SOLAR INFORMATION PROCESS MODEL

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Solar Information Process Model

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ABSTRACT

The MITRE Solar Information Process Model (SIP) is a computerized model that simulates information processes in solar markets. As such, it represents a useful tool in the formulation of solar information outreach programs. For each market investigated, SIP model outputs include prioritized listings of the information needs of key decision makers and other strategically important market participants, and related information flow paths. This report provides macro-descriptions of the model and its logic together with a detailed illustrative example of its application. It also presents the findings and conclusions resulting from utilization of the model in the analysis of information processes in eight solar markets within the residential, commercial and agricultural sectors.

ACKNOWLEDGEMENTS

The authors wish to thank Marie Coluzzi for the support she provided not only in model programming but also in converting input data generated by the authors into machine sensible form, entering the data and executing model runs.

FOREWORD

This document is one of a series of interrelated technical reports resulting from the "Analytic Tools and Strategies for Solar Energy Technology Transfer" study performed by The MITRE Corporation, Metrek Division, for the U.S. Department of Energy. Other reports in the series are:

- Solar Information Outreach Strategies and Action Plans (MTR-7971)
- Solar Energy Technology Transfer Source Book (MTR-7674)
 - Volume I: Buildings
 - Volume II: Agriculture
- Solar Information Outreach Monitoring and Action Plan Assessment System (MTR-7972).

Technical Report MTR-7971, catalogs recommended information outreach action plans and strategies aimed at addressing important solar-related concerns, problems and needs of important participants in the solar markets relating to water and space heating in buildings and agricultural process heat applications. The MITRE Solar Information Process Model--the subject of this document--is one of the resources used in formulating the strategies and action plans documented in MTR-7971.

The Source Book (MTR-7674) is a convenient source of related reference data and serves as an aid in the planning and management of market-specific solar information outreach initiatives. In addition, it provides names and addresses of many of the entities (e.g., manufacturers, architects, financiers, etc.) that have strategic roles in solar market development.

Technical Report MTR-7972, provides the design concept and functional specifications for a DOE Solar Information Outreach Monitoring and Action Plan Assessment System. The objective of this system is to assist DOE to keep abreast of solar market development and needs and to assess the effectiveness of its solar information outreach initiatives.

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1.0 INTRODUCTION

1.1 Objectives

The Solar Information Process (SIP) model discussed in this report was designed and developed by The MITRE Corporation as part of a study entitled, "Analytic Tools and Strategies for Solar Energy Technology Transfer".* It simulates the net results of information processes in specific solar markets and constitutes a useful analytic tool in the formulation of solar information outreach programs.

Succeeding sections describe the model, from the perspective of a DOE solar information outreach program planner, and present findings and conclusions which resulted from applying the model to the analysis of information processes in the following solar markets:

- Water and space heating in residences and commercial buildings
 - New one- and two-family homes market (custom construction)
 - New one- and two-family homes market (speculative and tract construction)
 - New mobile homes market
 - One- and two-family homes retrofit market, including mobile homes
 - New commercial buildings market
 - Commercial buildings retrofit market.
- Agricultural process heat (crop drying and animal shelter heating)
 - Rational farms market (i.e., the market in which the farmer characteristically views farming as a business and is usually willing to invest in more efficient capital equipment to control costs)

*"Analytic Tools and Strategies for Solar Energy Technology Transfer," Contract Number EG-77-C-01-4041 between DOE and The MITRE Corporation.

- Traditional farms market (i.e., the market in which the farmer characteristically views farming as a way of life and prefers to repair existing capital equipment or purchase used rather than new equipment).

More specifically, this report:

- Describes model processing
- Shows, via an example, how the model works and how to interpret model results
- Shows the findings and conclusions resulting from using the model to analyze information processes in the above-mentioned markets.

A complementary report, MITRE Working Paper 12736*, provides a technical description of the model and serves as a programmer's guide.

1.2 Background

The commercialization of innovative technologies to the point where they achieve significant market penetration is typically a relatively protracted process. During this process, innate conservatism, and initial market uncertainties about the new product, its performance, operating economics, etc., are progressively diluted and eventually overcome. In this context, effective information outreach represents a vital activity in current efforts to accelerate the commercialization of solar energy technologies.

In the development of solar information outreach programs, a wide range of issues must be addressed. These include:

- For each market, who are the participants, and how do they interact?

*M. Coluzzi, K. Rebibo and P. Spewak, "Solar Energy Technology Transfer Model--Program Description and Logic" (WP-12736), The MITRE Corporation, 1978.

- Of these participants, who are the principal decision makers? What is their relative impact in decision making processes, and how do they interact?
- What are the major concerns and inhibitions of each of the decision makers with respect to solar systems? What is the relative importance of each such concern?
- What information is needed to ameliorate, and hopefully resolve, such concerns?
- What are the most effective means of getting the most important information to the most important participants/decision makers, taking into account:
 - The credence that a particular participant puts in various information sources
 - The coverage and impact of alternative disseminating mechanisms
 - Cost and time characteristics of alternative information processes?
- Who are the information multipliers in the system? To what extent does providing information to one participant (who may, or may not be a principal decision maker) indirectly satisfy the information needs of other participants?

The SIP model represents a systematic and analytic methodology for integrating data on the above and related issues, to derive outreach activity priorities, and critical information-flow sequences within specific solar markets.

2.0 SOLAR INFORMATION PROCESS MODEL: LOGIC AND PROCESSING

2.1 Model Logic: Macro Description

The MITRE/Metrek Solar Information Process model is a quantitative structural model that simulates the net results of information processes in solar markets. That is, the model takes the array of information dissemination tasks--getting each item of information needed by each participant to that participant by the most effective mechanism--and prioritizes them. Prioritization is on the basis of:

- The relative importance of each participant in the functioning of the market under investigation
- The relative importance to each participant of several solar-related concerns or inhibitions
- The relative importance attached to each item of information needed by each participant with respect to each concern
- Information generation and sequencing; that is, the development of information by combining data and other items of information, and the passing of information between participants. For example, "economic viability" information is developed by combining the following items:
 - System procurement and installation cost
 - System performance parameters
 - Conventional fuel cost
 - Maintenance costs
 - etc.

Information processes include:

- Production of information from data and other intelligence
- Tailoring of information to the requirements of, and in the language of, each participant who needs it
- Information packaging
- Information dissemination.

As such, the model is a tool for setting information outreach priorities in the formulation of market-oriented solar information outreach programs.

For each solar market analyzed, the model takes cognizance of:

- Heating, ventilation and air conditioning (HVAC) equipment decisionmaking
 - Decision makers and their relative importance in the overall functioning of the market
 - Decisionmaking processes
- Market practices
 - Interactions between market participants
 - Traditional sources of information and other services: who typically gets what from whom
- Information processes
 - Information needs of each participant and the relative weight attached to each need
 - Information dissemination mechanisms and their attributes, e.g.:
 - Coverage
 - Impact
 - Cost/Time characteristics
 - The construction of information from data and other intelligence.

Figure 2-1 depicts the model's logic diagrammatically.

The model has utility in the following applications:

- Identification of critical participants by application (i.e., market sector)
- Prioritization of information needs
 - By market sector
 - By participant
 - By region

FIGURE 2-1
FLOW DIAGRAM: SIP PROGRAM PLANNING MODEL

- Prioritization of information dissemination mechanisms by participant group
- Evaluation of interacting group activities
- Prioritization of technology transfer tasks in the light of total impact on a solar market
- Identification of information-flow critical paths (i.e., who needs what information and in what sequence)
- Adjustment of programmatic content and priorities with solar technology transfer evolution (i.e., feedback from program tracking).

2.2 Model Inputs, Processing And Outputs

Comprehensive, technical descriptions of model inputs, processing and outputs are provided in MITRE Working Paper 12736.*

2.2.1 Model Inputs

Model inputs consist of quantitative measures of:

- Participants and their relative importance
- Information processes
 - Information production
 - Information transfer between participants
 - Information dissemination mechanisms (e.g., relative coverage, impact, cost, etc.)

Descriptions and examples of the most important model inputs are provided in Table II-1. Additional examples are provided in Section 3.0.

2.2.2 Model Processing

Figure 2-2 summarizes the major steps involved in model processing. Essentially, the model determines overall information outreach

*op. cit.

TABLE II-1

MITRE SOLAR INFORMATION PROCESS MODEL INPUT DATA

Input Arrays	Array Definitions
(1) PRTIMP (PART)	- Relative importance of the participants within the functioning of the market under analysis (Scale: 0-1)
(2) COMPRE (MEC)	- Comprehension rate of each mechanism (Scale: 0-1)
(3) INFIMP (PART, INF)	- Relative importance of each item of information to each market participant (Scale: 1-5)
(4) MECEFF (PART, MEC)	- Relative effectiveness of each information dissemination mechanism for each participant (Scale: 0-1)
(5) COST (INF, MEC)	- Cost of each information mechanism for each information need (thousands of dollars)
(6) PRDCSR (PART1, INF, PART2)	- Participants who can meet the information needs of other participants (0 = No, 1 = Yes)
(7) PTOP (PART1, PART2 NPRT)	- Participant-to-participant effectiveness of information transfer (Scale: 0-1)
(8) INFINF (INF1, INF2)	- Information needs that are required to compute other information needs (0 = No, 1 = Yes)

PART = Participant

MEC = Information Dissemination Mechanism

INF = Information Need

FIGURE 2-2
MITRE SOLAR INFORMATION PROCESS MODEL
PROCESSING STEPS

priorities within each market sector, according to a specified criterion.

Ideally, one would prefer to determine information dissemination priorities on the basis of a (validated) relationship which expresses solar market penetration as a function of the quantity of information disseminated to the most important market participants by content (subject matter), quantity and dissemination mode. This would provide a rational, analytic basis for allocating available resources. However, at the present time, the knowledge to construct such a function is not available. Furthermore, the dissemination of information to strategic and important market participants does not alter other parametric variables that critically influence market acceptance. For example, the dissemination of solar-related information to developers, homeowners, financiers, utilities, etc. does not:

- Make solar systems less expensive
- Alter their economic viability
- Change the payback period
- Alter the cost of conventional fuels
- Make solar systems perform better or give them greater reliability.

Hence, it was necessary to develop another criterion for determining information outreach priorities. The criterion ultimately adopted was information benefit, defined as the relative impact on the market under investigation of meeting a specific information need of a specific participant. This criterion is predicated upon the following assumption:

- If all items of information needed by all market participants were met, and if information transfer processes were 100 percent effective, then there would be 100 percent impact.

The 100 percent impact represents potential impact. Actual impact is vastly smaller than 100 percent because of inefficiencies in the information processes. Among these are:

- Incomplete coverage: information dissemination mechanisms do not reach 100 percent of the target audience
- Mechanism (e.g., periodicals, workshops, electronic media, etc.) inefficiencies: no mechanism transmits information with complete effectiveness to all members of the audience it covers
- Participant-to-participant transfer inefficiencies: the processes whereby one participant category personally conveys information to another participant are less than perfect.

Model processing involves allocating the actual impact among the set of participant/information need combinations. For example, if there are 20 participants and if each has 10 information needs, there are 200 participant/information need combinations. The model allocates the available actual percentage of impact among the 200 participant/information need combinations. Three types of information benefits are calculated:

- Primary benefits: benefits that result when a participant group which receives information (regardless of source) uses that information to satisfy its own needs
- Secondary benefits: benefits which accrue to a participant group when it passes information which it receives to others. For example, if a solar equipment dealer receives "economic viability" information from a manufacturer, repackages it and then disseminates it to a potential solar system buyer, that dealer accrues secondary benefits
- Total benefits: the sum of primary and secondary benefits. Total benefits and the total benefit/cost ratio are used to establish information outreach priorities.

2.2.3 Model Outputs

The principal model outputs are:

- Totality of all participant/information need combinations ranked in terms of:
 - Total benefits
 - Total benefit/cost ratio.
- Information flow paths: the alternative paths over which information flows to participant groups that need it. Figure 2-3 provides illustrative examples of alternative information flow paths.
- Specific information needs of each participant group:
 - Benefits (i.e., primary, secondary, and total benefits) which accrue by meeting these needs
 - The best three mechanisms for disseminating each item of needed information
 - The benefit/cost ratio of the best information dissemination mechanism for meeting each need.

Table II-2 shows examples of participant/information need combinations ranked according to total benefits, specifically for the new one and two family homes speculative construction market.

Paths Over Which Homeowners Can Obtain Information about Tax Incentive Programs		
(1)	→ Federal System Integration Agencies →	Homeowners
(2)	→ Federal System Integration Agencies → Solar Equipment Manufacturers →	Homeowners
(3)	→ Federal System Integration Agencies → Solar Equipment Manufacturers → Mechanical Contractors →	Homeowners
(4)	→ Federal System Integration Agencies → Mechanical Contractors →	Homeowners

Paths Over Which Homeowners Can Obtain Information Regarding Solar System Performance and Reliability		
(1)	→ Solar Equipment Manufacturers →	Homeowners
(2)	→ Solar Equipment Manufacturers → Mechanical Contractors →	Homeowners
(3)	→ Solar Equipment Manufacturers → Federal System Integration Agencies →	Homeowners
(4)	→ Solar Equipment Manufacturers → Federal System Integration Agencies → Mechanical Contractors →	Homeowners
(5)	→ Solar Equipment Manufacturers → R&D Performers → Federal System Integration Agencies → Mechanical Contractors →	Homeowners

FIGURE 2-3
ILLUSTRATIVE EXAMPLES OF ALTERNATIVE INFORMATION FLOW
PATHS OVER WHICH HOMEOWNERS SATISFY THEIR
INFORMATION NEEDS: ONE- AND TWO-FAMILY HOMES, HOT WATER
SYSTEM RETROFIT MARKET

TABLE II-2

MITRE SOLAR INFORMATION PROCESS MODEL
SAMPLE MODEL OUPUT

NEW ONE- AND TWO-FAMILY HOMES MARKET (SPECULATIVE CONSTRUCTION)

Task	Participant Group	Information Need Category	Total Benefits Index
1	Equipment Manufacturer	Installation & Maintenance	8.685
2	Equipment Manufacturer	Design/Performance	7.365
3	Mechanical Engineer	Design/Performance	4.186
4	Mechanical Engineer	Installation & Maintenance	3.654
5	Equipment Manufacturer	List of Installers	2.550
6	Equipment Manufacturer	List of Maintainers	1.878
7	Mechanical Engineer	Installation & Maintenance	1.674
8	Equipment Manufacturer	Warranties	1.034
9	Equipment Manufacturer	List of Designers	1.002
10	Mechanical Engineer	Economic Viability	0.932

3.0 APPLICATION OF THE MODEL USING A HYPOTHETICAL EXAMPLE

Section 2.0 provided a macro description of SIP model logic and processing. Section 3.0 shows how the model works by means of a hypothetical example selected to simplify computations and facilitate explanations of processing procedures. The example relates to information processes associated with the one-and-two-family homes retrofit market for solar water heating systems.

3.1 Example Inputs

Assume that four participant groups have roles in the decisionmaking and information processes associated with the one- and two-family homes retrofit market for solar water heating systems:

- Homeowner
- Solar equipment manufacturer
- Dealer/Installer
- Financier.

Analysis of the decisionmaking processes associated with this market showed that the homeowner is the pre-eminent decision maker with respect to equipment selection.* However, decisionmaking by the homeowner is influenced by the actions of manufacturers and dealers; specifically:

- The manner in which they market their products
- Their ability to provide, persuasively, the information needed by homeowners to make decisions

*R. Hewett, et al., Solar Energy Technology Transfer Source Book, Volume I: Buildings (MTR-7674), The MITRE Corporation, 1978.

- Their ability to support their products (i.e. provide quality installation and maintenance services and replacement parts).

Unless the homeowner has self-financing capability, a decision on his part to opt for solar also requires the concurrence of the financier. Hence, although the homeowner is the pre-eminent decision maker, others have important roles in the process. Table III-1 shows the assumptions used in the example regarding the relative influence of each of the four actors in the decisionmaking and information processes associated with the subject market. Table III-1 defines the input array PRTIMP (NPRT).

Table III-2 shows the items of information needed by each of the four participants in the example, and the relative importance attached to each item. For the purposes of this illustrative example, each participant is assumed to have no more than five information needs. These data constitute the input array INFIMP (NPRT, NINF) as described in Subsection 2.2.1. Table III-2 shows that manufacturers have five information needs. However, some of them are not needed by manufacturers for their own consumption. For example, manufacturers require "installation and maintenance" information--not for their own purposes but for dissemination to dealers. Dealers rely upon manufacturers for such information.

In order to satisfy each information need of each participant, an appropriate dissemination mechanism must be chosen. Table III-3 shows the mechanisms assumed to be available to participants and their relative effectiveness:

TABLE III-1

RELATIVE IMPORTANCE OF THE PARTICIPANTS IN THE
FUNCTIONING OF THE MARKET UNDER ANALYSIS:

ARRAY PRTIMP (PART)

ARRAY PRTIMP (PART)		
Participant	Participant Number (PART)	Relative Importance PRTIMP (PART)
Homeowner	1	0.6
Manufacturer	2	0.1
Dealer	3	0.2
Financier	4	0.1

TABLE III-2

INFORMATION NEEDS OF EACH PARTICIPANT AND THE RELATIVE IMPORTANCE
ATTACHED TO THOSE NEEDS: INPUT ARRAY INFIMP (PART, INF)

ARRAY INFIMP (PART, INF)							
Participants	Participant Number (PART)	Information Needs					
		System Cost	Performance and Reliability	Installation and Maintenance	Market Potential	End User Preferences	Credit Worthiness of Borrowers
Homeowner	1	5	4	1	1	1	1
Manufacturer	2	4	4	4	5	5	1
Dealer	3	3	3	5	4	4	1
Financier	4	1	3	1	1	1	5

Scale

- 5 : Information Needs of Greatest Importance
- 4 : Information Needs of Great Importance
- 3 : Information Needs of Considerable Importance
- 2 : Information Needs of Lesser Importance
- 1 : Information Needs of No Importance

TABLE III-3

INFORMATION DISSEMINATION MECHANISMS AND THEIR
RELATIVE EFFECTIVENESS: INPUT ARRAY MCEFF (PART, MEC)

Participant	Participant Number (PART)	Relative Effectiveness of Each Mechanism MECEFF (PART, MEC)			
		Television	Trade Journals	Inter- personal	NSHCIC*
Homeowner	1	.3	.0	.5	.2
Manufacturer	2	0	.8	.2	0
Dealer	3	0	.4	.4	.2
Financier	4	0	.5	.5	0

*National Solar Heating and Cooling Information Center

Scale: 0-1

- Television
- Professional and trade journals
- Interpersonal communications (i.e., person-to-person information dissemination)
- National Solar Heating and Cooling Information Center.

The data in Table III-3 define input array MECEFF (PART, MEC). The zero values in any of the cells of array MECEFF (PART, MEC) indicate that mechanism "MEC" is not appropriate for disseminating information to participant "PART." For example, array MECEFF (PART, MEC)--as defined in Table III-3--shows that television is not an appropriate mechanism for conveying information to manufacturers. On the other hand, professional and trade journals are most appropriate for reaching manufacturers.

Mechanism effectiveness is defined to be a function of three measures:

- Coverage: percentage of the target audience reached by the mechanism
- Image: credibility of the mechanism as perceived by the target audience
- Efficiency: ease with which information is transmitted to the target audience, once the audience is reached.

Mechanism effectiveness for each participant category is given by

$$\text{MECEFF (PART)} = \text{Coverage} \times \text{Image} \times \text{Efficiency}$$

For example, the homeowner is widely covered by television (assume 80 percent coverage). However, a typical homeowner might believe only 60 percent of the things he hears or sees on television--a less than

perfect image. Then too, the homeowner may not absorb all the information presented--assume 63 percent. Hence, for homeowners, the mechanism effectiveness of television is

$$80\% \times 60\% \times 63\% \text{ or } 30 \text{ percent.}$$

In reality, of course, mechanism effectiveness is a much more complex phenomenon than the multiplication function given above.

In addition to differences in the effectiveness of different information dissemination mechanisms, the model takes cognizance of differences in relative comprehension rates. Table III-4 shows the comprehension rates assumed for each of the four mechanisms.

Table III-5 shows the costs to the Federal Government, in thousands of dollars, of using alternative mechanisms to satisfy the various information needs of participants. These values constitute input array COST (INF, MEC). Array COST (INF, MEC) does not take cognizance of differences in participants. That is, it gives the cost of using specific mechanisms to meet specific information needs without taking into account the specific participant which has that need.

Table III-6 shows the effectiveness of participant-to-participant information transfers. These values define input array PTOP (PART 1, PART 2). Table III-6, for example, shows that dealers are more effective in conveying solar-related information to homeowners than manufacturers.

TABLE III-4

INFORMATION DISSEMINATION MECHANISMS AND THEIR RELATIVE
COMPREHENSION RATES: INPUT ARRAY COMPRE (MEC)

ARRAY COMPRE (MEC)		
Mechanism	Mechanism Number	Relative Comprehension Rate (COMPRE (MEC))
Television	1	.8
Professional and Trade Journals	2	.6
Interpersonal	3	.8
NSHCIC *	4	.6

*National Solar Heating and Cooling Information Center
Scale: 0-1

TABLE III-5

COST (\$,000) TO THE GOVERNMENT OF USING EACH MECHANISM
TO DISSEMINATE INFORMATION: INPUT ARRAY COST (INF, MEC)

Information Need	Information Need Number (INF)	Cost of Using Mechanism MEC To Meet Information Need INF COST (INF, MEC)			
		Television	Professional and Trade Journal	Interpersonal	NSHCIC*
Economic Viability	1	25	10	15	5
Performance and Reliability	2	20	15	15	8
Installation and Maintenance	3	50	25	30	10
Market Potential Information	4	0	15	15	10
End User Preferences	5	0	15	15	0
Credit Worthiness of Borrowers	6	0	0	10	0

*National Solar Heating and Cooling Information Center

TABLE III-6

PARTICIPANT-TO-PARTICIPANT INFORMATION

TRANSFER EFFECTIVENESS: INPUT ARRAY PTOPTOP (PART 1, PART 2)

ARRAY PTOPTOP (PART 1, PART 2)				
Assisting Participant (PART 1)	Participant-to-Participant Transfer Effectiveness (Part 2)			
	Homeowner	Manufacturer	Dealer	Financier
Homeowner	0	.1	.1	.1
Manufacturer	.5	0	.9	.1
Dealer	.9	.2	0	.3
Financier	.6	.1	.1	0

3.2 Processing of the Example

3.2.1 Computation of Primary Benefits

The principal steps involved in model processing are depicted in Figure 2-2. After reading and storing the input data, actual processing begins with the computation of primary benefits. As was mentioned in Subsection 2.2, benefits are defined in terms of:

- Percentage of the market that is impacted by satisfying a specific information need of a specific participant.

Primary benefits are those that result when a participant group which receives information uses that information itself. Primary benefits are derived via the following steps:

- (a) Conversion of the elements of each row of input array INFIMP (PART, INF) from the 1-5 scale to proportions. This is done by:
 - Changing the 1's in INFIMP (PART, INF) to zeros
 - Summing all elements in each row of array INFIMP (PART, INF)
 - Dividing each element of each row of INFIMP (PART, INF) by the row sum computed above.

Table III-7 shows array INFIMP (PART, INF) before and after its proportionalization.

- (b) Computation of new array RELIMP (PART, INF): Array RELIMP (PART, INF) is the matrix which shows the relative importance of meeting each information need of each participant in terms of impact on the market under investigation. It is assumed that if all needed information is delivered to all participants, then the total market impact is 100 percent. Hence, the sum of all elements in RELIMP (PART, INF) equals 1.0. This array is computed as follows:

$$\text{RELIMP (PART, INF)} = \text{PRTIMP (PART)} \times \text{INFIMP (PART, INF)} \\ \text{(normalized to 1.0)}$$

Array RELIMP (PART, INF) is shown in Table III-8.

TABLE III-7

CONVERSION OF THE ELEMENTS OF EACH ROW OF INPUT ARRAY INFIMP (PART, INF)
FROM THE 1-5 SCALE TO PROPORTIONS

ARRAY INFIMP (PART, INF) EXPRESSED IN TERMS OF THE 1-5 SCALE

Participants	Participant Number (PART)	Information Needs					
		System Cost	Performance and Reliability	Installation and Maintenance	Market Potential	End User Preferences	Credit Worthiness of Borrowers
Homeowner	1	5	4	1	1	1	1
Manufacturer	2	4	4	4	5	5	1
Dealer	3	3	3	5	4	1	1
Financier	4	1	3	1	1	1	5

ARRAY INFIMP (PART, INF) EXPRESSED IN TERMS OF PROPORTIONS

Participants	Participant Number (PART)	Information Needs					
		System Cost	Performance and Reliability	Installation and Maintenance	Market Potential	End User Preferences	Credit Worthiness of Borrowers
Homeowner	1	.56	.44	0	0	0	0
Manufacturer	2	.18	.18	.18	.23	.23	0
Dealer	3	.20	.20	.33	.27	0	0
Financier	4	0	.38	0	0	0	.62

TABLE III-8

COMPUTED ARRAY RELIMP* (PART, INF)

ARRAY RELIMP (PART, INF)							
Participants		Information Needs					
Participants Category	Participant Number (PART)	System Cost	Performance and Reliability	Installation and Maintenance	Market Potential	End User Preferences	Credit Worthiness of Borrowers
Homeowner	1	.33	.27	0	0	0	0
Manufacturer	2	.02	.02	.02	.02	.02	0
Dealer	3	.04	.04	.07	.05	0	0
Financier	4	0	.04	0	0	0	.06

*Array RELIMP (PART, INF) shows the relative importance of meeting each specific information need "INF" of each participant "PART": normalized to 1.0

(c) Computation of new array PRIMARY BENEFIT (PART, INF, MEC), where

$$\text{PRIMARY BENEFIT (PART, INF, MEC)} = \frac{\text{RELIMP (PART, INF)} \times \text{MECEFF (PART, MEC)}}{\text{COST (INF, MEC)}}$$

(d) Determination of primary benefits and the best information dissemination mechanism for each participant/information need/mechanism combination by finding the mechanisms MEC⁺ in which

$$\frac{\text{PRIMARY BENEFIT (PART, INF, MEC}^+) }{\text{COST (INF, MEC}^+) } > \frac{\text{PRIMARY BENEFIT (PART, INF, MEC)}}{\text{COST (INF, MEC)}}$$

Table III-9 shows the following for each participant/information need combination:

- Primary benefits
- Best information dissemination mechanisms
- Primary benefit/cost ratio of the best mechanism
- Hypothetical cost of using the best mechanism to satisfy each participant/information need combination.

On the basis of Table III-9, and solely with respect to primary benefits, the most important tasks are getting information to homeowners--the end users of solar systems in the market under investigation.

3.2.2 Development of Information Chains

After computing primary benefits, the model develops information chains that define alternative information flow paths and are used to compute secondary benefits. A tree is developed for each participant/information need combination. The trees show all paths over which information needed by a specific participant group can reach that group.

TABLE III-9

INFORMATION DISSEMINATION TASKS RANKED ACCORDING TO
PRIMARY BENEFIT/COST RATIO

Task Number	Participant	Information Need	Best Dissemination Mechanism	Cost of Best Mechanism (\$)	Primary Benefit	Primary Benefit/Cost Ratio
1	Homeowner	Economic Viability	NSHCIC*	5,000	2.00	4.00
2	Homeowner	Performance and Reliability	Interpersonal	15,000	4.00	2.67
3	Financier	Credit Worthiness	Interpersonal	10,000	0.94	0.94
4	Dealer	Economic Viability	NSHCIC	5,000	0.24	0.48
5	Manufacturer	Economic Viability	Professional and Trade Journals	10,000	0.44	0.44
6	Dealer	Market Potential	Interpersonal	15,000	0.64	0.43
7	Dealer	Installation and Maintenance	NSHCIC	10,000	0.40	0.40
8	Financier	Performance and Reliability	Interpersonal	15,000	0.56	0.38
9	Manufacturer	Market Potential	Professional and Trade Journals	15,000	0.55	0.36
10	Manufacturer	End User Preferences	Professional and Trade Journals	15,000	0.55	0.36
11	Dealer	Performance and Reliability	Interpersonal	15,000	0.48	0.32
12	Manufacturer	Performance and Reliability	Professional and Trade Journals	15,000	0.44	0.29
13	Manufacturer	Installation and Maintenance	Professional and Trade Journals	25,000	0.44	0.18

*National Solar Heating and Cooling Information Center

In the example, there are four participants. Each has between two and five information needs. Collectively, there are 13 participant/information needs combinations. For each combination, the model develops one or more chains. The number of chains generated is a function of the number of participant categories from which the subject participant can acquire the information. Figure 3-1 shows the chains associated with the delivery of "economic viability" and "performance and reliability" information to homeowners. It indicates, for example, that there are three paths for conveying "economic viability" information to homeowners. Homeowners can obtain such information from:

- The manufacturer
- The NSHCIC--which obtains it from the manufacturer
- The solar equipment dealer--who also obtains the information from the manufacturer.

On the basis of Figure 3-1, one can conclude that:

- There are multiple paths over which homeowners can obtain solar-related information
- Manufacturers are the ultimate sources of the solar-related information disseminated to homeowners.

3.2.3 Computation of Secondary Benefits

As discussed in Subsection 2.2, secondary benefits are those that accrue to a participant group when it passes information received (or generated) to other groups. In the present example, secondary benefits arise in two cases:

INFORMATION CHAINS FOR CONVEYING "ECONOMIC VIABILITY" INFORMATION TO HOMEOWNERS	
Chain (a)	Manufacturer → Homeowner
Chain (b)	Manufacturer → NSHCIC → Homeowner
Chain (c)	Manufacturer → Dealer → Homeowner
INFORMATION CHAINS FOR CONVEYING "PERFORMANCE AND RELIABILITY" INFORMATION TO HOMEOWNERS	
Chain (a)	Manufacturer → Homeowner
Chain (b)	Manufacturer → Dealer → Homeowner

FIGURE 3-1
EXAMPLES OF INFORMATION CHAINS DEVELOPED BY THE
MITRE SOLAR INFORMATION PROCESS MODEL

- Case A: information is passed directly to another participant group which needs it. For example, referring to Figure 3-1, Case A secondary benefits accrue to manufacturers by disseminating "performance and reliability" information to homeowners.
- Case B: information is used by the participant group, along with other information/data, to compute an item of information needed by another group, and then convey the new information to the other group. For example, referring to Figure 3-1, manufacturers use "system cost" and "performance and reliability" information to develop "economic viability" information. Hence, Case B secondary benefits accrue to manufacturers as a result of their developing "economic viability" information and disseminating it to homeowners.

Quantitatively, the Case A secondary benefits which accrue to participant group PART1, which passes information item INF1 to participant group PART2, are given by the equation

$$\text{SECONDARY BENEFIT (PART1, INF1)} = \text{RELIMP (PART2, INF1)} \times \text{PTOP (PART1, PART2)} \times \text{MECEFF (PART1, MEC}^+)$$

where MEC⁺ is the best mechanism for conveying information need INF1 to participant group PART1.

With respect to Case B, let INF1 denote an item of information needed by participant PART 1 that is used to compute information item INF2 to be conveyed to participant PART2. In addition, let N be the total number of information items needed by participant PART1 to compute INF2. Then the Case B secondary benefits that accrue from delivering information item INF1 to participant PART1 are given by

$$\text{SECONDARY BENEFIT (PART1, INF1)} = \text{RELIMP (PART1, INF2)} \times \text{PTOP (PART1, PART2)} \times \text{MECEFF (PART1, INF1)} \times 1/N$$

Table III-10 shows--in rank order--the secondary benefits which accrue to participants in the example, and indicates that only

TABLE III-10

RANK-ORDERED LISTING OF THE SECONDARY BENEFITS ACCRUING TO PARTICIPANTS IN THE SAMPLE PROBLEM

Task	Participant	Information Need	Primary Benefit	Secondary Benefit
1	Manufacturer	Economic Viability	0.44	4.00
2	Manufacturer	Performance and Reliability	0.44	3.29
3	Dealer	Performance and Reliability	0.48	3.01
4	Dealer	Economic Viability	.24	1.80
5	Manufacturer	Installation and Maintenance	0.44	1.44
6	Manufacturer	Market Potential	0.55	1.15
7	Homeowner	Economic Viability	2.00	0.00
8	Homeowner	Performance and Reliability	4.00	0.00
9	Manufacturer	End User Preferences	0.55	0.00
10	Dealer	Installation and Maintenance	0.40	0.00
11	Dealer	Market Potential	0.64	0.00
12	Financier	Performance and Reliability	0.56	0.00
13	Financier	Credit Worthiness	0.94	0.00

manufacturers and dealers receive secondary benefits. They are the only participants which process and disseminate information to others. Homeowners and financiers are end users--rather than processors or disseminators--of information. Hence, they receive no secondary benefits.

According to Table III-10, the participant/information need combination leading to the greatest quantity of secondary benefits is "provision of economic viability information to manufacturers." As Figure 3-1 shows, manufacturers--the generators of this information item--disseminate it to:

- Homeowners
- Dealers, who subsequently disseminate it to homeowners.

Secondary benefits accrue to manufacturers in both cases.

3.2.4 Computation of Total Benefits and Total Benefit/Cost Ratio

After calculating the primary and secondary benefits for each participant/information need combination, the model develops total benefits and the total benefit/cost ratio. Total benefits are the sum of the primary and secondary benefits. The total benefit/cost ratio for each participant/information need combination is the total benefit divided by the cost of the best information dissemination mechanism:

$$\text{Total Benefit/Cost Ratio} = \frac{\text{Primary Benefit} + \text{Secondary Benefit}}{\text{Cost of Best Mechanism}}$$

Total benefit and total benefit/cost ratio are the indices used in the model for establishing priorities.

Table III-11 shows the 13 participant/information need combinations in the example ranked according to total benefit/cost ratio. In addition, Table III-11 shows:

- Primary benefit
- Secondary benefit
- Total benefit
- Best information dissemination mechanism
- Cost associated with using the best mechanism.

3.3 Results and Conclusions from the Sample Application

Table III-11 summarizes SIP model outputs for the foregoing examples marker example, from which the following conclusions may be drawn:

- Using total benefit/cost ratio as the criterion, the most important information tasks are to:
 - Provide manufacturers with "economic viability" information
 - Provide solar equipment dealers with "economic viability" information.
- The most important participant in the overall functioning of this market is the homeowner. However, the most important information tasks are to satisfy the information needs of the participants to whom homeowners go for information--manufacturers and dealers.
- If costs are ignored and total benefit--rather than total benefit/cost ratio--is used as the basis for establishing priorities, the most important tasks are to supply:
 - Manufacturers with "economic viability" information
 - Homeowners with "performance and reliability" information.
- Manufacturers and dealers, in addition to being end users of information, generate, package and disseminate information to others. Hence they accrue primary and secondary benefits.

TABLE III-11

MITRE SOLAR INFORMATION PROCESS MODEL OUTPUT:
 PARTICIPANT/INFORMATION NEED TASKS RANKED ACCORDING TO TOTAL BENEFIT/COST RATIO

Task	Participant	Information Need	BEST INFORMATION DISSEMINATION MECHANISM	Primary Benefit	Secondary Benefit	Total Benefit	Cost** (\$)	Total Benefit/ Cost Ratio
1	Manufacturer	Economic Viability	Professional and Trade Journal	0.44	4.00	4.44	10,000	4.44
2	Dealer	Economic Viability	Interpersonal	0.24	1.80	2.04	15,000	4.08
3	Homeowner	Economic Viability	NSHCIC*	2.00	0.00	2.00	5,000	4.00
4	Homeowner	Performance and Reliability	Interpersonal	4.00	0.00	4.00	15,000	2.67
5	Manufacturer	Performance and Reliability	Professional and Trade Journal	0.44	3.29	3.73	15,000	2.48
6	Dealer	Performance and Reliability	Interpersonal	0.48	3.02	3.50	15,000	2.33
7	Manufacturer	Market Potential	Professional and Trade Journal	0.55	1.15	1.70	15,000	1.13
8	Financier	Credit Worthiness of Borrowers	Interpersonal	0.94	0.00	0.94	10,000	0.94
9	Manufacturer	Installation and Maintenance	Professional and Trade Journal	0.44	1.44	1.88	25,000	0.75
10	Dealer	Market Potential	Interpersonal	0.64	0.00	0.64	15,000	0.43
11	Dealer	Installation and Maintenance	NSHCIC	0.40	0.00	0.40	10,000	0.40
12	Financier	Performance and Reliability	Interpersonal	0.56	0.00	0.56	15,000	0.38
13	Manufacturer	End User Preferences	Professional and Trade Journal	0.55	0.00	0.55	15,000	0.36

*National Solar Heating and Cooling Information Center.

**Cost to the Federal government in using each mechanism.

- Homeowners and financiers are end users of information. Hence, the total benefits which accrue to them consist entirely of primary benefits.
- As Figure 3-1 shows, there are typically multiple paths over which end users of information can acquire it.
- Since satisfying a specific information need of a specific participant involves information development, packaging and dissemination activities by other participants, the market is characterized by the passing of information between participants who are not the ultimate end users of that information. Hence, the total benefits consist primarily of secondary benefits.

3.4 Examples of Using MITRE Solar Information Process Model Results to Formulate Information Outreach Initiatives

The participant/information need priorities, as listed in Table III-11, are a basis for:

- Formulating market-specific information outreach initiatives
- Assigning priorities to initiatives.

Thus, in the foregoing example, analysis of decisionmaking and information processes in the one and two family homes retrofit market for solar water heaters shows that the homeowner is the key participant. Homeowners, as part of their decisionmaking process, require "economic viability" information--information which they obtain ultimately from manufacturers, as Figure 3-1 shows. Hence, of highest priority is the requirement for a Government solar information outreach initiative to:

- Appraise manufacturers of methods whereby homeowners determine "economic viability"
- Provide manufacturers with (or assist them to collect) the specific items of information needed to determine economic viability--focussing on those items which are difficult for manufacturers to obtain without Federal assistance.

Similarly, analysis of the functioning of the subject market shows that dealers--who typically function as retailers, installers and maintainers--are an intermediary between the two strategic participants: homeowners and manufacturers. As Table III-11 shows, tasks of high priority are to convey "economic viability" and "performance and reliability" information to dealers--information which they obtain from manufacturers and disseminate to homeowners. According to Table III-11, the optimum means for conveying such information to dealers is person-to-person. This indicates the need for a further, market-specific outreach initiative:

- Sponsor a series of workshops which bring solar manufacturers and dealers together to:
 - Convey "economic viability" and "performance and reliability" information to dealers
 - Provide feedback to manufacturers regarding equipment-related problems that dealers are experiencing.

By combining the results obtained from analyzing decisionmaking and information processes in the market with model results, it is possible to formulate other information outreach initiatives as was done above.

4.0 ANALYSIS OF INFORMATION PROCESSES IN SOLAR MARKETS: RESULTS AND CONCLUSIONS

This Section summarizes the findings and conclusions that resulted from applying the MITRE Solar Information Process Model to the analysis of information processes in the solar markets relating to water and space in residences and commercial buildings and agricultural process heat applications.

- With respect to information processes, each market participant can be characterized in terms of one or more of the following functional attributes:

- Information/data generator
- Information end user
- Information packager/repackager
- Information disseminator

Tables IV-1 and IV-2 show the characteristic information process functions of participant groups within the buildings and agricultural process heat markets, respectively.

- Tables IV-3 through IV-8 show the fifteen most important participant information-need combinations, using total benefits (see Subsection 2.2.2) as the measure of importance, in each market (or group of markets):

- New one-and-two-family-homes market (custom construction): Table IV-3
- New one-and-two-family-homes market (speculative construction): Table IV-4
- New mobile-homes market: Table IV-5
- One-and-two-family-homes retrofit market (including mobile homes): Table IV-6
- Commercial-building market (new and retrofit): Table IV-7
- Agricultural-process-heat market (rational and traditional farms): Table IV-8.

These tables show the participant groups' information needs which must be satisfied before subsequent information needs can be met.

- Table IV-9 lists the principal decision makers in each market. Comparison with Tables IV-3 through IV-8, indicates that, in general, the information needs to be satisfied first are not those of these principal decision makers, but those of entities from which principal decision makers obtain their information: Federal system/ integration agencies and manufacturers.
- In both the buildings and APH markets, Federal system/ integration agencies (e.g., DOE, USDA, etc.) and solar manufacturers serve as the ultimate sources of information for all other participant groups.
- Solar/equipment manufacturers and Federal system/integration agencies, the ultimate sources of information for the principal decision makers and other participants, obtain information for their own use and for dissemination to others by
 - generating it themselves
 - obtaining it from the R&D community
- R&D performers and solar equipment manufacturers are the major generators of
 - Solar/system/engineering, performance, and reliability information
 - Solar/system/installation and maintainability information
 - Marketing-research information
 - End-user desires and preferences
 - Market Assessment
 - Market demographics
- A&E firms, architects, mechanical engineers, mechanical contractors and energy and conservation consultants function not only as end users of information, but also as sources of information for
 - Developers
 - Homeowners
 - Farmers
 - Mobile home manufacturers
 - Financiers
- Since satisfying a particular information need of a particular participant involves information generation, packaging, and dissemination activities by other participants, the buildings and APH markets are characterized by the passing of

information between participants who are not the ultimate users of that information. Hence, in the general case, the total benefits resulting from meeting each information need consist primarily of secondary benefits.

- There are a multiplicity of paths over which end users of information can acquire it. These paths are not necessarily equally efficient. Since end users of information utilize sources in which they have the most confidence, the objective should be to identify "optimum" information paths, but rather to insure that, whatever information source end users go to, the information that they need is there.
- Significant benefits (especially secondary benefits) accrue when the information needs of state and local government agencies (e.g., Tax Assessment Agencies, Consumer Protection Agencies, etc.) are satisfied, since these entities are perceived as sources of information by homeowners, farmers, and other decision makers. This is especially true of information relating to:
 - Qualified installers
 - Building codes and solar-related ordinances
 - Property taxes
 - Resale values.

TABLE IV-1

SOLAR INFORMATION PROCESS FUNCTIONS OF
PARTICIPANT GROUPS WITHIN BUILDING MARKETS

Participant Group	Information/Data Generator	Information End User	Information Packager/ Eepackager	Information Disseminator
(1) End Users (Building Owners)		X		
(2) Equipment Manufacturers/Dealers	X	X	X	X
(3) Architects		X		X
(4) Mechanical Engineers		X		X
(5) General Contractors/Developers		X		
(6) Mechanical Contractors		X		X
(7) System Maintainers		X		X
(8) Labor Unions		X		
(9) Financiers		X		X
(10) Insurers		X		X
(11) Utilities	X	X		
(12) Standards Developers (Non-Government)	X	X	X	X
(13) R&D Performers	X	X		X
(14) Energy & Conservation Consultants		X		X
(15) Information Disseminators		X	X	X
(16) Federal System Integration Agencies	X	X	X	X

TABLE IV-1 (Concluded)

SOLAR INFORMATION PROCESS FUNCTIONS OF
PARTICIPANT GROUPS WITHIN BUILDING MARKETS

Participant Group	Information/Data Generator	Information End User	Information Packager/ Repackager	Information Disseminator
(17) Federal Standards Agencies/ Other Federal Agencies	X	X	X	
(18) State and Local Governments	X	X	X	X
(19) Mobile Home Manufacturers		X		X

TABLE IV-2

SOLAR INFORMATION PROCESS FUNCTIONS OF PARTICIPANT
GROUPS WITHIN THE AGRICULTURAL PROCESS HEAT MARKETS

Participant Group	Data/Information Generator	Information End User	Information Packager/ Repackager	Information Disseminator
(1) Ender Users (Farmers and Ranchers)		X		
(2) Solar Manufacturers and Dealers <ul style="list-style-type: none"> • Manufacturers • Dealers 	X	X X	X	X X
(3) A&E Firms		X		X
(4) General Contractors		X		
(5) Mechanical Contractors		X		X
(6) Solar System Maintainers		X		X
(7) Financiers		X		X
(8) Insurers		X		X
(9) Utilities		X		
(10) Non-Government Standards Developers	X	X	X	X
(11) R&D Performers	X	X	X	X
(12) Information Disseminators		X	X	X
(13) Federal System Integration Agencies	X	X	X	X
(14) Federal Standards Agencies/ Other Federal Agencies	X	X	X	X
(15) State and Local Governments	X	X	X	X

TABLE IV-3

THE MOST IMPORTANT INFORMATION NEEDS OF PARTICIPANT GROUPS, RANKED IN TERMS OF TOTAL BENEFITS
(NEW ONE- AND TWO-FAMILY HOMES MARKET: CUSTOM CONSTRUCTION)

Participant Group	Solar-Specific Information Need	Are the Needs Adequately Met	Federal STT Assistance Necessary
(1) Solar manufacturers and dealers	System design and performance information	No	Yes
(2) Federal system integration agencies	Lists of qualified installers and maintainers	No	Yes
(3) Solar manufacturers and dealers	System installation and maintenance information	No	Yes
(4) Federal system integration agencies	System design and performance information	No	Yes
(5) Solar manufacturers and dealers	Lists of qualified installers and maintainers	No	Yes
(6) Solar manufacturers and dealers	Market potential information	No	Yes
(7) Federal system integration agencies	System installation and maintenance information	No	Yes
(8) State and local governments	Lists of qualified installers and maintainers	No	Yes

TABLE IV-3 (Concluded)

THE MOST IMPORTANT INFORMATION NEEDS OF PARTICIPANT GROUPS, RANKED IN TERMS OF TOTAL BENEFITS
(NEW ONE- AND TWO-FAMILY HOMES MARKET: CUSTOM CONSTRUCTION)

Participant Group	Solar-Specific Information Need	Are the Needs Adequately Met	Federal STI Assistance Necessary
(9) Federal system integration agencies	Tax incentives	Yes	
(10) Federal system integration agencies	Demonstration program results	No	Yes
(11) Homeowners	Lists of qualified installers and maintainers	No	Yes
(12) Homeowners	Lists of qualified designers	No	Yes
(13) Homeowners	Tax incentives	Yes	
(14) Homeowners	System cost information	Yes	
(15) Homeowners	Economic viability information	No	Yes

SOURCE: MITRE SIP Model

TABLE IV-4

THE MOST IMPORTANT INFORMATION NEEDS OF PARTICIPANT GROUPS, RANKED IN TERMS OF TOTAL BENEFITS
(NEW ONE- AND TWO-FAMILY HOMES MARKET: SPECULATIVE CONSTRUCTION)

Participant Group	Solar-Specific Information Need	Are the Needs Adequately Met	Federal STT Assistance Necessary
(1) Solar manufacturers and dealers	System installation and maintenance information	No	Yes
(2) Solar manufacturers and dealers	System design and performance information	No	Yes
(3) Federal system integration agencies	System installation and maintenance information	No	Yes
(4) Federal system integration agencies	System design and performance information	No	Yes
(5) Mechanical engineers	System design and performance information	No	Yes
(6) Mechanical engineers	System installation and maintenance information	No	Yes
(7) Federal system integration agencies	Lists of qualified installers and maintainers	No	Yes
(8) Solar manufacturers and dealers	Lists of qualified installers and maintainers	No	Yes

TABLE IV-4 (Concluded)

THE MOST IMPORTANT INFORMATION NEEDS OF PARTICIPANT GROUPS, RANKED IN TERMS OF TOTAL BENEFITS
(NEW ONE- AND TWO-FAMILY HOMES MARKET: SPECULATIVE CONSTRUCTION)

Participant Groups	Solar-Specific Information Need	Are the Needs Adequately Met	Federal STT Assistance Necessary
(9) Federal system integration agencies	Economic viability information	No	Yes
(10) Federal system integration agencies	Tax incentives	Yes	
(11) Federal system integration agencies	End user preferences	No	Yes
(12) Solar manufacturers and dealers	Market potential information	No	Yes
(13) Federal system integration agencies	Investment requirements	No	Yes
(14) Mechanical contractors	System installation and maintenance information	No	Yes
(15) Federal system integration agencies	Demonstration program results	No	Yes

SOURCE: MITRE SIP Model

TABLE IV-5

THE MOST IMPORTANT INFORMATION NEEDS OF PARTICIPANT GROUPS, RANKED IN TERMS OF TOTAL BENEFITS
(NEW MOBILE HOMES MARKET)

Participant Group	Solar-Specific Information Need	Are the Needs Adequately Met	Federal STT Assistance Necessary
(1) Solar manufacturers and dealers	System installation and maintenance information	No	Yes
(2) Solar manufacturers and dealers	System design and performance information	No	Yes
(3) Federal system integration agencies	System installation and maintenance information	No	Yes
(4) Federal system integration agencies	System design and performance information	No	Yes
(5) Mechanical engineers*	System installation and maintenance information	No	Yes
(6) Mechanical engineers*	System design and performance information	No	Yes
(7) Federal system integration agencies	Economic viability information	No	Yes
(8) Federal system integration agencies	Tax incentives	Yes	

TABLE IV-5 (Concluded)

THE MOST IMPORTANT INFORMATION NEEDS OF PARTICIPANT GROUPS, RANKED IN TERMS OF TOTAL BENEFITS
(NEW MOBILE HOMES MARKET)

Participant Group	Solar-Specific Information Need	Are the Needs Adequately Met	Federal STT Assistance Necessary
(9) Federal system integration agencies	Demonstration program results	No	Yes
(10) Federal system integration agencies	End user preferences and requirements	No	Yes
(11) Federal system integration agencies	Market potential information	No	Yes
(12) Mechanical engineers*	Economic viability information	No	Yes
(13) Mobile home manufacturers	System installation and maintenance information	No	Yes
(14) Mobile home manufacturers	Investment requirements	No	Yes
(15) Mobile home manufacturers	System design and performance information	No	Yes

*The mechanical engineer is a consultant to the mobile home manufacturer.

SOURCE: MITRE SIP Model

TABLE IV-6

THE MOST IMPORTANT INFORMATION NEEDS OF PARTICIPANT GROUPS, RANKED IN TERMS OF TOTAL BENEFITS
(ONE- AND TWO-FAMILY HOMES RETROFIT MARKET, INCLUDING MOBILE HOMES)

Participant	Solar-Specific Information Need	Are the Needs Adequately Met	Federal STT Assistance Necessary
(1) Solar manufacturers and dealers	System installation and maintenance information	No	Yes
(2) Solar manufacturers and dealers	System design and performance information	No	Yes
(3) Federal system integration agencies	Lists of qualified installers and maintainers	No	Yes
(4) Solar manufacturers and dealers	Lists of qualified installers and maintainers	No	Yes
(5) Federal system integration agencies	System design and performance information	No	Yes
(6) Federal system integration agencies	System installation and maintenance information	No	Yes
(7) Federal system integration agencies	Tax incentives	Yes	
(8) State and local governments	Lists of qualified installers and maintainers	No	Yes

TABLE IV-6 (Concluded)

THE MOST IMPORTANT INFORMATION NEEDS OF PARTICIPANT GROUPS, RANKED IN TERMS OF TOTAL BENEFITS
(ONE- AND TWO-FAMILY HOMES RETROFIT MARKET, INCLUDING MOBILE HOMES)

Participant Group	Solar-Specific Information Need	Are the Needs Adequately Met	Federal STT Assistance Necessary
(9) R&D performers	Economic viability information	No	Yes
(10) Federal system integration agencies	Economic viability information	No	Yes
(11) Homeowners	Lists of qualified installers and maintainers	No	Yes
(12) Homeowners	Tax incentives	No	Yes
(13) Homeowners	System cost information	Yes	
(14) Homeowners	Economic viability information	No	Yes
(15) Homeowners	Sources for financing	No	Yes

SOURCE: MITRE SIP Model

TABLE IV-7

THE MOST IMPORTANT INFORMATION NEEDS OF PARTICIPANT GROUPS, RANKED IN TERMS OF TOTAL BENEFITS
(NEW AND RETROFIT COMMERCIAL BUILDINGS MARKETS)

Participant Group	Solar-Specific Information Need	Are the Needs Adequately Met	Federal STT Assistance Necessary
(1) Solar manufacturers and dealers	System installation and maintenance information	No	Yes
(2) Solar manufacturers and dealers	System design and performance information	No	Yes
(3) Solar manufacturers and dealers	Lists of qualified installers and maintainers	No	Yes
(4) Mechanical engineers	System design and performance information	No	Yes
(5) Federal system integration agencies	System design and performance information	No	Yes
(6) Federal system integration agencies	System installation and maintenance information	No	Yes
(7) Solar manufacturers and dealers	Lists of qualified installers and maintainers	No	Yes
(8) Mechanical engineers	System installation and maintenance information	No	Yes

TABLE IV-7 (Concluded)

THE MOST IMPORTANT INFORMATION NEEDS OF PARTICIPANT GROUPS, RANKED IN TERMS OF TOTAL BENEFITS
(NEW AND RETROFIT COMMERCIAL BUILDINGS MARKET)

Participant Group	Solar-Specific Information Need	Are the Needs Adequately Met	Federal STT Assistance Necessary
(9) Solar manufacturers and dealers	Lists of qualified designers	No	Yes
(10) Federal system integration agencies	Lists of qualified installers and maintainers	No	Yes
(11) Federal system integration agencies	Lists of qualified designers	No	Yes
(12) Mechanical contractors	System installation and maintenance information	No	Yes
(13) Mechanical engineers	System cost information	Yes	
(14) Federal system integration agencies	Economic viability information	No	Yes
(15) Federal system integration agencies	Demonstration program results	No	Yes

SOURCE: MITRE EIP Model

TABLE IV-8

THE MOST IMPORTANT INFORMATION NEEDS OF PARTICIPANT GROUPS, RANKED IN TERMS OF TOTAL BENEFITS
(AGRICULTURAL PROCESS HEAT MARKETS: RATIONAL AND TRADITIONAL FARMS)

Participant Group		Solar-Specific Information Need	Are the Needs Adequately Met	Federal STT Assistance Necessary
(1)	Solar manufacturers	System design and performance information	No	Yes
(2)	Solar manufacturers	System installation and maintenance information	No	Yes
(3)	Solar APH equipment dealers	Lists of qualified installers and maintainers	No	Yes
(4)	Solar manufacturers	Lists of qualified installers and maintainers	No	Yes
(5)	Solar APH equipment dealers	System installation and maintenance information	No	Yes
(6)	Solar APH equipment dealers	System design and performance information	No	Yes
(7)	Solar manufacturers	Market potential information	No	Yes
(8)	Federal system integration agencies	System design and performance information	No	Yes

TABLE IV-8 (Concluded)

THE MOST IMPORTANT INFORMATION NEEDS OF PARTICIPANT GROUPS, RANKED IN TERMS OF TOTAL BENEFITS
(AGRICULTURAL PROCESS HEAT MARKETS: RATIONAL AND TRADITIONAL FARMS)

Participant Group	Solar-Specific Information Need	Are the Needs Adequately Met	Federal STT Assistance Necessary
(9) Federal system integration agencies	System installation and maintenance information	No	Yes
(10) Federal system integration agencies	Lists of qualified installers and maintainers	No	Yes
(11) Solar APH equipment dealers	Sources for financing	Yes	
(12) Federal system integration agencies	Tax incentives	Yes	
(13) Federal system integration agencies	Economic viability information	No	Yes
(14) Solar APH equipment dealers	Tax incentives	Yes	
(15) State and local government agencies	Economic viability information	No	Yes

SOURCE: MITRE SIF Model

TABLE IV-9

EQUIPMENT DECISION MAKERS IN SOLAR MARKETS

- (1) New One and Two Family Homes Market (Custom Construction)
 - Home Buyer
 - Architect
 - Mortgage Lender
 - Construction Financier
- (2) New One and Two Family Homes Market (Speculative and Tract Construction)
 - Housing Developer
 - Mortgage Lender
 - Mechanical Engineer
 - Construction Financier
 - Mechanical Contractor
- (3) New Mobile Homes Market
 - Mobile Home Manufacturer
- (4) One and Two Family Homes Retrofit Market (Including Mobile Homes)
 - Homeowner
 - Mechanical Contractor
 - Financier
- (5) New and Retrofit Commercial Buildings Markets
 - Developer or Building Owner
 - Architect
 - Mechanical Engineer
 - Mechanical Contractor
 - Mortgage Lender
 - Construction Financier
- (6) Agricultural Process Heat Markets (Rational and Traditional Farms Markets)
 - Farmer
 - APH Equipment Dealer
 - Financier
 - A&E Firm (In the Case of Large, Complex Projects)
 - Mechanical Contractor (In the Case of Large Projects)

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