SOLAR HEATING AND COOLING
TECHNICAL DATA AND SYSTEMS ANALYSIS

PROGRESS REPORT

CONTRACT NAS8-31293

Submitted to
National Aeronautics & Space Administration
Marshall Space Flight Center, Alabama

(Summary for Period September 1975 - June 1976)

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ABSTRACT

The research activities described herein were accomplished by The University of Alabama in Huntsville as Task I under Contract NAS8-31293 for the Marshall Space Flight Center (MSFC), National Aeronautics and Space Administration (NASA).

These research activities were applied to Task I of the contract during the period, September 1975 - June 1976, and consisted of continuing the acquisition and processing of selected parametric data for inclusion in a computerized Data Base using the Marshall Information Retrieval and Data System (MIRADS) developed by NASA-MSFC. This Data Base provides extensive technical and socioeconomic information related to solar energy heating and cooling on a national scale. A broadly based research approach has been used to assist in the support of program management and the application of a cost-effective program for solar energy development and demonstration.
ACKNOWLEDGEMENTS

This report has been prepared by a solar energy research team of the Center for Environmental and Energy Studies (CEES), The University of Alabama in Huntsville, as a summary of progress under NASA Contract NAS8-31923. David L. Christensen, Research Associate, is the Principal Investigator of the overall research study. Ronald Rubery is the UAH Task Team Leader for the efforts described in this report. Other major contributors to the project and to this report are:

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The University of Alabama in Huntsville also wishes to acknowledge the assistance and valuable contributions made by numerous other individuals of NASA-MSFC and to express thanks for the cooperation of various government agencies, industries, universities, technical societies, and other professional organizations.
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I. INTRODUCTION AND BACKGROUND

Since the initial award of NASA Contract NAS8-31293 to The University of Alabama in Huntsville in October 1974 for the performance of "Solar Heating and Cooling Technical Data and Systems Analysis", the basic research activities (as outlined in the September 1975 Progress Report) have developed into an extensive data research and collection activity. Basic UAH research efforts have primarily concentrated on the areas of architectural design, materials characteristics, climatic conditions, economics, and heating and cooling systems and emphasize the collection, processing, and submission of data to expand the computerized data base required for systems analysis support of the MSFC systems development role in the National Solar Heating and Cooling Demonstration Program.

The MSFC Data Base has an extensive capability to be expanded to include data for any type of energy consideration and is intended to permit rapid retrieval of technical and socioeconomic data in formats that are accessible by remote terminals through interactive operations. This comprehensive computerized National Solar Energy Base which MSFC is developing for the Energy Research and Development Administration (ERDA) incorporates vast statistical data on such diverse items as weather trends, population, equipment test data, facility description parameters, operational data from national solar heating and cooling demonstration sites, utility rates, construction and urbanization trends, and prices and price indices.

Supporting the data research and gathering requirements for this Data Base has been the focal point of UAH contract activities on NAS8-31293 since May 1, 1975. The total contract value for this period of October 1974 through June 1976, has been $156,444. Of this total, some $79,000 has been used for development of the Data Base under Task I.

This report covers the extension and expansion of the scope of work for Task I for the period of performance from September 1, 1975 through June 30, 1976. Separate Progress Reports describe the UAH activities for other tasks performed on NAS8-31293. These other tasks include documentation of solar energy activities which provides management and educational materials related to national solar energy heating and cooling programs, surveys and catalogs of solar radiation measuring equipment, and evaluations of nationwide locations for solar radiation data stations. Close liaison and consultation with solar energy experts and professional organizations involved with solar energy activities have likewise been accomplished under this contract.

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II. CURRENT CONTRACT ACTIVITIES

Data describing climatic conditions; architectural details of homes, office buildings and manufacturing buildings; heating and cooling systems and components including cost and performance parameters; and energy availability and related costs are required for conducting system analyses of solar heating and cooling applications. This type of data is necessary as primary input parameters for computer programs which allow analyses of application and site requirements, performance criteria, research and development needs, and economic comparisons related to solar heating and cooling systems to determine their marketability.

The following work statements, covering a period of performance from September 1, 1975 through June 30, 1976, were added to NASA Contract NAS8-31293 by amendments and this work is now being performed by The University of Alabama in Huntsville:

1. Continue the gathering of solar radiation and surface weather data from the National Weather Service (NWS); continue the effort of collecting climatological data and maintain the MSFC/UAH awareness and participation in climatological data gathering projects for solar analysis use; provide updates as they become available, to the initial list of solar radiation data sources.

2. Continue to seek authoritative and centralized sources of representative building associations who can provide blueprints and catalogs; maintain the search, collection and sorting of useful books, documents, publications, etc. necessary to the task (i.e. listing recognized associations involved with building materials); continue to evaluate and provide new source documents containing the physical properties and costs of materials.

3. Continue the compilation of source lists of government documents available throughout the various government depository systems to be utilized within the program; continue the effort being provided to maintain the bibliography card file for the Statistical Abstract source material; continue the Statistical Abstract evaluation as directed by the MSFC Technical Monitor; continue to update and complete, as necessary, the computerized data format sheets and submit them to the MSFC Technical Monitor.

4. Continue to search for additional information involving the characteristics and performance of heating and cooling equipment and provide the information to the Technical Monitor as it becomes available; maintain continuous updates to the source lists of heating and cooling manufacturers. This information will continue to be forwarded to the Technical Monitor as it becomes available through the contract period of performance;
utilize the results of the Program Opportunity Announcement of ERDA and other data to develop a cataloging of standardized descriptions and data on solar systems and components; continue the collection and cataloging of available data through the use of the ARI Index of Manufacturers.

Detailed formats previously developed through the combined efforts of MSFC and UAH personnel are being used to insure flexibility and effectiveness in the final analyses. Each of the task areas (climate, equipment, architecture, economics) are discussed in detail in the following sections of this report, and activities to date are included. All responsible task team members have been completing these format sheets with as much data as is available within the designated data categories.
SUB-TASK OBJECTIVES

To collect atmospheric, solar radiation and environmental data and organize it for use in simulations and evaluations of solar energy in various forms.

APPROACH

Review available sources and determine the availability and present format of atmospheric observational data. Determine specific locations and regions of primary interest and establish priorities.

ACTIVITIES AND PROGRESS

Telephone conversations with Mr. Vince Haggerty of the National Climatic Center (NCC), Asheville, North Carolina, determined that weather data tapes are now available for about $60 to $75 per reel. One reel contains 10 years of hourly surface records for any years before 1965 and 3-hourly records for years subsequent to 1965. The surface weather data must be re-formatted for the MSFC computer programs as it is better to select only that surface data which matches the solar radiation data of present interest.

As the result of a sample survey to locate new sources of solar radiation and hourly surface data, a draft copy of a preliminary solar radiation source document was initiated, primarily due to the amount of interest generated through the survey efforts. The draft copy of the "Initial Report on the Availability of Solar Radiation Data" document describes the need for solar radiation data having stricter controls on maintenance of equipment and recording procedures. As it takes several years before the new data reaches sufficient quantity to apply to solar energy projects, it is desirable to locate these alternate sources of solar radiation data as soon as possible.

The preliminary report was prepared with the cooperation of the National Weather Service and other organizations and provides locations which have recorded and collected solar radiation data, which may be applicable to present and planned solar energy projects. The data itself has not been collected nor evaluated. An address list of organizations who participated in this survey is included in the preliminary report.

The following electronic tape data were acquired by UAH during the report period:

1. Five reels of daily solar radiation, BCD, 800 BPI, format 280. This completes the entire availability of solar radiation data collected for the periods under analyses.

2. Three reels of surface weather data and seven reels of solar radiation data were delivered to the Technical Monitor during this period that were originally ordered prior to this report period.
Sixty-four reels of hourly surface data in format 1440, BCD, even parity, 7 track, 800 BPI; encompassing 27 different weather stations.

As a further aid to support the MSFC climatological studies, CEES collected various sets of documents from the NCC at Asheville, North Carolina, including:

1. "Monthly Norms of Temperature, Precipitation, and Heating and Cooling Degree Days 1941-70".

2. "Monthly Averages of Temperature and Precipitation for State Climatic Divisions 1941-70".

The climatological normals and averages presented in these documents are based on records for the 30-year period 1941-70, inclusive. Data are assembled by individual states.
ARCHITECTURAL DATA - SUB-TASK 2

SUB-TASK OBJECTIVES

Acquire architectural data sufficient to describe typical buildings, including residential, commercial, public and manufacturing facilities.

APPROACH

Since completion of the formats for describing architectural data for any building, research efforts have concentrated on locating suppliers of residential and commercial blueprints, such as known architects affiliated with the AIA and motel/hotel corporations willing to loan blueprints, for analyses and adaptability to solar heating and cooling systems. This effort has expanded into contacting such agencies as HUD and professional associations to acquire various data such as minimum housing standards, standardized building cost data (i.e. labor rates, materials cost, etc.).

ACTIVITIES AND PROGRESS

A supplier of blueprints for "standard" home construction has been utilized to assist in the home construction analyses. This firm has, as one of its functions, the capability of providing blueprints of typical homes that could be considered compatible for conversion to a solar heating and cooling system. Twelve different home designs have been acquired from the Homes for Living Corporation of New York, N. Y. These plans were useful except for the lack of schematics depicting the duct work for the heating and cooling system; however, through the assistance of the ASHRAE Manual J document for heating and cooling load calculations it is possible to design appropriate systems for the various home plans. Its utilization should produce a workable heating and cooling layout system for each of the 12 blueprints.

To assist the activity of identifying various standard construction costs and related construction parameters, the aid of the Robert Snow Means Construction Company which annually publishes the book, Construction Cost Data, was acquired.

The Department of Housing and Urban Development furnished several volumes of data related to minimum standards for the construction industry. The specific volumes being utilized are: HUD - Minimum Property Standards, (1973 editions), for care-type housing, one family, and two family dwellings. HUD is presently in the process of developing minimum standards that would be applicable to the application of solar heating and cooling systems to specific structures.

To assist in the problem of collecting specific construction data representative of a Standard Metropolitan Statistical Area (SMSA), formal communications were established with key city personnel for each SMSA, such as the City Building Permit Officer. These sources, along with the various professional and trade associations (see Attachment A) have proven very instrumental in the collection of the various site construction and other related architectural information.
In conjunction with the establishment of a file on trade and professional associations, a listing of related organizations has been developed. This listing has been approved by the Technical Monitor and is being retained on active file. It is being compiled into one master listing along with related classifications being investigated under the UAH research efforts.

In addition to the various home site blueprints, the UAH has been very successful in soliciting commercial blueprints of motel construction from Holiday Inns of America as well as Days Inns Incorporated. Analysis of these blueprints should aid in determining the feasibility of applying solar energy heating and cooling systems to structures of this type.
THERMAL LOADS DATA - SUB-TASK 3

SUB-TASK OBJECTIVES

Collect the thermal properties of various categories of materials to allow thermal analyses of residential or commercial buildings and associated equipment.

ACTIVITIES AND PROGRESS

Various references on building materials were collected. However, due to the variation of sources, no single reference has all the information necessary to meet data entry requirements. Small portions of the required data may be found in each reference. Also, most of the existing physical property data are given in a range of values since the intended usage of the various materials is quite diversified.

Due to the variation of properties cited in the materials source files and references, two alternative approaches were suggested: Collect all building materials nomenclature and cost data from "The Building Construction Cost Data, 1976", and similar sources and use them for a "baseline materials source list". Then combine the individual properties of each material from other references and add these to the nomenclature and cost data list. Once this total listing has been developed, it will only be necessary to update and improve the baseline materials data base as new sources of better information are acquired.

An alternative suggestion was to obtain the names of existing building material suppliers from the "National Association of Building Manufacturers" or similar organizations and mail directly to these organizations a material survey type questionnaire requesting their assistance for entering data. Once this data has been collected, it would be necessary to organize the information under major categories, reorganize and edit as needed, and load this data into the computer.
HEATING AND COOLING EQUIPMENT - SUB-TASK 4

SUB-TASK OBJECTIVES

Continue in the acquisition of data on conventional and solar heating and cooling systems, subsystems, and components sufficient for performance evaluation.

APPROACH

Continue to survey manufacturers' literature and handbooks, ASHRAE data books, manufacturer computer programs, and governmental and industrial studies and surveys for pertinent data. Develop composite listing of sources and contacts for gathering additional data.

ACTIVITIES AND PROGRESS

Conventional Equipment

The Air Conditioning and Refrigeration Institute (ARI) Index to Manufacturers, a representation of sixty-one firms supplying HVAC equipment on the U.S. market, is presently being utilized in the research efforts.

All of the firms in the report were contacted by telephone or by formal letter requesting specific data on product line and related prices. In addition, the Thomas Register and the 1975 Plant Engineering Directory and Specifications Catalogue were utilized to obtain data on additional manufacturers which market HVAC equipment.

Over 140 data packages on conventional heating and cooling manufacturers have been submitted.

Contacts have been made with the U.S. Department of Commerce in Washington, D.C. as well as affiliated offices in Birmingham, Alabama, resulting in the receipt of the 1973 and 1974 statistical reports on sales of Air Conditioning and Refrigeration Equipment and warm air furnaces. This data was useful in determining priorities of work based on the significance of equipment sales.

Solar Equipment

The equipment research team assembled data sources for solar collector manufacturers and supplies of components (coatings, plating, paint, glaze absorbers, storage, etc.). This list is continuously refined and purged of errors and duplications.

The files now contain approximately 120 manufacturers of solar collectors. Technical data on about one-half of these are available and have been transferred to the Technical Monitor for review. The flow of data has been on a constant basis and as it becomes available, it is incorporated into the files. Attachment B represents additional information concerning manufacturers, experimenters and sales outlets for solar energy collectors that was gathered and organized during the contract period. This information is continuously reviewed and submitted on data format input sheets.
CONCLUSION

As new information is received on conventional and solar heating and cooling manufacturers and their products, it has been processed and entered into the data base.

Efforts have also been made to establish a more reliable standard for solar collector data points from which to state efficiency, output, etc. It is anticipated that at some point, such data will be standardized to aid in making comparisons between the various subsystems.

Product information related to solar heating and cooling systems, subsystems, and components has been inventoried, catalogued, and delivered in three volumes to the MSFC Technical Monitor. Also, some 167 systems installations have been identified to date, ranging from residential to heavy commercial and process applications. Many of these are privately funded programs but could provide data of interest to the National Demonstration Program (such as solar radiation data taken at new sites).

A major effort was completed to purge and re-enter all known vendors involved with the manufacture or study of solar and conventional heating and cooling equipment, including a total update of the manufacturers' survey. The task team is also purging the Standard Change Integration Tracking (SCIT) listings (used by the Solar Heating and Cooling Team of NASA-MSFC) and incorporating only selected manufacturers from it into the Manufacturers Survey. This documentation effort should be representative of all available vendors involved with the research, development, manufacturing, and sales aspects of conventional as well as solar heating and cooling equipment.
SUB-TASK OBJECTIVES

Continuation of efforts as outlined in the September 1975 report but with more emphasis on the acquisition of detailed data within the specific geographic and economic areas that will enhance the analyses of economic influences affecting the overall solar heating and cooling technical data and system analyses.

APPROACH

Investigate and acquire new sources and data to be utilized in the overall project.

ACTIVITIES AND PROGRESS

Most of the activity within the Economics section has been devoted to completing the large number of format sheets developed for related subjects, such as economics, fuel rates, construction costs, etc. However, as deemed necessary by the MSFC Technical Monitor, this section has investigated new areas of interest. As a result, the activities and progress achieved under Economics has been divided into the following activities: economics as related to the statistical abstracts, energy, REmote CONsole (RECON), data insurance, library research, and bibliography.

Economics

A large number of data format sheets (some 2,500) based on the Statistical Abstract of the United States were completed and delivered to the Technical Monitor. The areas covered by these sheets include:

1. Population
2. Vital Statistics
3. Education
4. Geography and Environment
5. Finances and Employment
7. Income, Expenditures and Wealth
8. Prices
9. Transportation and Agriculture
10. Mining and Mineral Products
11. Distribution and Services
12. Energy
13. Construction and Housing

Some sheets in the following areas have been completed for all of the Statistical Abstracts (1950-1975):

1. Prices
2. Mining and Mineral Products
3. Distribution and Services
4. Energy
5. Construction and Housing
The two most recent abstracts, 1974 and 1975, have been completed in their entirety as related to the format data sheets.

Data sheets have also been provided that are based on Federal Power Commission News Release Bulletins and three Census Bureau series that deal with manufacturers.

Energy

Format sheets for recording data related to energy were also provided in support of the data recording activity.

In order to obtain samples of various energy company rates, demand schedules, etc., data was collected by soliciting selected energy supplying companies within the ten (10) selected SMSA's. The task team obtained considerable assistance from the Federal Power Commission (FPC) in this effort. The FPC publishes documents on each state that identifies consolidated energy company rates as related to the various counties within each state. Due to the completeness of these publications, the design and entry of data into the format sheets was simplified.

Some 1,406 packets of electrical energy format sheets have been completed. This completes this particular effort and includes all the states except Alaska and Hawaii.

Due to the effort required to transfer the electrical energy data from the publications to the appropriate computer format, limited effort has been placed on searching out additional data related to the other energy sources. However, an attempt has been initiated to contact 45 different companies from the ten (10) major SMSA's requesting coal, butane, and propane cost data. Some of the requests resulted in favorable responses and this data is being held in reserve in the hope that a better and more centralized source of data can be located.

The FPC provides some assistance through their publication, Federal Power Commission News Release Bulletins. These bulletins provide fuel, cost and quality data in such areas as: coal deliveries at steam-electric plants; coal purchases for steam-electric plants; deliveries by sulfur content of coal at steam-electric plants; fuel oil deliveries at steam-electric plants and for combustion turbine and internal combustion units; fuel oil purchases for steam-electric plants; gas deliveries at steam-electric plants and for combustion turbine and internal combustion units; gas purchases for steam-electric plants.

REmote CONsole (RECON) Data Search

As an aid in the search for data related to the various disciplines necessary for overall project analyses, various UAH team members have been trained to use the MSFC RECON data search system. This system provides a means to search for data under various topics (i.e. construction, population, demography, economic development, etc.).
If a topic search results in a favorable response, the particular document listings of interest are then requested from the NASA data bank. Once UAH is in receipt of the listing, it is reviewed in more depth to determine if any of the subject matter should be pursued further. The following list represents various topics that have been investigated by the UAH task team for submittal to MSFC and as such have been requested from the data bank for further analyses:

1. Architecture
2. Buildings
3. Ceilings
4. Comprehensive Strength
5. Materials Conductivity
6. Construction Materials
7. Elastic Properties
8. Materials Flexibility
9. Floors
10. Inflatable Structures
11. Roofs
12. Shelters
13. Solar Furnaces
14. Walls

These fourteen different topical bibliographies were reviewed and summaries of the relevant articles were written by the economics task team. The articles include the following:

1. The Utilization of Solar Energy to Help Meet Our Nation's Energy Needs
2. Proceedings of the Solar Heating and Cooling for Building Workshop
4. Domestic Solar Energy Systems for Delaware
5. Systems Analyses of Solar Energy Programs. Appendix: Research Tasks
7. Fuel Energy and the Steel Industry, A Bibliography
13. Future U. S. Demand Patterns and the Use of Hydrogen
17. Solar Heating and Cooling of Buildings, Phase O. Feasibility and Planning Study
An additional 33 topics were searched and found to be irrelevant.

**Insurance**

The economics section has also attempted to locate various data on insurance rates applicable to both homeowners and owners of businesses. A random sample of insurance books in the UAH Library revealed that the books that are available are primarily textbooks.

Contact was then made with the Insurance Information Institute in New York City. It was determined that the data in question is not available on a nation-wide basis; however, their publication, *Insurance Facts*, provides a list of all insurance commissioners for the various states. Contact was made with the commissioners of Georgia and Washington State. As a result, the task team acquired consumer information that is prepared for specific communities. By examination, it was determined that this is the type of information of interest and arrangements are being made to contact the other 48 commissioners in order to obtain similar publications.

**Library Research**

The economics section has put a great deal of effort into establishing a good working relationship with the various libraries in the area in order to assist in the data collection effort.

The UAH Library has been very helpful within its limits and has made available over 500 government documents. The categories and specific numbers of these documents are listed in Attachment C. The Alabama A&M Library also permitted the use of 32 documents. Inter-library loans have been arranged with both the Auburn University and University of Alabama, Tuscaloosa, Libraries for documents that UAH, Alabama, A&M, and the Redstone Scientific Information Center (RSIC) were unable to provide. The task team also prepared lists of the documents requested from the 10 monthly GPO catalogues, 1975, and delivered them to MSFC. These lists represent all government documents selected from the 10 different catalogues (Attachment D) and indicates the comprehensive nature of the MSFC Data Base.
The libraries have also been very helpful in allowing the task team to check out research books. A listing by subject of the various books that have been used is enclosed (Attachment E).

Working Bibliography

The Economics Section maintains an up to date card catalogue on all sources of data used throughout this project by all team members. The subject headings used for maintaining documentation control are listed below:

| Accounting     | Housing                        |
| Architectural  | Insurance                      |
| Catalog        | Materials                      |
| Concrete       | Measurement                    |
| Construction   | Metals                         |
| Economics      | Metric System                  |
| Electricity    | Solar Energy                   |
| Energy         | Statistics                     |
| Energy Growth  | Wind                           |
| Gas            |                                |

Other Activities

Complete proceedings from the 1975 International Solar Energy Congress and Exposition have been loaned to UAH from Wyle Laboratories of Huntsville and are being reviewed by MSFC. The volumes and related subjects are:

1. Series 10
   A. Economic and Social Aspects
   B. Developing Countries
   C. General Papers

2. Series 20
   A. Solar Radiation, Photovoltaic, Photo Chemical, Photobiological Processes
   B. Solar Furnaces

3. Series 30
   A. Materials Flat Plate Collectors Energy Storage

4. Series 40
   A. Solar Heating and Cooling of Buildings
   B. Drying and Distillation

5. Series 50
   A. Focusing Collectors
   B. Solar Thermal Power
In addition, efforts are being made to provide pictorial and graphic data to enhance the visual output capability of the computerized Data Base. Pictorial materials are being developed under other related tasks of this contract which can possibly be utilized.

Also, members of the UAH research team participated directly in the National Solar Energy Workshop held in Huntsville, Alabama in May, 1976. At this workshop, the computerized Data Base was demonstrated by MSFC to key energy officials of participating states and various agencies of the Federal Government. A remote terminal was installed for interactive operations during the three day workshop.
Contract funding for Task I covering the period of performance from September through 30 June amounted to $78,384.
ATTACHMENT A

ASSOCIATIONS AND ORGANIZATIONS

This attachment provides an organized listing of the associations and organizations that have provided specific and general data as well as those who are available to assist in providing additional research data for supporting the various tasks.

ARCHITECTURAL

1. American Institute of Architects
2. American Institute of Building Design
3. Engineers Council for Professional Development (ECPD)

CONSTRUCTION

1. American Building Contractors Association
2. American Society of Testing and Materials
3. The Association of General Contractors of Boston
4. Better Business Bureau of Boston
5. Edward G. Scharf & Son
6. Homes for Living
7. H.U.D. Alabama Area Office
10. Import Hardwood Products Associations
11. International Conference of Building Officials
12. International Masonry Institute
13. National Association of Building Manufacturers
15. National Building Materials Distribution Association
17. National Housing Center
18. Pettey Associates
20. Underwriters' Laboratory

DISTRIBUTION & SERVICES

1. Better Business Bureau of Boston
2. Better Business Bureau of Huntsville
EN ENERGY
1. Federal Power Commission - Mr. Charles Moscarella
2. Federal Power Commission - Mr. William Webb
3. Gas Operations Advisory Committee - New York State
4. International Solar Energy Society
5. Tennessee Valley Authority
6. American Gas Association

EQUPMENT
1. Air Conditioning and Refrigeration Institute
2. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
3. Association of Home Appliance Manufacturers
4. Refrigeration Engineers and Technicians Association
5. Underwriters' Laboratory

HOUSING
1. American Building Contractors Association
2. Homes for Living
3. H.U.D. Alabama Area Office
6. National Association of Building Manufacturers
8. National Housing Center
9. Pettey Associates
10. U.S. Dept. of Commerce Bureau of the Census

INSURANCE
1. Insurance Information Institute
2. Health, Education and Welfare - Office of Consumer Information
3. National Association of Insurance Commissioners

LIBRARY
1. Alabama A&M Library
2. Auburn University
3. MSFC Technical Library
4. Redstone Scientific Information Center (RSIC)
5. UAH Library
MATERIALS

1. American Society of Testing and Materials
2. Association of Scientific Information Dissemination Center (ASIDIC)
3. Underwriters' Laboratory

POPULATION

1. U.S. Department of Commerce
ATTACHMENT B

PRELIMINARY LISTING
OF
SOLAR ENERGY COLLECTORS
(MANUFACTURERS, EXPERIMENTERS AND SALES OUTLETS)

The following listing of manufacturers, experimenters and sales outlets for solar energy collectors was developed by The University of Alabama in Huntsville in support of NASA Contract NAS8-31293 to perform solar heating and cooling technical data and systems analysis. Material is being gathered for a computerized data base which includes climatic conditions and topographical features of various sites; economic factors from all sections of the nation, including fuel and energy costs; architectural techniques, properties of construction materials; and selected parameters for both conventional and solar energy heating and cooling equipment.

Neither the UAH, NASA, ERDA, nor any other agency of U. S. Government or the State of Alabama can assume any responsibility for the accuracy of any statement in this listing. It is provided for informational purposes only. Anyone interested in further information is expected to communicate directly with the contact designated in the listing. Telephone numbers are provided where possible.

The codings (see asterisks*) describe the status of available brochures and technical data sheets that have been gathered and provided to MSFC for entry into the computerized Technical Data Base to be used for systems analysis and development.

CODE:  * Brochures on Hand
      ** Data Sheet on Hand
      *** Brochures and Data Sheet on Hand
SOLAR ENERGY COLLECTORS—MANUFACTURERS, EXPERIMENTERS AND SALES OUTLETS

1. **AAI Corporation**
P.O. Box 6767
Baltimore, MD 21204
Attn: I.R. Barr
(301) 666-1400

**2. Alpha Designs, Inc.**
1014 Vine St., Suite 2230
Kroger Building
Cincinnati, OH 45202
Attn: Miroslav Uroshevich
(513) 621-1243

*3. **Aluminum Company of America**
1501 Alcoa Building
Pittsburgh, PA 15219
Attn: William F. Lewis
(412) 553-2748

***4. **Ametek**
One Spring Avenue
Hatfield, PA 19440
Attn: John Bowen, Manager
(215) 248-4600

***5. **Aquasolar, Inc.**
1234 Zacchini Avenue
Sarasota, FL 33577
(813) 366-7080

***6. **Arizona Solar Enterprises**
6719 E. Holly St.
Scottsdale, AZ 85257
Attn: Mr. Walters
(602) 945-0512

7. **Beutel’s Solar Heater Co.**
1527 N. Miami Ave.
Miami, FL 33136
Attn: Orvar Lindstrom
(305) 371-1426

8. **Brown Manufacturing Co.**
P.O. Box 14546
Oklahoma City, OK 73114
Attn: Russell Brown, President
(405) 751-1323

***9. **Burke Rubber Company**
2250 S. 10th St.
San Jose, CA 95112
Attn: Larry Schader
(408) 297-3500

***10. **Chamberlain**
845 Larch Ave.
Elmhurst, IL 60126
(312) 279-3600

11. **Coleman Solar Service**
8900 NW 34th Ave.
Miami, FL 33136
Attn: Mr. Gay
(305) 233-1999

***12. **Corning Glass Works**
Houghton Park C7
Corning, NY 14830
Attn: Jim Murry, Manager,
    Special Projects
(607) 972-9000

*13. **CSI**
Solar Systems Division
12400 49th St., N
Clearwater, FL 33520
Attn: L.H. Sallen, President
(813) 577-4489

***14. **D & J Sheet Metal Company**
10055 NW 7th Ave.
Miami, FL 33150
Attn: Jake Sticher
(305) 757-7033

***15. **Daystar**
41 Second Ave.
Burlington, MA 01803
Attn: Clifton Smith, V. P. Marketing
(617) 272-8460
16. Dome East Corporation  
325 Duffy Avenue  
Hicksville, NY 11801  
Attn: Jeff Thomas  
(516) 938-0545  

17. Dynatherm Corporation  
Marble Court off Industry Lane  
Cockeysville, MD 21030  
Attn: A. Streb, V.P. Marketing  
(301) 666-9151  

18. E & K Service Company  
16824 74th Avenue, NE  
Bothell, WA 98011  
Attn: James Ebanks  
(206) 486-6660  

19. Ecotechnology  
234 Barbara Ave.  
Solana Beach, CA 92075  
Attn: Daryl Pettus  
(714) 755-8361  

20. Edwards Engineering Corporation  
101 Alexander Ave.  
Pompton Plains, NJ 07444  
Attn: James Campbell  
(201) 835-2808  

21. Emerson Electric Company  
8100 W. Florissant St.  
St. Louis, MO 63136  
Attn: William Nusbaum, V. President  
(314) 553-2000  

22. Energex Corporation  
5515 Industrial Road, Suite 513  
Las Vegas, NV 89118  
(702) 736-2994  

327 W. Vermijo  
Colorado Springs, CO 80903  
Attn: Peter O. Wood, President  
(303) 475-0332  

24. Energy Converters, Inc.  
2501 N. Orchard Knobb Ave.  
Chattanooga, TN 37406  
Attn: Mr. Rhodes  
(404) 875-2503  

25. Energy Design Associate, Inc.  
3003 19th Dr., NE  
Gainesville, FL 32601  
Attn: Richard Rodgers  
Director of Research  
(904) 377-7883  

634 Crest Drive  
El Cajon, CA 92021  
Attn: C.L. Caster  
(714) 440-4646  

27. Environmental Energies, Inc.  
21243 Grand River  
Detroit, MI 48219  
Attn: B. O'Shea, President  
(313) 533-1985  

28. FAFCO, Inc.  
138 Jefferson Drive  
Mental Park, CA 94025  
Attn: Freeman Ford  
(905) 321-6311  

29. FESCO  
Falbel Energy Systems Corporation  
472 Westover Road  
Stamford, CT 06902  
Attn: Gerald Falbel, President  
(203) 357-0626  

30. Fiberglass Engineering Company  
10223 Residency Road  
Manassas, VA 22110  
Attn: James D. Morris  
(703) 361-1200  

31. Fred Rice Production, Inc.  
SAV Solar Heater (New Zealand)  
6313 Peach Avenue  
Van Nuys, CA 91411  
Attn: Frederick Rice  
(213) 786-3860  

32. Free Heat  
P.O. Box 8934  
Boston, MA 02114  
Attn: Edward Kunz, President  
(617) 247-1769
33. Fun & Frolic, Inc.
P.O. Box 277
Madison Heights, MI 48071
Attn: Edward Konopka, President
(313) 399-1560

34. Future Systems, Inc.
12500 W. Cedar Road
Lakewood, CO 80228
Attn: Bill Thompson, Director of
Corporate Communications
(303) 989-0431

35. Garden Way Labs
P. O. Box 66
Charlotte, VT 05445
Attn: Dr. Douglas Taff, Director
(802) 425-2147

36. General Dynamics
2361 S. Jefferson Davis Highway
Suite 1112
Arlington, VA 22202
Attn: W. Ruhe
(202) 785-6500

37. General Electric
P.O. Box 8661
Room 8036
Building 8
Philadelphia, PA 19101
Attn: D. L. Kirkpatrick
(215) 962-4926

38. General Industries
2238 Moffett Drive
Fort Collins, CO 80521
Attn: John Hensley, General Manager
(303) 493-1688

39. Grumman Aerospace
Energy Program Plant 25
Bethpage, NY 11714
Attn: Don Stein, Commercial Sales
(516) 575-9186

40. Halmac Company
2414 Makiki Heights Drive
Honolulu, HI 96822
Attn: L. M. Judd, Jr., President
(808) 533-6464

41. Halstead Industries, Inc.
Halstead & Mitchell Div.
P.O. Box 1110
Scottsboro, AL 35768
Attn: Otto Nussbaum
(205) 259-1212

42. Helio-Dynamics, Inc.
518 S. Van Ness
Los Angeles, CA 90020
Attn: Truman Temple, President
(213) 384-9853

43. Hitachi Chemical Company
America, Limited
437 Madison Avenue
New York, NY 10022
Attn: H. Aburatani, Manager
(212) 838-4804

44. Hittman Associates, Inc.
9190 Red Branch Road
Columbia, MD 21045
Attn: Dr. Curran, Sr. Staff Consultant
(301) 730-7800

45. Honeywell, Inc.
Systems and Research Center
2600 Ridgeway Parkway
Minneapolis, MN 55413
Attn: Roger Schmidt, Manager
Solar Pilot Plant
(612) 378-4078

46. I.B.M.
Building 965-2
Department 725
Essex Junction, VT 05452
Attn: Dick Pratt, Staff Engineer
(802) 769-0111

47. Ilse Engineering Inc.
7177 Arrowhead Road
Duluth, MN 55811
Attn: Mr. John Ilse
(218) 729-6858

48. Illinois Institute of Technology
Institute of Gas Technology
3424 S. State Street
Chicago, IL 60616
Attn: Dr. Lavan, Associate Professor
Department of Mechanics
(312) 567-3189
49. International Environment Corporation  
129 Halsted Avenue  
Mamaroneck, NY 10543  
Attn: Richard Rothschild, President  
(914) 698-8130

Route 1, Box 319A  
Brandywine, MD 20614  
Attn: George Gaydos  
(301) 888-1267

51. International Solarthermics Corporation  
Box 397  
Nederland, CO 80466  
Attn: Bob Strickland, V. President of Administration  
(303) 258-3272

52. Intertechnology Corporation  
100 Main Street  
Warrenton, VA 22186  
Attn: Norris Beard, Director Marketing Operation  
(703) 347-7900

53. Itek Corporation  
Optical Systems Division  
10 Maguire Road  
Lexington, MA 02173  
Attn: Norm Groalick, Engineer  
(617) 276-2000

54. J & R Simmons Construction Co., Inc.  
2185 Sherwood Drive  
S. Daytona, FL 32019  
Attn: John Simmons, Vice President  
(904) 767-6367

55. Johnson Diversified, Inc.  
2340 Queen Ann Street  
Merrit Island, FL 32952  
Attn: Stan Johnson, President  
(302) 452-5545

56. Kalwall Corporation  
1111 Candia Road  
Manchester, NH 03105  
Attn: Keith Harrison, Vice President  
(603) 627-3861

57. KTA Corporation  
12300 Washington Avenue  
Rockville, MD 20852  
Attn: Dr. W. E. Tragert  
(301) 881-0047

58. McArthurs, Inc.  
P. O. Box 236  
Forest City, N.C. 28043  
Attn: W. N. McArthurs  
(704) 245-7223

59. Materials Consultants, Inc.  
2150 S. Josephine Street  
Denver, CO 80210  
Attn: Dr. J. D. Plunkett, President  
(303) 722-8258

60. Motorola, Inc.  
New Venture Dev.  
4039 E. Raymond Street  
Phoenix, AZ 85040  
Attn: Dr. I. Lesk, Manager of Solar Program  
(602) 244-5511

61. National Plastics, Inc.  
Lab Sciences Division  
604 Park Drive  
Boca Raton, FL 33432  
Attn: Joseph Cariseo, President  
(305) 392-0501

112 West 34th Street  
Suite 916  
New York, NY 10-01  
Attn: Louis Varon, President  
(212) 524-2474

63. Northrup, Inc.  
302 Nichols Drive  
P. O. Box 452  
Hutchins, TX. 75141  
Attn: Harold Hammer, Vice President of Marketing  
(214) 225-4291

64. Owens-Illinois  
P. O. Box 1035  
Toledo, OH 43666  
Attn: Richard E. Ford, Marketing Manager  
(419) 243-1015

65. P. R. Distributors  
1232 Zacchini Avenue  
Sarasota, FL 33577  
Attn: John Pickett, Owner  
(813) 958-5660
66. People/Space Company
259 Marlboro Street
Boston, MA 02116
Attn: Robert Shannon, Partner
(617) 261-2064

67. Phoenix of Colorado Springs, Inc.
P. O. Box 7246
Colorado Springs, CO 80933
Attn: Douglas Jardine, President
(303) 633-2633

68. Piper Hydro
2895 E. LaPalma
Anaheim, CA 92806
Attn: James Piper, President
(714) 630-4040

69. PPG Industries, Inc.
One Gateway Center
Pittsburgh, PA 15222
Attn: Neil M. Barker, Manager
(412) 434-3552

70. Powell Brothers, Inc.
5903 Firestone Blvd.
South Gate, CA 90280
Attn: Hayward Powell, Vice President
(213) 869-3307

71. R-M Products
5010 Cook Street
Denver, CO 80216
Attn: Donald P. Erickson
(303) 825-0203

72. Raypak, Inc.
3111 Agoura Road
Westlake Village, CA 91359
Attn: Mr. Boniface
(213) 889-1500

73. Refrigeration Research, Inc.
Solar Research Division
525 N. 5th Street
Brighton, MI 48116
Attn: Frank Rockwell, Chief Engineer
(313) 227-1151

74. Revere Copper and Brass, Inc.
Solar Energy Department
P. O. Box 151
Rome, NY 13440
Attn: William Heidrich, Manager
(315) 338-2401

75. Reynolds Metal Company
2315 Dominguez Street
Torrance, CA 90508
Attn: D. Louding, Plant Manager
(213) 328-7421

76. SES, Inc.
#1 Tralee
Industrial Park
Newark, DE 19711
(302) 731-0990

77. Shelly Radiant Ceiling Company
8110 North St. Louis Avenue
Skokie, IL 60076
Attn: William Shelley, President
(312) 675-8899

78. Shultz Field Enterprises Solar Utilities Company
11404 Sorrento Valley Road
Suite 112
San Diego, CA 92121
Attn: Jack Shultz, Owner

79. Skytherm Process & Engineering
2424 Wilshire Blvd.
Los Angeles, CA 90057
Attn: Harold Hay
(213) 389-2300

80. Sol-R-Tec, Inc.
The Trade Center
Hartford, VT 05047
Attn: John Deveres, Vice President
(802) 295-9343

81. Sol-Therm Corporation
7 W. 14th Street
New York, NY 10011
Attn: I Sittenfeld
(212) 691-4623

82. Solar Corporation
9620 Royalton Drive
Veberly Hills, CA 90210
Attn: Hal Meier, President
(213) 276-0372
83. Solar Applications, Inc.  
2200 E. Washington Street  
Phoenix, AZ 85034  
Attn: Robert E. Hopp, Vice President  
(602) 244-1822

84. Solar Development, Inc.  
4180 Westroads Drive  
West Palm Beach, FL 33407  
(305) 842-8935

85. Solar Dynamics, Inc.  
4527 E. 11th Avenue  
Hialeah, FL 33013  
Attn: Mr. Chester, Vice President  
(305) 688-4393

86. Solar Energy Company  
P.O. Box 69-B  
Norland Branch  
Miami, FL 33169  
Attn: Mr. Balmer  
(305) 233-0711

87. Solar Energy Components, Inc.  
1605 Cocoa Blvd.  
Cocoa, FL 32922  
Attn: Walter Autry, President  
(305) 632-2880

88. Solar Energy Development, Inc.  
1437 Alameda Avenue  
Lakewood, OH 44107  
Attn: Nicholas Macron, President  
(216) 221-3500

89. Solar Energy Digest  
Equipment Division  
P.O. Box 17776  
San Diego, CA 92117  
Attn: Bill Edmondson, Owner  
(714) 277-2960

90. Solar Energy Products Company  
121 Miller Road  
Avonlake, OH 44012  
Attn: Frank Rom, President  
(216) 933-5000

91. Solar Energy Research Corporation  
1228 15th Street  
Denver, CO 80202  
Attn: James Wiengard, President  
(303) 573-5499

92. Solar Energy Systems  
1243 South Florida Avenue  
Rockledge, FL 32955  
Attn: Roy C. Mealee, President  
(305) 632-6251

93. Solar Equipment Corporation  
P.O. Box 327  
Edison, NJ 08817  
Attn: John Cotsworth, President  
(201) 549-3800

94. Solar Physical Corporation  
1350 Hill Street  
El Cajon, CA 92020  
Attn: Jack Hedger, President  
(714) 440-1625

95. Solar Utilities Company  
11404 Sorrento Valley Road Suite 112  
San Diego, CA 92121  
Attn: Jack Schultz (Owner)  
(714) 452-8822

96. Solar Water Heater Company  
P. O. Box 341872  
Coral Gables, FL 33155  
Attn: W. V. Morrow, President  
(305) 221-4611

97. SOLARCOA  
P. O. Box 15358  
Long Beach, CA 90815  
Attn: Mr. A. L. Ottum

98. Solaron Corp.  
4850 Olive Street  
Commerce City, CO 80022  
(303) 289-2268

1802 Dennis Dr.  
Tyler, TX 75701  
Attn: Mr. Jim Eftes, Owner  
(214) 592-5343

100. Solarway  
P.O. Box 217  
Redwood Valley, CA 95470  
Attn: Ben Piraino, General Manager  
(707) 485-7616
101. Solergy, Inc.
150 Green Street
San Francisco, CA 94111
Attn: Ronald Smith, President
(415) 398-6813

102. Southwestern Systems, Inc.
P. O. Box 5508
Yuma, AZ 85364
Attn: William S. Mitchell
(602) 782-9174

103. Stampco, Inc.
4549 St. Augustine Road
Building #13
Jacksonville, FL 32207
Attn: R. C. Decker
(904) 737-6144

104. Steelcraft Corporation
Environmental Design Division
P. O. Box 12408
Memphis, TN 38112
Attn: Gary Ford, Vice President
(901) 452-5200

105. Stolle Corporation
1501 Michigan Street
Sidney, OH 45365
Attn: E. G. Beck, Vice President
(513) 492-1111

106. Suhay Enterprises
2112 W. Oak
Burbank, CA 91506
Attn: Frank L. Suhay
(213) 846-6245

107. Sun Stove
Solar Energy Equipment
Division of Sun Unlimited Research Corporation
P. O. Box 941
Sheboygan, WI 53081
(414) 452-8194

108. Sun Systems, Inc.
P. O. Box 155
Eureka, IL 61530
Attn: Dr. Y. B. Safdari, President
(309) 467-3632

109. The Sundu Company
3319 Keys Lane
Anaheim, CA 92804
(714) 828-2873

110. Sunearth, Inc.
Box 99
Milford Square, PA 18935
Attn: Howard S. Katz, President
(215) 536-8555

111. Sunsav, Inc.
250 Canal Street
Lawrence, MA 01840
Attn: Peter Ottmar, President
(617) 686-8040

112. Sunsource
9570 West Pico Blvd.
Los Angeles, CA 90035
(213) 271-7248

113. Sunwater Company
1112 Pioneer Way
El Cajon, CA 92020
Attn: Ed Smith, President
(714) 440-3151

114. Sunworks, Inc.
669 Boston Post Road
Guilford, CT 06437
Attn: Everett M. Barber, President
(203) 453-6191

115. T. D. Bross Line Construction Company
42 E. Dudley Town Road
Bloomfield, CT 06002
Attn: Mr. Theodore Bross, President
(203) 243-1781

116. Thomason Solar Homes, Inc.
6802 Walker Mill Road, SE
Washington, DC 20027
Attn: H. Thomason
(301) 336-0009

117. Wallace Company
Gainesville, GA. 30501
Attn: Joe Pendergrass
(404) 534-5971

118. Ying Manufacturing Corporation
1940 W. 144th Street
Gardena, CA 90249
Attn: Mr. Yu, Vice President
(213) 770-1756

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ATTACHMENT C
GOVERNMENT DOCUMENTS

This attachment provides a numerical accounting by subject of all government documents that have been utilized by the Economics Section.

<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>NUMBER OF DOCUMENTS</th>
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<td>Distribution and Services</td>
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<td>Governments</td>
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<td>Catalogues</td>
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ATTACHMENT D

GOVERNMENT DOCUMENTS LIST

This attachment provides a selected listing of those government documents that have been designated by the MSFC Technical Monitor as possible sources of valuable data for all related research areas. The basic sources were provided by the UAH research team from selected bibliographies and listings of government documents.
MONTHLY CATALOG - UNITED STATES GOVERNMENT PUBLICATIONS, JULY 1975

<table>
<thead>
<tr>
<th>Publishing Agency</th>
<th>Library Call No.</th>
<th>Document Title</th>
</tr>
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<tbody>
<tr>
<td>Agriculture Department</td>
<td>A 1.38 1501</td>
<td>Miscellaneous publication One-weekylum klyndu. June 1975. Item 13-A</td>
</tr>
<tr>
<td>Census Bureau</td>
<td>C 56.25/5 94-5/1</td>
<td>Census of construction industries 1972 Industry series CC 93/1 General contractors, single-family houses and operative builders, 1972. Item 12-A</td>
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<tr>
<td></td>
<td>C 56.25/5 94-5/2</td>
<td>Census of small rural towns. 1972. Major small counties in standard metropolitan statistical areas BS 95/1 (Atlanta)</td>
</tr>
<tr>
<td></td>
<td>C 56.25/5 94-5/7</td>
<td>Economic census. 1972, publication program. Mar 1975. Item 146</td>
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<tr>
<td>Atomic Energy Joint Committee</td>
<td>Y 4.51 5/6/1-A</td>
<td>Analysis identifying issues in fiscal year 1976 ERDA budget.</td>
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<td></td>
<td>Y 4.64 7/1/15/1976/5-A</td>
<td>Fiscal power restructuring, fuel and electricity base reflection. Jr 11 and 12, 1975. Item 999</td>
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<tr>
<td>House of Representatives</td>
<td></td>
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<tr>
<td></td>
<td>H 4-1 5/6</td>
<td>Emergency middle-income housing act of 1975. Report together with supplemental, additional, individual, and minority views from Committee on Banking, Currency, and Housing to accompany H.R. 3645, Mar 14, 1975. Item 1000-A</td>
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<tr>
<td></td>
<td>Y 4.2 7/16/2/4</td>
<td>Housing assistance payments, community development block grants and 1977 rehabilitation loans. Hearings before Subcommittee on Housing, and Community Development, 94th Congress, 1st session, Apr 10, 1975. Item 1013</td>
</tr>
<tr>
<td></td>
<td>Y 4.5 6/1 1 6/1</td>
<td>Building and construction states legislative problems, hearings, 94th Congress, 1st session, Apr 27, 1975. Item 1023</td>
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<td>Y 4.5 6/15/4</td>
<td>Committee publication wash., 94th Congress</td>
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<tr>
<td></td>
<td>Y 4.5 6/15/4</td>
<td>Oversight hearings on nuclear energy, reactor of major issues hearings, 1. Hearings before Subcommittee on Energy and Environment 94th Congress, 1st session, Apr 28-May 2, 1975. Item 1023</td>
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<tr>
<td></td>
<td>Y 4.5 6/15/4</td>
<td>International energy policy, hearing before Subcommittee on Foreign Relations, 94th Congress, 1st session, May 1, 1975. Item 1023</td>
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| House of Representatives (continued) | | |
| | Y 4.5 6/15/4 | Science and Technology Committee |
| | Y 4.5 6/15/4 | Analysis identifying issues in fiscal year 1975 ERDA budget, report for Committee on Science and Technology, Committee on Interior and Related Affairs, Senate and Joint Committee on Atomic Energy, 94th Congress, 1st session by Office of Technology Assessment, May 1975. Item 1050 |
| | Y 4.5 6/15/4 | ERDA authorization, 1975 and transition period, fossil fuels, hearings before Subcommittee on Energy Research, Development and Demonstration, 94th Congress, 1st session, Apr 18-20, 1975. Item 1050 |
| | Y 4.5 6/15/4 | Energy and Power Committee |
| | Y 4.5 6/15/4 | Finance Committee |
| | Y 4.5 6/15/4 | Energy subcommittee, July 4, 1975. Item 1050 |
| | Y 4.5 6/15/4 | Interior and Insular Affairs Committee |
| | Y 4.5 6/15/4 | Analysis identifying issues in fiscal year 1976 ERDA budget, Focus attention oil subcommittee on electric power production and industrial uses, background paper. Item 1050 |
| | | Energy Research and Development Administration |
| | | Environmental Data Service |
| | C 65.17/95 5 | Key to and atmospheric information sources. User's guide to OASIS, Ocean, Atmosphere and Space Information System, May 1974. Item 1050 |
| | | Environmental Protection Agency |
| | | Energy Conversion Administration |
| | FE 1.2 6/15/4 | Analysis of energy coal sales and purchases, Apr 1975. Item 1055-A |
### Federal Energy Administration (continued)

<table>
<thead>
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<th>Document Title</th>
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<tr>
<td>Study of effects of rising energy prices on low and moderate income elderly, final summary report, Jan 1975. Item 434-A-1</td>
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### Federal Power Commission

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### General Accounting Office

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<tr>
<td>Ways to improve management of automated data processing resources, Department of Navy, Apr 16, 1975. Item 436</td>
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<tr>
<td>Life cycle cost estimating, in status and potential use in major weapon system acquisitions, Department of Defense. Dec 30, 1974. Item 436</td>
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<tr>
<td>National standards needed for residential energy conservation, Department of Housing and Urban Development. June 20, 1975. Item 436</td>
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### Geological Survey

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<td>Circulator Geothermal estimates of undiscovered recoverable oil and gas resources in United States. 1975. Item 436</td>
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### Mines Bureau

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<tr>
<td>Information circular Estimating direct costs of development on black-swell mine, 1975. Basic estimated capital investment and operating costs for underground low-sulfur coal mines, mines with annual production of 1.0 to 4.99 million tons from 7/4 to 7/4 coal bed, 1975. Item 436-A</td>
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### National Aeronautics and Space Administration

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<td>National Aeronautics and Space Administration</td>
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### Publishing Agency

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MONTHLY CATALOG - UNITED STATES GOVERNMENT PUBLICATIONS, AUGUST 1975

**Title:**... Energy Alternatives: A comparative analysis, NSERI and the evaluation of energy alternatives.

**Issue:**...

**Title:**... Science and Technology Committee

**Title:**... Energy data requirements of Federal government, hearings before Subcommittee on Activities of Regulatory Agencies, 93rd Congress, 2d session

**Title:**... Energy and natural business, Hearings before Subcommittee on Minerals, Nuclear Fuels, and other bills, 93rd Congress, 2d session, on S.2021 and other bills, May 6-10, 1974.

**Title:**... Federal Power Commission oversight, Hearings before Subcommittee on Waterpower of Energy and Power, 93rd Congress, 1st session, on implications of President's proposal for energy independence act of 1975, Feb 17-20, 1975, 1975, 1975...
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<tr>
<td>Energy Research and Development Administration</td>
<td>ERDA research and development report</td>
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<td>ER 1.11 ERDA-15</td>
<td>Solar energy program, Apr 1975, Item 1021-C</td>
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<tr>
<td>ER 1.11 ERDA-48</td>
<td>National plan for energy research, development, and demonstration 1975, Item 1021-C</td>
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<tr>
<td>ER 1.11 ERDA-50</td>
<td>Proceedings of symposium on sodium technology related to fusion reactor systems, Mount Laboratory, Miamisburg, OH, Oct 1 and 2, 1974, Item 1021-C</td>
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**Federal Energy Administration**

| FE 1.24 89 | How business in Los Angeles cut energy use by 20%, preliminary research results, July 1975, Item 434-A-1 |
| FE 1.8 77 | How to save money by installing your home, practical instructions and advice, 1972 |

**Federal Power Commission**

| PP 1.10 H 81/72 | National electric rates and standards for electric service in communities of 2,000 population or more, residential, commercial, and industrial services, June 1972, Item 427-A-43 |

**Geological Survey**

| I9.3 1412 | Bulletin Coal resources of United States, 1975, Item 620 |
| I9.4/2726 | Circular Assessment of geothermal resources of United States, 1975, Item 620-A |

**Housing and Urban Development Proprietary**

| HM 1.3M 75/2/75 | Buying and financing mobile homes, Apr 1975, Item 582 |

**Mon. Bureau**

| I20.29/66 | Information circular Reserve base of coal for underground mining in Western United States, 1975, Item 627-A |

**National Aeronautics and Space Administration**

| NAS 1.15 3-67/67 | NASA technical memorandum 174 (draft) Fluid manifold design for solar energy storage unit, June 1975 |

**National Bureau of Standards**

| C 13.29/7-71 | Building science series Proposed concept for determining need for air conditioning for buildings based on thermal response and human comfort, Aug 1975, Item 261-A |
| C 13.10 479 | Special publication Proceedings of 7th annual conference of National Conference of States on Building Codes and Standards, Sept 1975, Item 267 |

**Reclamation Bureau**

| 127.2 P 6/1/74 | Power facilities operated by Bureau of Reclamation, RS Ithaca, July 1974 |
Holding Agency
Library Call No.

Federal Power Commission
FP 1.14.N 18


Housing and Urban Development Department

HO 1.4/11-H 91/rev. 2


HO 1.4/11/C 18/rev. 1


Labor Statistics Bureau

LS 2.2 1564


Utility Record

US 1.27 5080


US 2.8 1973


National Science Foundation

NS 1.1 En 2/4/v. 1, 2

Assessment of energy parks, vs. dispersed electric power generating facilities, final report. v. 1-2. May 30, 1975. 2 v. Item 634-C

NS 1.2 En 2/5

Energy use and climate, possible effects of using solar energy instead of stored energy. Apr 1972. Item 634-C

NS 1.2 CI 3

Identification of research and development priorities and of testing problems associated with implementation of in situ recovery of shale oil, resulting from UC/DOE/NIAP workshop held at University of CA, Sun Dunes, Sept 3-7, 1971. Item 634-C

NS 1.2 G 27/2

Fuel economy assessment of geothermal energy resource development, Apr 15, 1972. Item 634-C

NS 1.2 Su 4/16

Workshop proceedings, solar cooling for buildings, Feb 6-10, 1972, Los Angeles, CA held in conjunction with unorganized meeting of American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE). 1974. Item 634-C
Federal Power Commissions (continued)

National electric rate basic, rate schedules for electric service in communities of 2,500 population or more, residential, commercial and industrial services.

FP 1.18-1 9/74
FP 1.18-4 9/74
FP 1.18-9 9/74
FP 1.18-19 9/74
FP 1.18-26 9/74
FP 1.18-33 9/74
FP 1.18-41 9/74
UT. July 1974. Item 437-A-02
FP 1.18-42 9/74
FP 1.20 9/74

Federal Trade Commission

FP 1.26en 2

Labor Statistics Bureau

L 2.31865

National Bureau of Standards

C 13.29/2.64
Building science series
Refurbishing existing housing for energy conservation, economic analysis, Dec 1974. Item 261-A
C 13.29/2.74
Pre-design analysis of energy conservation options for multi-story commercial office building. Nov 1975. Item 261-A
C 13.46 615
State building regulatory program for mobile homes and manufactured buildings, summary, Sept 1974. Item 209-A

Tennessee Valley Authority

Y 2.1 25/1 7/74/.2

Transportation Department

TD 1.20/2 7/74/12
DOT-15C-O15 (series)
ATTACHMENT E

BOOKS AND PAMPHLETS BY SUBJECT

This attachment provides a list of the books and pamphlets utilized by the UAH research team. Authors, publishers and sources are available upon request.

ACCOUNTING

Insurance Agency Accounting

ARCHITECTURAL

Architectural Graphic Standards
Building Products Register
Kidder-Parker Architects' and Builders' Handbook
MANUAL J Load Calculation
Stainless Steel for Architectural Use

CATALOG

Legally Available U.S. Government Information
World Wide Chamber of Commerce Directory 1975-76

CONCRETE

Movement and Distribution of Concrete

CONSTRUCTION

AIA Building Products Register
Architectural Graphic Standards
Building Construction
Building Construction Cost Data 1976
Building Construction Handbook
Building Construction—Materials and Types of Construction
Catalog of NBS Standard Reference Materials 1975-76
Construction Cost Data Book
Construction Publishing Company Publications
Construction of Structural Steel Building Frames
Creep in Engineering Structures
CRYOGENIC Fundamentals
Encyclopedia of Associations
Engineering Materials Handbook
Estimating Construction Costs
The Estimator
Handbook of Foamed Plastics
Heating Ventilating Air Conditioning Guide
HUD Minimum Property Standards. Care-Type Housing
HUD Minimum Property Standards. Multifamily Housing
HUD Minimum Property Standards. One & Two Family Dwellings
Kidder-Parker Architects' and Builders' Handbook
The Laborator
Manual J Load Calculation
MARKS' Mechanical Engineers' Handbook
Material Data Book
Materials for Architecture
MSFC Program Stock Catalog
National Association of Home Builders
National Construction Estimator
Revision No. 1 "Minimum Property Standards for Care-Type Housing"
Revision No. 1 "Minimum Property Standards for Multifamily Housing"
Revision No. 2 "Minimum Property Standards for Care-Type Housing"
Revision No. 2 "Minimum Property Standards for Multifamily Housing"
Revision No. 2 "Minimum Property Standards for One and Two Family Dwellings"
Solar Energy Heating & Cooling Products, A Catalog
Steel and Timber Structures
Sweet's Industrial Construction Catalog File
Text Book of the Materials of Engineering
Thermal Insulation
Thermal Performance of Buildings
Thermal Radiation Properties Survey
Thermodynamic Properties of Refrigerants
Uniform Building Code

ECONOMICS

The Quality of Life in the U.S., 1970, Index, Rating, and Statistics
Economic Report of the President
Quality of Life Indicators in the U.S. Metropolitan Areas, 1970

ELECTRICITY

All Electric Homes in the United States
Electric Power Statistics
Statistics of Privately Owned Electric Utilities in the U.S. 1973
Statistics of Publicly Owned Electric Utilities in the U.S. F.P.C.
Typical Electric Bills 1974
Typical Electric Bills 1975

ENERGY

All Electric Homes in the United States
A Realistic View of U.S. Natural Gas Supply
Building for Energy Conservation, Proceedings
The Consumer Costs of Deregulation of the Field Price of Natural Gas
Electric Power Statistics
Energy Conservation, It Benefits All of Us!
Energy in Perspective
Energy in the American Economy, 1850-1975
Guidelines for Energy Conservation for Immediate Implementation;
Small and Light Industry
Measures for Reducing Energy Consumption for Homeowners and Renters
National Gas Reserves Study
New Energy Technologies for Buildings
1975 New York Gas Report
The Potential for Conversion of Oil-Fired and Gas-Fired Electric
Generating Units to Use of Coal
Statistics of Privately Owned Electric Utilities in the U.S. 1973
Statistics of Publicly Owned Electric Utilities in the U.S. F.P.C.
Typical Electric Bills 1974
Typical Electric Bills 1975

ENERGY

All Electric Homes in the United States
A Realistic View of U.S. Natural Gas Supply
Building for Energy Conservation, Proceedings
The Consumer Costs of Deregulation of the Field Price of Natural Gas
Electric Power Statistics
Energy Conservation, It Benefits All of Us!
Energy in Perspective
Energy in the American Economy, 1850-1975
Guidelines for Energy Conservation for Immediate Implementation; Small
and Light Industry
Measures for Reducing Energy Consumption for Homeowners and Renters
National Gas Reserves Study
New Energy Technologies for Buildings
1975 New York Gas Report
The Potential for Conversion of Oil-Fired and Gas-Fired Electric
Generating Units to Use of Coal
Statistics of Privately Owned Electric Utilities in the U.S. 1973
Statistics of Publicly Owned Electric Utilities in the U.S. F.P.C.
(A) Technical Basis for Energy Conservation
Typical Electric Bills 1975
U.S. Coal and the Electric Power Industry
Wind Power

ENERGY GROWTH

MEGASTAR, The Meaning of Energy Growth: An Assessment of Systems,
Technologies, and Requirements

GAS

The Consumer Costs of Deregulation of the Field Price of Natural Gas
National Gas Reserves Study
A Realistic View of U.S. Natural Gas Supply

GOVERNMENTS

HOUSING

HUD Minimum Property Standards. Care-Type Housing. HUD
HUD Minimum Property Standards. Multifamily Housing. HUD
HUD Minimum Property Standards. One & Two Family Dwellings. HUD
Revision No. 1 "Minimum Property Standards for Care-Type Housing". HUD
Revision No. 1 "Minimum Property Standards for Multifamily Housing"
Revision No. 2 "Minimum Property Standards for Care-Type Housing". HUD
Revision No. 2 "Minimum Property Standards for Multifamily Housing"
Revision No. 2 "Minimum Property Standards for One and Two Family Dwellings"

INSURANCE

Insurance Agency Accounting
Insurance Facts
Insurance Funds and Their Investment
Insurance Industry 15-16
Insurance Industry 17-17A
Insurance Industry 18-18A
Insurance Industry 18B-19
Insurance, A Practical Guide
Insurance Principles and Practices

INSURANCE - PROPERTY & LIABILITY

Property and Liability Insurance
Risks We Face, An Introduction to Property Insurance

MATERIALS

Mechanical Behavior of Materials at Elevated Temperatures
Movement and Distribution of Concrete
Properties of Materials at Low Temperature (Phase I)
Property Measurements at High Temperatures
Thermal Conductivity Measurements of Insulation Materials at Cryogenic Temperatures

MEASUREMENT

VNR Metric Handbook

METALS

The Physical Examination of Metals

METRIC SYSTEM

VNR Metric Handbook

SOLAR ENERGY

Solar Energy Heating & Cooling Products, A Catalog
TERRASTAR. Auburn University Engineering Systems Design
STATISTICS

The Quality of Life in the U.S., 1970, Index, Rating, and Statistics
Quality of Life Indicators in the U.S. Metropolitan Areas, 1970

WIND

Wind Power