of living would remain the same if they practiced energy conservation. The majority of the remaining percentage felt it would lower.
- Installing a solar hot water heater was perceived to be the most difficult energy conserving measure for a family to adopt, primarily because it is considered too expensive. Driving a car less was the second most difficult to adopt because it would be inconvenient. Storm windows and doors were also noted as too costly, along with most other energy conservation measures.

Comments

Most of the findings given here were consistent with those in a thorough study of Denver by the same company. (See Evaluation of a Marketing Program Designed to Increase Consumer Consideration of Energy-Efficient Products in Denver, Colorado, a summary of which follows.)

3.21 EVALUATION OF A MARKETING PROGRAM DESIGNED TO INCREASE CONSUMER CONSIDERATION OF ENERGY-EFFICIENT PRODUCTS IN DENVER, COLORADO (National Demographics Ltd., for the U.S. Department of Energy, 1978)

Study Description

This study consisted of two surveys and an intervening communications program in the city of Denver. Surveys were conducted simultaneously in Salt Lake City without the communications program. Those results were used as a control sample.

The first Denver survey was conducted during the summer of 1977 and consisted of personal interviews of 357 randomly selected adult homeowners to provide a baseline of information.

The second step was a marketing/demonstration program consisting of paid multimedia advertising, a home energy retrofit contest, and a shopping center display, designed to sensitize consumers to the economic benefits of purchasing energy-efficient products.

The second Denver survey of 506 randomly selected adult homeowners was conducted eight months later to determine the effects of the marketing demonstration program.

Objective

The objectives were to determine whether the concept of "life-cycle costing" or energy cost of ownership could accelerate the acceptance of energy-efficient and energy-con-

serving products and to identify which marketing/communications approaches would be most effective in doing so.

Findings and Conclusions

Compared with the control sample in Salt Lake City:

- Homeowners in Denver were significantly more aware of the energy-saving potential of several products and behaviors after the demonstration than prior to it.
- Homeowners were more aware after the demonstration that heating conservation contributed a large percentage to total energy conservation.
- There was a general disbelief that utilizing energy-conserving products and techniques would reduce utility bills to a significant degree. Denver homeowners estimated an average of only 9% potential savings on their utility bills after the marketing program.
- In general, Denver residents exhibited a greater awareness of the energy problems as a top national priority and their own ability to personally contribute to the solution during the second survey.
- Approximately 71% of the respondents said they were willing to pay an initial 10-15% more for energy-efficient products.
- There was a growing concern among those surveyed that widespread energy conservation programs would lead to a lowering of their individual standard of living.
- There was a significant increase in the number of Denver residents that indicated they would pay \$5-\$10/yr to join an organization for the promotion of energy conservation.
- There were significant increases in the number of homeowners who were installing energy-conserving devices and whose friends and acquaintances were also doing so.
- Those homeowners who tended to view energy conservation most favorably were generally young and above average in both income and education.
- Scientists and engineers were rated as the most credible sources of energy information, followed by the Department of Energy.
- The demonstration marketing program was successful in bringing about significant changes in the consumers' level of awareness concerning the energy problem and consumers' attitudes toward energy conservation techniques and products.
- The average consumer has a distorted view of the potential savings and cost of energy conservation products, etc.
- A great deal of present energy "jargon" is not understood by the consumer. Thus, any media campaign on energy conservation should be educational.

Comments

The survey methodology appears to be scientifically sound. The only obvious limitation was the geographical restriction. This may limit the ability to generalize specific findings and conclusions to the consumer on a national basis. This study has been broadened to six areas nationwide (see Project Payback summary above).

3.22 FEDERAL INCENTIVES FOR SOLAR HOMES, AN ASSESSMENT OF PROGRAM OPTIONS (Epstein and Barrett, Regional and Urban Planning Implementation, Inc., for the U.S. Department of Housing and Urban Development, July 1977)

Study Description

This study reports on a 6-month research program that concentrated on single-family homes. A series of open-ended interviews were conducted with developer/builders, mortgage financiers, industry and government officials, and solar equipment dealers and manufacturers. In addition, a survey was taken of 1,500 homeowners and potential homebuyers in Boston, Mass.; Philadelphia, Pa.; Jacksonville, Fla.; Columbus, Ohio; Nashville, Tenn.; Houston, Tex.; Tucson, Ariz.; and San Jose, Calif.

Objective

The purpose was to provide information and analysis that would aid in making a choice among the incentives being considered to stimulate the rate of solar adoption. The specific incentives considered were: tax credits ranging from 20-50% with a maximum \$2,000 credit; rebates in the same range; direct loan programs to separately finance 100% of solar costs at terms varying from 7% over 10 years to 1% over 20 years; and a combined solar loan and mortgage at 75% of solar costs with interest ranging from 1-7% over 30 years.

Findings and Conclusions

- Federal incentives can increase the rate of growth of the residential solar market substantially, if provided at high enough subsidy levels to elicit significant consumer response.
- Tax credit or rebate programs seem to have more appeal than loan programs, especially for solar hot water systems.
- A grant or rebate program when purchasing a solar system appears preferable to a tax credit.
- Broad-based financial incentives might best be limited initially to solar hot water systems, which are at a more advanced stage of commercialization, easier to certify, and less costly. Support for space heating could be continued through demonstration programs.
- Solar system and component certification procedures may be as important to the success of any incentive program as the type of financial support given.
- Providing proportionately more benefits for low income households appears inappropriate at this time, along with concern for extending subsidies to higher income households in the context of a program to encourage homeowners to "pioneer" a new technology.
- As a complement to more direct forms of subsidy, Congress might consider measures to help ensure that purchasers can finance an average portion of their solar home at ordinary terms.
- Incentives capable of providing a significant level of solar energy use in multi-family projects would probably require an unprecedented and unacceptable level of government subsidy.

- In response to a question asking homeowners to rank the importance of factors relating to the purchase of solar systems, the following factors were ranked in this order:
 - Reduction of utility bills
 - Initial price of the system
 - Reduced dependence on utility companies
 - Repair and upkeep cost of the system
 - Amount of heat and hot water provided
 - Civic duty to help conserve energy
 - Number of years system will last
 - Desire for a cleaner environment
 - Increase in the resale value of the house
 - Manufacturer's reputation
 - Availability of financing for the systems
 - Increase in mortgage payments
 - Solar collector appearance on outside of house
 - Increase in down payment for a new house
- Another series of questions asked how confident consumers were in being able to currently obtain reliable and dependable systems that make economic sense. Thirty-six percent felt that it was not likely they could find reliable and dependable systems, and 37% felt it was likely. Forty-eight percent felt it was not likely that they would find systems that made economic sense, and 29% felt that it was likely.

Comments

This report is well done and based upon sufficient data to make the findings and conclusions very meaningful. It should be noted that direct grant or rebate programs received considerable support as the preferred financing means.

3.23 FINANCING THE SOLAR HOME: UNDERSTANDING AND IMPROVING MORTGAGE-MARKET RECEPTIVITY TO ENERGY CONSERVATION AND HOUSING INNOVATION (Barrett, Epstein and Haar: Lexington Books, June 1977)

Study Description

The findings of this study were based on interviews of approximately 200 residential mortgage lenders, federal agency representatives, executives of secondary market entities, and others active in residential finance from the New England states, Washington, D.C., Florida, and New York City.

Objective

The purpose was to present the results of a study that investigated the probable response of mortgage lenders to requests for financing solar homes, to identify design, and to evaluate possible programs and incentives to reduce the constraints against such financing.

Findings and Conclusions

- The mortgage lenders surveyed indicated that single-family housing was the best area to test innovations because some of the risk was assumed by the owners.
- According to a majority of mortgage lenders, the cost of energy will become increasingly more important in the decision to make a home loan in the future.
- Most lenders felt that a solar system would either decrease the value of a home or not have any effect.
- About half of those surveyed felt that solar systems were a major housing innovation and would take some time to penetrate the market. Nearly half also felt that solar systems were just another kind of heating system and would require no adjustment in their lending practices.
- The main concerns lenders had with regard to solar homes were: uncertainty with regard to market value, reliability, performance, and durability; higher initial costs; difficulty of conversion to conventional systems; scarcity of qualified installers and maintenance people; appearance; nature of manufacturers; life-cycle cost and payback estimates; insurability of the homes; novelty of the systems; and legal and liability uncertainties.
- Lenders view both payback period and life-cycle cost estimates as aids in establishing appraised value rather than as aids in determining loan viability.
- Most lenders felt that solar's good image and potential were points in favor of loans for solar homes, and were not overly concerned about warranties on the equipment. They were more concerned with the reputation of the manufacturer and whether they would still be in business if something went wrong with the system.
- Those lenders who had financed solar homes had done so based upon their usual criteria, but financed them for a lower percentage of the total value.
- Most lenders felt that loans for retrofitting solar energy would be available as normal home improvement loans, with the primary considerations being the borrower's credit rating and product quality.
- The Federal Housing Administration, the Federal Home Loan Mortgage Corporation, the Federal National Association, and the Government National Mortgage Association indicated that they had no official policy regarding the purchases of mortgages on solar homes and probably would not develop one until they received requests for such purchases in more substantial numbers.
- A property tax exemption on solar systems was the only nonlender incentive discussed that might affect a lender's views of a potential solar loan's liability, because it would result in a lower monthly payment (principal, interest, taxes, and insurance).

- Conversion insurance (converting a home to a conventional system to make it more saleable), "top part of the risk" mortgage insurance, and secondary market eligibility were the most acceptable mortgage market incentives of those discussed.
- The lender's primary concern was the impact that innovation (solar systems) would have on the market value of the property.
- Lenders are generally persuaded by developer/builders to utilize housing innovations. Therefore, they are not likely to become interested in solar energy without being influenced by the developers.
- Lenders felt that their criteria and performance in making loans on solar homes would probably have little effect on the rate of development of the solar industry.
- Mortgage companies would look at financing solar homes very favorably if the homes had VA or FHA approval.
- Based on the findings presented in the book, the following recommendations are made by the authors:
 - Make energy conservation a factor in borrower underwriting.
 - Establish a certification service to supply lenders with up-to-date evaluations of available solar systems.
 - Raise present VA and FHA mortgage ceilings in an amount sufficient to accommodate the additional cost of solar systems.
 - Provide a special solar insurance program, insuring lenders against special risks.
 - Provide the lending community with appropriate information on the options to finance solar homes and incentives to facilitate such loans.

Comments

The authors of this book cautioned that the findings could not be generalized to the entire mortgage market industry because of the geographic concentration of the sample and the resultant homogeneity of opinion. In different regions, lenders must deal with various factors in the mortgage market. However, the study is useful to gain an insight into how lenders view and deal with housing innovations in general.

3.24 COLDER . . . DARKER: THE ENERGY CRISIS AND LOW-INCOME AMERICANS, AN ANALYSIS OF IMPACT AND OPTIONS (Eunice S. Grier, Washington Center for Metropolitan Studies for the Community Services Administration, June 1977)

Study Description

This report is an analysis based upon two national surveys, the first in 1973 for the Ford Foundation's Energy Policy Project, and the second in 1975 for the Federal Energy Administration. Both surveys utilize personal interviews of a representative sample of U.S. households, and data on consumption and costs from their utilities.

Objective

The objective was to assess the impact of the energy situation on the lives of low-income Americans and to recommend possible alternatives for them and their use of energy.

Findings and Conclusions

- Americans with low incomes use energy mainly for essentials such as heating, lighting, refrigeration, and short-distance driving, but pay more per unit of consumed energy.
- Many low-income households were paying 20% or more of their incomes for energy for their homes and cars in 1975.
- About 54% of low-income Americans occupy single-family detached homes, predominantly small dwellings. The median size is under five rooms, compared to over seven rooms for those with high incomes. Nearly 40% have no way to control the temperature.
- More higher-income households than low-income households made energy-conserving changes in behavior between 1973 and 1975. However, this is probably more a result of opportunity than of motivation. High-income households use a great deal more energy.
- As energy costs continue to climb, many low-income households will increasingly face choices between spending for energy and spending for other essentials.

Comments

The low-income family's interest in and ability to pay for solar energy systems was not addressed in this study. The study's major contribution is that it lends some insight into the energy usage and needs of low-income people.

3.25 PHOTOVOLTAIC POWER SYSTEMS MARKET IDENTIFICATION AND ANALYSIS (The BDM Corporation for the U.S. Department of Energy, November 1978)

Study Description

This study investigated approximately 170 potential photovoltaic applications in the transportation, agriculture, utilities, military, mining, commerce and services, residential/consumer, forestry, communications, construction, industry, and leisure/ recreation areas. Data were obtained from government statistics, trade associations, industry and user sources, in addition to brainstorming sessions, expert opinion, and literature reviews.

Objective

This study endeavored to determine the United States and world market potential for photovoltaic (PV) energy systems.

Findings and Conclusions

- The market size, amount of time required to achieve that size, and overall market potential as a function of PV unit array price must be estimated on an application-by-application basis because of the variables involved.
- The steps involved in determining market size for each application are, in order: estimating the size of the PV system, estimating the price at which a PV system would compete with the conventional power source for that application, estimating the date at which the PV systems would begin to penetrate the market, and estimating the rate of takeover in that market.

Comments

This study provides a great deal of detailed information on specific PV applications and identifies many applications possibly not considered before. It deals primarily with economic and technical constraints and gives little consideration to socioinstitutional constraints. No overall market penetration estimates were made due to the many variables involved in each individual application and the uncertainties of PV technological development and accompanying price decreases.

3.26 EMBRYO WINDMILL MARKET PROBED IN PIONEER RESEARCH EFFORT (Don Morris Marketing News, March 1978)

Study Description

This is a magazine article describing the windmill market research of Robert Ferber, Research Professor and Director of the Survey Research Center of the University of Illinois and editor of the Journal of Consumer Research. Mr. Ferber interviewed 300 adults in 6 locations around the country: Rhode Island, the Chicago area, western Michigan, southeastern Wyoming, western Washington, and Sandy Hook Recreational Area in New Jersey to obtain these findings.

Objective

The purpose of the research was to assess public sentiment about the development of wind energy.

Findings and Conclusions

- Support for wind power was high, with 76% favoring it in Chicago and 93% in Wyoming. Nuclear energy was approved by 60-70%, followed by other sources of energy.
- Knowledge of and approval for wind energy development was highest among men, the better educated, and those with higher incomes.
- "Most people in all of the areas sampled except one felt the use of windmills for electric energy was a good idea. The exception was in the area where knowledge about wind energy is by far the lowest, namely, the Chicago metropolitan area."
- The most frequently mentioned advantages of solar and wind energy were the promising low-cost supply situation and various environmental advantages. The most mentioned disadvantage was limited supply.

- The largest number of advantages were given for solar, wind, and hydroelectric power. The fewest disadvantages were mentioned for solar and wind.
- The old Dutch motif dominated peoples' preference for windmill design. However, the more educated preferred newer windmill designs.
- The desire for an abundance of energy (preferably domestically produced) and the willingness to pay more for it if it is pollution-free seemed to dominate the thinking of those surveyed.

Comments

This study is one of several dealing specifically with wind energy. The findings were generally consistent with the results of general public attitudinal studies on solar energy.

3.27 A REVIEW OF SELECTED SOLAR MARKET STUDIES AND TECHNIQUES, PROGRESS REPORT (Berliner, Christmas, Costello & Fellhauer, Solar Energy Research Institute, October 1978)

Study Description

This report consists of a literature review of six solar energy market studies and related technologies other than active solar space and water heating. The studies cover solar energy's use in industrial process heat, passive, solar thermal electric, photovoltaic, wind, and ocean thermal. It also discusses market research techniques and a preliminary plan for SERI market studies for FY79.

Objective

The purpose was to provide an information base as a starting point for the solar market studies to be undertaken by SERI in FY79.

Findings and Conclusions

- The four market studies available concerning the use of solar energy to provide industrial and agricultural process heat limited the applications to those requiring temperatures below 600°F and some preheat for processes requiring higher temperatures. The conclusions were reached by secondary data collection, industry contact, and penetration models. The regions of the country most suitable for such use and conventional fuels most feasible for replacement were identified. The qualities of energy required by processes on a geographic basis need to be analyzed further to project market penetration and assist industry in developing systems.
- Very little market research has been done for passive solar systems. The current and future markets need to be defined more clearly along with potential market penetrations.
- All solar thermal electric market studies to date have restricted themselves to the utility grid-connected market in the southwestern United States. The market penetration estimates used could have been refined. Further research is needed in that field, along with more study of nonutility applications.

- A number of studies have been done on the PV market; however, the results vary significantly with few quantitative analysis techniques being used. A large number of potential markets are indicated, but the size of those markets and the price necessary to penetrate them is still uncertain.
- The limited market analysis conducted for wind systems indicated a potential market for displacing expensive conventional fuels in remote areas. The research used nonrepresentative survey data, sensitivity analyses, and industry contacts.
- A single ocean thermal energy conversion (OTEC) system market study concluded that OTEC could become competitive with coal and nuclear energy in three market areas if the initial capital investment could be reduced.
- Some of the different marketing research techniques that might be helpful in further research are multiple regression, conjoint analysis, discriminant analysis, automatic interaction detection, canonical analysis, factor analysis, cluster analysis, and multidimensional scaling.

Comments

This paper presents the information from the review studies in a somewhat inconsistent manner. However, it appears to be the only available review of market studies on solar technologies other than space and water heating.

3.28 SOLAR HEATING AND COOLING OF BUILDINGS (SHACOB) COMMERCIALIZATION REPORT: PART B—ANALYSIS OF MARKET DEVELOPMENT (Arthur D. Little, Inc., for the U.S. Department of Energy, September 1977)

Study Description

This study is a computer approach to a solar market penetration analysis covering the period from 1977 to 1990. The market penetration was measured against natural gas, oil, and electricity under four different scenarios. The business-as-usual reference assumes only minimal government support activity; the National Energy Plan (NEP) scenario assumes an investment tax credit, a residential tax credit, and a government buildings program; the expanded NEP scenario assumes the NEP as a base with an expanded government buildings program and utility and product certification activities; the new initiatives scenario further expands the solar incentives program and includes accelerated depreciation for solar devices, low-interest loans, and a larger government buildings program.

Objective

The objective was to construct and analyze results of a quantitative model to arrive at market penetration figures for SHACOB, assuming a variety of incentive scenarios.

Findings and Conclusions

The findings are presented in Table 3-3.

Table 3-3. SOLAR INCENTIVE COMPARISONS SUMMARY TABLE

	Annual			Cumulative		
	1977	1985	1990	1977	1985	1990
1. Residential Units Sold (000)^a						
- Reference Case	46	87	144	46	749	1,330
- NEP	46	577	774	46	3,465	6,951
- Expanded NEP	46	641	850	46	4,211	8,042
- New Initiatives	46	882	1,162	46	7,209	12,451
2. Nonresidential Units Sold (000)^b						
- Reference Case	1	2	3	1	14	26
- NEP	1	9	12	1	44	98
- Expanded NEP	1	9	13	1	52	111
- New Initiatives	1	12	16	1	77	149
3. Total Collector Area (MM ft²)						
- Reference Case	4	7	10	4	62	103
- NEP	4	55	65	4	315	623
- Expanded NEP	4	61	72	4	389	731
- New Initiatives	4	86	102	4	697	1,177
4. Total Solar Equipment Sales (MM \$)						
- Reference Case	153	236	352	153	2,197	3,684
- NEP	153	1,225	1,507	153	7,939	14,975
- Expanded NEP	153	1,355	1,648	153	9,422	17,120
- New Initiatives	153	1,863	2,270	153	15,822	26,429
5. Government Cost of Incentives (MM \$)^c						
- Reference Case	87	11	12	87	451	509
- NEP	87	17	18	87	1,831	1,919
- Expanded NEP	87	17	19	87	2,202	2,294
- New Initiatives	87	230	278	87	5,587	6,887

Table 3-3. SOLAR INCENTIVE COMPARISONS SUMMARY TABLE (concluded)

	Annual			Cumulative		
	1977	1985	1990	1977	1985	1990
<u>Cumulative Annual Savings</u>						
6. Total Energy Saved (10^{12} Btu) ^d						
- Reference Case	1	2	2	1	13	23
- NEP	1	12	15	1	67	138
- Expanded NEP	1	13	17	1	83	161
- New Initiatives	1	19	24	1	149	258
7. Btus (000) Saved/\$ Government Cost						
- Reference Case	N/A	N/A	N/A	11.5	28.8	45.2
- NEP				11.5	36.6	71.9
- Expanded NEP				11.5	37.7	70.2
- New Initiatives				11.5	26.6	37.4

^aAverage residential collector size (all devices) for the NEP case in 1985 is 80 ft².

^bAverage non-residential collector size (all devices) for the NEP in 1985 is 965 ft².

^cGovernmental RD&D expenses for solar prior to 1977 were not included for comparative purposes. RD&D expenditures for 1979 are estimates and have been divided evenly among the three solar devices.

^dEnergy savings are measured at the point of entry to the building. In the case of electricity, these savings do not reflect power plant or distribution losses. Under the assumptions of the NEP, and taking energy savings in 1985 as an example, an energy saving of 67×10^{12} Btu at the wall is equivalent to 122.5×10^{12} Btu of primary energy (electric Btu saved $\times 3$ plus gas and oil Btu saved, or: $[27.5 \times 3] + 20.7 + 19.3 = 122.5$).

For conversion to oil equivalent, 2.1 quads = 1 million barrels of oil per day. Thus an energy saving of 122.4×10^{12} Btu annually is the equivalent of 58,300 barrels of oil per day.

Comments

This report is an excellent source of information for evaluating the impact of various combinations of solar incentives.

3.29 RESIDENTIAL SOLAR HEATING AND COOLING CONSTRAINTS AND INCENTIVES, A REVIEW OF THE LITERATURE (Arthur D. Little, Inc., for the U.S. Department of Housing and Urban Development, May 1976)

Study Description

This report reviews and analyzes the literature available in 1976 on market constraints on solar heating and cooling (SHAC) and possible governmental incentives to overcome them. It also makes recommendations for areas of further research and provides very useful abstracts of over 30 studies dealing with the same subject matter.

Objective

This report attempted to provide a comprehensive review and assessment of the literature available in 1976 on SHAC market constraints.

Findings and Conclusions

- The feasibility of solar heating and cooling of buildings has been demonstrated. However, the market constraints must be overcome if the nation is to realize substantial energy savings from solar energy development.
- Five categories constrain the development of solar energy:
 - Economic/Financial Constraints—Solar systems may not prove competitive with conventional systems using typical first-cost comparisons, it is difficult to obtain financing on solar systems at rates comparable to conventional loans, there are higher tax assessments on solar homes, etc.
 - Technical Constraints—Consumers and builders may think solar systems have no standards of performance, reliability, and quality.
 - Social/Political Constraints—Producers or distributors of conventional fuels and energy might view solar development as a threat to their business and oppose such development.
 - Institutional/Industrial Constraints—Labor unions and builders may oppose solar innovations as a resistance to change.
 - Regulatory/Legal Constraints—Unfavorable zoning restrictions, building codes, utility rate structures, and a lack of "sun rights" may thwart solar energy development.
- The incentives discussed are divided into three groups:
 - Economic/Financial Incentives—tax credits and deductions and exemptions, subsidies, preferential loan rates, and guaranteed or insured loans.
 - Promotional Incentives—governmental collection and dissemination of information, demonstration programs, and use of solar systems on government buildings.

- Regulatory/Legal Incentives—governmental support of or establishment of industry standards, and regulatory control of codes, utility rates, etc.
- The economic/financial constraints will have the greatest effect on the rate of solar development.
- The highest priority should be developing a data base for comparing solar and conventional system costs and a computer model that will facilitate such comparisons.
- Further research to evaluate possible financial incentives to consumers and manufacturers should be undertaken.
- The feasibility of alternative forms of solar system ownership should also receive further consideration.
- More information on solar systems needs to be disseminated to overcome the constraints imposed by the lack of knowledge of the systems' capabilities, limitations, and performance.

Comments

This is a very comprehensive report on the subject matter, although it is somewhat outdated by newer research.

3.30 SOLAR HEATING AND COOLING OF BUILDINGS, PHASE O FEASIBILITY AND PLANNING STUDY, FINAL REPORT (General Electric for the National Science Foundation/RANN, May 1974)

Study Description

This study reports on a multidisciplinary approach examining the costs, system performance, climatic variation, societal, legal, and environmental aspects of the development of solar energy for the heating and cooling of buildings.

Objective

The purposes of this study were to assess the potential for solar heating and cooling applications and identify the most cost-effective system/building/region combinations.

Findings and Conclusions

- "Strong government support will be required in order to make the commercial market place viable by the year 1982."
- The total capture potential by the year 2000 is estimated to be approximately 39 million candidate buildings. If 100% of these buildings were utilizing solar systems, a savings of 21% of the energy demand for heating and cooling of buildings would result.
- It is estimated that the market penetration by the year 2000 will reach 4.4 million buildings, saving 2.5% of the fuel used for heating and cooling of buildings. This accounts for approximately 12% of the capture potential.
- Cost-effective capture potential is dominated by new construction.

- The development of the solar industrial base will be the primary limiting factor of market penetration. Government incentives can do much to aid in that development.
- A realization of the projected market penetration by the year 2000 would:
 - reduce air pollution by over 430 thousand tons annually,
 - reduce solid wastes by about 20 million tons annually, and
 - reduce radioactive wastes in the air and water by over 1 million curies and solid waste by over 670 million curies.
- Introducing cost-effective solar air conditioning would substantially increase potential market and market penetration in terms of energy savings.
- The most important government policies needed to stimulate solar heating and cooling are in the following areas:
 - proof-of-concept experiment implementation,
 - early introduction of solar systems on government buildings,
 - legal safeguards and minimizing zoning restrictions, and
 - sponsorship of R&D for economic and reliable equipment—especially for cooling.

Comments

This study may be somewhat outdated, and the results of actual experience over the intervening five years may have altered the quantitative projections. However, the basic research appears to have been sound enough that the general conclusions are valid.

3.31 SOLAR HOME HEATING IN CANADA: PROBLEMS AND PROSPECTS (Foster & Sewell, Office of the Science Advisor, Canadian Department of Fisheries and Environment, 1977)

Study Description

This report deals basically with the barriers that will retard the diffusion of solar technology in Canada, the incentives that might accelerate it, and a brief description of technology and other diffusion processes. It draws heavily from U.S. experience with solar energy and other research in the field. It also makes some market penetration estimates for Canada through the year 2076.

Objective

The purpose was to present information that would aid in the understanding of solar technology, the effect of barriers and incentives to solar energy development, and the diffusion process in Canada.

Findings and Conclusions

- Canada is presently faced with an energy crisis similar to the United States, but has not committed itself to move in any direction. Solar energy, as an option, is becoming economically competitive with conventional fuels.

- About 40 solar homes have been built to date, but they have created little interest in comprehensive adoption.
- With no change in the barriers to development, only about 5,000 solar homes will be built in the next 10 years. This is partly because Canadian solar manufacturers cannot produce components at a low enough unit cost to gain acceptance.
- If Canada imports a great number of components, the cost may go down to an acceptable level, but control over another energy source is lost.
- If the Canadian federal government's efforts to remove such barriers are successful, Canadian manufacturers could accelerate production, and perhaps as many as 750,000 new and retrofitted solar homes would be in place in 10 years.
- The following actions are recommended to speed the development of solar:
 - pass a solar space and water heating act,
 - establish a consortium to promote solar energy use,
 - establish solar zones of priority,
 - fund, through taxes on conventional fuels, programs for the social change that will accompany a switch to solar,
 - promote research and development,
 - establish standards for equipment manufacture,
 - promote a solar heating market by establishing a solar information center,
 - encourage the construction industry by providing training and low-interest construction loans,
 - encourage trade union cooperation,
 - control insurance rates on solar homes,
 - encourage local governments to become involved,
 - encourage utilities to become involved,
 - gain architects' cooperation, and
 - set up a program of ongoing evaluation to review and improve the overall solar program.

Comments

This report is an excellent overview of the Canadian solar field, present and future.

3.32 CANADIAN PERSPECTIVE ON UNITED STATES SOLAR POLICIES (Foster and Sewell, University of Victoria for the Canadian Department of Energy, Mines and Resources, December 1977)

Study Description

This report is a comprehensive look at the U.S. solar industry and the government incentives and constraints to its development. The information was gathered by background studies and interviews with numerous government officials and solar manufacturers.

Objective

The objective was to examine the U.S. national program for accelerating the adoption of solar systems and its impact on the industry, in addition to determining the implications for the Canadian government and solar industry.

Findings and Conclusions

Only significant or unusual findings and conclusions are presented because the bulk are common knowledge to anyone involved in the U.S. solar industry. These findings were taken from a summary by C.H. Davidson:

- "It is significant that these agencies (ERDA, DOE, etc.) tended (a) to stress high technology solutions (e.g., 'active' rather than 'passive' solar innovations), (b) to pay little attention to the sociological aspects of efficient energy use (it must be remembered that the objective throughout has been to develop a solar 'industry'), (c) to devote significant parts of their budgets to other forms of renewable energy sources (e.g., nuclear).
- "There has been no strong solar lobby, which again may explain the controversies surrounding the solar aspects of the U.S. National Energy Plan—despite the importance of the incentives it provides.
- "Standards are necessary to protect the public; currently, performance criteria are being drawn up . . . simultaneously, it is necessary to establish procedures to accredit the laboratories which will be required to carry out the actual product or system certification.
- "The situation regarding solar technology and its application in Canada is (will be) directly influenced by the developments . . . in the United States."
- U.S. research is likely to be pertinent to Canada. Canadian research that is to be funded should probably be specialized.

Comments

This report has little bearing on market research, other than cataloging the possible incentives and constraints and discussing their possible impact. However, the report does provide an opportunity to see ourselves as others see us.

APPENDIX A
BIBLIOGRAPHY

An Attitudinal Study of the Home Market for Solar Devices. Decisions and Designs Inc. for the Federal Energy Administration, September 1977.

Attitudes, Usage Patterns and System Characteristics Among Owners of Solar Pool Heaters and Owners of Solar Water Heaters. Marylander Marketing Research, Inc. 1976.

Canadian Perspective on United States Solar Policies. Foster and Sewell, University of Victoria for the Canadian Department of Energy, Mines and Resources, December 1977. (Canadian Cat. No. M27-19/1978).

Colder. . . Darker: The Energy Crisis and Low-Income Americans, An Analysis of Impact and Options. Ernice S. Grier, Washington Center for Metropolitan Studies for the Community Services Administration, June 1977.

The Diffusion and Adoption of Solar Equipment Among California Homeowners: Report on a Pretest Study. Dorothy Leonard-Barton, Institute for Communication Research, Stanford University, December 1977.

Early Market Experience of Solar Energy in the United States. Alan Hirshberg, Booz-Allen and Hamilton, Inc., May 1979.

Embryo Windmill Market Probed in Pioneer Research Effort. Don Morris, Marketing News, March 1978.

Evaluation of a Marketing Program Designed to Increase Consumer Consideration of Energy Efficient Products in Denver, Colorado. National Demographics Ltd. for the U.S. Department of Energy, 1978.

Federal Incentives for Solar Homes, An Assessment of Program Options. Epstein and Barrett, Regional and Urban Planning Implementation, Inc. for the U.S. Department of Housing and Urban Development, July 1977. (PB-272-295)

Financing the Solar Home: Understanding and Improving Mortgage-Market Receptivity to Energy Conservation and Housing Innovation. Barrett, Epstein and Haar, Lexington Books, June 1977.

The Montana Solar Public Opinion Survey. Jan Konigsberg, Montana Energy Office, May 1978.

Photovoltaic Power Systems Market Identification and Analysis. The BDM Corporation for the U.S. Department of Energy, November 1978. (HCP/M2533-01/1)

Project Payback: Preliminary Results of Pretest Survey of Homeowners Regarding Personal Energy Conservation. National Demographics, Inc., for the U.S. Department of Energy, November 1978.

Residential Solar Heating and Cooling Constraints and Incentives, A Review of the Literature. Arthur D. Little, Inc., for the Department of Housing and Urban Development, May 1976. (PB-258-238)

A Review of Selected Solar Market Studies and Techniques, Progress Report. Berliner, Christmas, Costello & Fellhauer, Solar Energy Research Institute, October 1978. (SERI/PR-52-076)

SDG&E Solar Water Heating Initial Purchaser Analysis. Marylander Marketing Research, Inc. for San Diego Gas & Electric Company, October 1978.

SDG&E'S Solar Water Heating System A Concept Study. Marylander Marketing Research, Inc. for San Diego Gas and Electric Company, April 1977.

Selling the Solar Home: Some Preliminary Findings. Real Estate Research Corp., 1978.

SHAC Evaluation: A Feasibility Study. Booz-Allen & Hamilton, August 1978.

Socio-Economic Factors Affecting the Adoption of Household Solar Technology: Preliminary Findings. Sparrow, Warkov & Cass, 1978.

Solar, Background Attitude and Awareness Study, Marketing Research Department, San Diego Gas and Electric Company, October 1976.

Solar Commercialization—The Consumer Experience. Yarosh & Litka, Florida Solar Energy Center, 1978.

Solar Commercialization—In Need of Help. Marvin M. Yarosh, Florida Solar Energy Center, 1978.

Solar Consumers: An Investigation Toward Commercialization. Jeffery Cook, Connelly, Garrett, for the Arizona Solar Energy Research Commission, June 1977.

Solar Energy and Today's Consumer. Report by the Subcommittee on Oversight and Investigations of the House Committee on Interstate and Foreign Commerce, December 1978.

Solar Energy Incentives Analysis: Psycho-Economic Factors Affecting the Decision Making of Consumers and the Technology Delivery System. The U.S. Department of Energy, January 1978. (HCP/M 2534-01)

Solar Energy Study. Research Department of Architectural Record, November, 1978.

Solar Heating and Cooling of Buildings (SHACOB) Commercialization Report: Part B—Analysis of Market Development. Arthur D. Little, Inc., for the U.S. Department of Energy, September 1977. (HCP/M 70066-01/1, 01/2 & 01/3)

Solar Heating and Cooling of Buildings, Phase O Feasibility and Planning Study, Final Report. General Electric for the National Science Foundation/RANN, May 1974. (NSF-RA-N-74-021B) (Doc. No. 74SD4219)

Solar Home Heating in Canada: Problems and Prospects. Foster & Sewell, Office of the Science Advisor, Canadian Department of Fisheries and Environment, 1977. (Canadian Cat. No. EN 102-1/16)

Solar Water Heating Economic Feasibility, Capture Potential, and Incentives. Jerome Scott, University of Delaware for the National Science Foundation, February 1977. (CPB-279 855)

Survey of Customer Attitudes Toward Home Solar Systems. Southern California Edison (SCE), December 1977.

Survey of the Emerging Solar Energy Industry 1977 Edition. Justin A. Bereny, Solar Energy Information Services, May 1977. (Library of Congress #77-71664)

What Home Shoppers Seek in Six Major Markets. Walker and Lee, a California Realty Firm for Housing Magazine, October 1978.

Document Control Page	1. SERI Report No. SP-434-475	2. NTIS Accession No.	3. Recipient's Accession No.
4. Title and Subtitle Solar Market Studies: Review and Comment		5. Publication Date April 1980	
7. Author(s) Vories, R.; Strong, H.		8. Performing Organization Rept. No.	
9. Performing Organization Name and Address Solar Energy Research Institute 1617 Cole Blvd Golden, Colorado 80401		10. Project/Task/Work Unit No. 6721.20	11. Contract (C) or Grant (G) No. (C) (G)
12. Sponsoring Organization Name and Address		13. Type of Report & Period Covered Special Publication	
15. Supplementary Notes		14.	
16. Abstract (Limit: 200 words) This report summarizes and comments on relevant solar energy market surveys and related studies to provide a basis for determining areas requiring additional research and possible policies and actions to aid in rapid adoption of solar technologies. Thirty-two studies are discussed. The first 19 studies directly assess the market for residential use of solar domestic hot water, space, and pool heating. Studies 20 and 21 inspect energy conservation surveys. Studies 22 and 23 examine the financial incentives and financial institutions in the expanding solar market. Study 24 considers energy and low-income people. Studies 25 and 26 assess market sizes for photovoltaic systems and wind machines. Studies 27-30 are not surveys per se, but represent secondary source and modeling efforts to gain understanding of the solar marketplace. Studies 31 and 32 present the Canadian perspective on the market feasibility of solar energy systems. Many of the studies contained flaws of concept and/or method to a degree that would bring into question the credibility of individual findings but, taken as an aggregate, they provide a useful compendium of opinion about present and potential solar energy users.			
17. Document Analysis a. Descriptors Market Research ; Surveys ; Research Programs ; Commercialization ; Solar Energy ; Domestic Hot Water Systems ; Resource Conservation ; Financial Incentives ; Wind Energy Conversion Systems ; Photovoltaic Energy Conversion Systems b. Identifiers/Open-Ended Terms c. UC Categories 58b			
18. Availability Statement National Technical Information Service U.S. Department of Commerce 5285 Port Royal Road Springfield, Virginia 22161		19. No. of Pages 60	20. Price \$5.25



Solar Energy Research Institute

A Division of Midwest Research Institute

1617 Cole Boulevard

Golden, Colorado 80401

Operated for the

U.S. Department of Energy

under Contract No. EG-77-C-01-4042

May 1980
SERI/SP-434-475