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SOLAR HEATING AND COOLING DEMONSTRATION PROJECT SUMMARIES

MASTER

MAY 1978

U.S. DEPARTMENT OF ENERGY
ASSISTANT SECRETARY FOR CONSERVATION
AND SOLAR APPLICATIONS
DIVISION OF SOLAR APPLICATIONS

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WASHINGTON, D.C. 20545

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FOREWORD

The National Program for Solar Heating and Cooling of Buildings, directed by The Department of Energy (DOE), responds to the Solar Heating and Cooling Demonstration Act of 1974 (P.L. 93-409, September 3, 1974). This Act calls for programs to develop, demonstrate, and promote the use of solar heating and cooling systems. The role of the Federal Government is to stimulate the use of solar heating and cooling equipment and to assist industry with the development of technology and the demonstration of systems.

The Federal program includes demonstrations of heating and/or combined heating and cooling systems for residential and commercial buildings. A comprehensive discussion of this program is contained in ERDA Report 76-6, dated November 1976. The report is being updated and will be redesignated DOE/CS-0007. Early solar system development relied heavily on the utilization of readily available, although not necessarily efficient, equipment with advances in technology being incorporated as they became available. The new technology being advanced by this program is directed at improving performance and reliability and reducing the cost of component and system procurement and operation. The schedule for this program following the Congressional directive in P.L. 93-409: "(b) . . . to provide for the demonstration within a three-year period of the practical use of solar heating technology and to provide for the development and demonstration within a five-year period of the practical use of combined heating and cooling technology."

This report is one of two documents which contain summaries of projects that were funded by ERDA/DOE through fiscal year 1977 and conducted under the National Program for Solar Heating and Cooling of Buildings. The two documents are as follows.

DOE/CS-0009 SOLAR HEATING AND COOLING DEMONSTRATION PROJECT SUMMARIES

This document presents brief descriptive overviews of the design and operating characteristics of all commercial and Federal residential solar heating and cooling systems and of the structures themselves. Also included are available pictures of the buildings and simplified solar system diagrams. A list of non-Federal residential installations is provided.

DOE/CS-0010 SOLAR HEATING AND COOLING RESEARCH AND DEVELOPMENT PROJECT SUMMARIES

This document describes the Conservation and Solar Applications Solar Heating and Cooling Research and Development Program. It summarizes the research and development program and the projects it presently supports for further development of collectors, thermal energy storage, heat pumps and heat exchangers, solar cooling, and systems and controls. The report has two parts, an introduction and a series of project descriptions. The introduction describes the evolution of the R&D program and outlines the present program. The second part of the report describes R&D projects. It includes a list and summary information for all current R&D projects.

NOTE:

The information contained herein represents current plans as of November 1, 1977, and as such, is subject to change. Errors or omissions should be brought to the attention of the Demonstration Branch, Division of Solar Applications.

INTRODUCTION

SOLAR HEATING AND COOLING DEMONSTRATION PROJECT SUMMARIES

The demonstration program includes commercial and residential-type buildings sponsored by DOE, alone, or jointly with other Federal agencies, city and state governments, and private agencies. The commercial projects include a wide variety of building types, such as: office buildings, schools, fire stations, civic centers, factories, and libraries. Residential projects include both single and multifamily dwellings of various configurations.

Approximately 200 projects will be instrumented to measure the performance of the solar systems. Analysis of the collected data will provide definitive guides for design criteria and permit realistic economic assessment of various solar systems.

The demonstrations are discussed in four sections:

- SECTION I Commercial Demonstration Program — Non-Federal Buildings
- SECTION II Commercial Demonstration Program — Federal Buildings
- SECTION III Residential Demonstration Program — Federal Buildings
- SECTION IV Residential Demonstration Program — Non-Federal Buildings

Maps showing the locations (by state) of the buildings are provided at the beginning of each section, along with an index which identifies each project and page number for the corresponding descriptive information. A map depicting the distribution of all demonstration projects is included in this introduction. The comparable map from last year's publication is also shown to depict the increase in the number of projects. The contents of this document are based on information available as of November 1, 1977.

SECTION I COMMERCIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS

DOE is responsible for the management of the commercial demonstrations in non-Federal buildings. These projects are selected primarily from responses to the Program Opportunity Notice (PON). This section contains data on:

- Four early proof-of-concept experiments started in 1974 by the National Science Foundation (NSF),
- Twenty-two projects initiated by NSF,
- Thirty-two projects from PON-1,
- Seventy-four projects from PON-2, and
- Fifty projects from the Hot Water Initiative.

SECTION II COMMERCIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS

DOE is also responsible for the management of this portion of the program. Projects are selected from proposals submitted by other Federal agencies. Participating agencies include Department of Defense, Government Services Administration, Tennessee Valley Authority, United States Postal Service, Department of the Interior, National Aeronautics and Space Administration, Veteran's Administration, Department of Justice, Treasury Department, and Department of Agriculture; descriptions of their commercial projects are contained in this section.

SECTION III RESIDENTIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS

The Department of Defense (DOD) manages this portion of the residential program. Projects are selected by DOD at various military installations throughout the United States.

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS

The Department of Housing and Urban Development (HUD) manages this part of the residential program. Projects are selected from responses to Request for Grant Applications (RFGA) issued by HUD. This section contains only a list of the HUD projects showing state, location, owner/builder, building type, number of units, solar application, and solar manufacturer. HUD's Cycle 1 projects are described in their document Solar Heating and Cooling Demonstration Program: a Descriptive Summary of HUD Cycle 1 Solar Residential Projects (GPO #023-000-00338-4). Cycle 2 descriptions are also available (GPO #023-000-00389-9) and the document for the Cycle 3 description is currently being processed by GPO.

DISTRIBUTION OF SOLAR HEATING & COOLING DEMONSTRATION PROJECTS COMMERCIAL AND RESIDENTIAL

DISTRIBUTION OF SOLAR HEATING & COOLING DEMONSTRATION PROJECTS COMMERCIAL AND RESIDENTIAL

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SECTION I

COMMERCIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS

COMMERCIAL DEMONSTRATION PROGRAM

NON-FEDERAL BUILDINGS

SECTION I COMMERCIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	SOLAR APPLICATION	SOLAR MANUFACTURER	PROGRAM TYPE			
							PON*	PON	HOT WATER INITIATIVE	OTHER**
I							1	2		
I-1	ALABAMA	Huntsville	City of Huntsville	Senior Citizens Center	H HW	Solar Unlimited		X		
I-2		Listerhill	Reynolds Metals Company, Product Development Division	Industrial Shower Facility	H HW	Reynolds Metals Company		X		
I-3		Mobile	Travis-Braun & Associates, Inc.	Low Rise Motel	HW	Revere Copper & Brass, Inc.			X	
I-4		Montevallo	Alabama Power Company	Office	H C HW	PPG Industries, Inc.	X			
I-5	ARIZONA	Phoenix	Rodeway Inns of America & R.V. Development Company	Low Rise Motel	HW	General Electric Company			X	
I-6		Scottsdale	City of Scottsdale	Office	H C	To Be Determined				X
I-7		Tempe	Tempe Union High School District 213	High School	H HW	Southwest Standard	X			
I-8		Tucson	Rodeway Inns of America & R.V. Development Company	Low Rise Motel	HW	Raypak, Inc.			X	
I-9	CALIFORNIA	Cerritos	City of Cerritos/Redevelopment Agency	City Hall	H HW	Ying Manufacturing Corporation		X		
I-10		El Toro	Fredericks Development Corporation	Apartments	HW	Unitspan Architectural Systems, Inc.				X
I-11		El Toro	Orange County	Library	H C	General Electric Company		X		
I-12		Fresno	ARATEX Services, Inc.	Industrial Laundry	HW	Ying Manufacturing Corporation	X			
I-13		Irvine	Irvine Unified School District	Elementary School	H C	Owens-Illinois, Inc.	X			
I-14		Long Beach	City of Long Beach	Fire Station	H HW	Raypak, Inc.		X		
I-15		Los Angeles	City of Los Angeles	Police Station	H HW	Solargenics, Inc.		X		
I-16		Mill Valley	Iris Images, Inc.	Film Laboratory	HW	Interactive Resources, Inc.	X			
I-17		North Highlands	Rodeway Inns of America & R.V. Development Company	Low Rise Motel	HW	Raypak, Inc.			X	
I-18		Orange	Norman Brock/Ridgeline Racquet Club, Inc.	Clubhouse	H C HW	Northrup, Inc.		X		
I-19		San Diego	San Diego Unified School District	High School	H C HW	Solartec Corporation/Northrup, Inc.		X		
I-20		San Francisco	Storek & Storek	Office	H HW	Chamberlain Manufacturing Corporation	X			
I-21		San Jose	Oak Grove School District	Elementary School	H C	KTA Corporation		X		
I-22		Santa Clara	City of Santa Clara	Community Center	H C HW	Ametek, Inc.				X
I-23		Santa Clara	Renault & Handley	Industrial Buildings	H HW	Revere Copper & Brass, Inc.		X		
I-24		Saratoga	City of Saratoga/Mechanics Research, Inc.	Library	H	Ying Manufacturing Corporation		X		
I-25		South Lake Tahoe	Lake Valley Fire District	Fire Station	H HW	Western Energy, Inc.	X			
I-26		Stanford	Stanford University	Food Service	H HW	Solar Energy Products Industries, Inc.		X		
I-27		Upland	Fredericks Development Corporation	Apartments	HW	Lennox Industries, Inc./Honeywell, Inc.				X
I-28	COLORADO	Aurora	Adams-Arapahoe Joint School District	Elementary School	H HW	American Heliothermal		X		
I-29		Boulder	Paul Shippee	High Rise Motel	HW	Colorado Sunworks			X	
I-30		Lakewood	Jefferson County School District	School for the Retarded	H HW	Rocky Mountain Products		X		

KEY:

H - Heating

C - Cooling

HW - Hot Water

*Program Opportunity Notice (PON) Projects administered by DOE.

**Includes projects initiated by the National Science Foundation

SECTION I COMMERCIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS (CONTINUED)

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	SOLAR APPLICATION	SOLAR MANUFACTURER	PROGRAM TYPE			
							PON*	PON*	HOT WATER INITIATIVE	OTHER**
1	2	3	4	5	6	7	8	9	10	11
I-31	CONNECTICUT	Littleton	City of Littleton	City Hall	H HW	Sunworks, Inc.		X		
I-32		Vail	Town of Vail	Bus Stop Shelter	H	Wormser Scientific Corporation		X		
I-33		Branford	John R. McColl, Jr./ William H. Wade	Commercial/ Industrial	H HW	Solaron Corporation		X		
I-34		Danbury	Danbury Hospital	Hospital	H HW	Libby-Owens-Ford Company		X		
I-35		East Hartford	American Motor Inns, Inc.	High Rise Motor Inn	HW	Sunworks, Inc.			X	
I-36		Hamden	Hamden Connecticut Housing Authority	Multifamily Elderly Housing	H HW	Solar Products Manufacturing Corporation				X
I-37	DIST. OF COLUMBIA	New Haven	Albie Booth Memorial Boys Club	Boys Club & Com- munity Center	H HW	Solar Heating Systems Corporation		X		
I-38		Stamford	Lutz-Sotire Partnership	Office	H	Sunworks, Inc.	X			
I-39		Washington, D.C.	Marriott Corporation	Restaurant	HW	Sunworks, Inc.				X
I-40		Brandon	Brandon Swimming Association	Sports/Medical Center	H C HW	Revere Copper & Brass, Inc.		X		
I-41		Cape Canaveral	Florida Solar Energy Center	Office	H C	General Electric Company		X		
I-42		Clermont	Days Inn of American, Inc.	Low Rise Motel	HW	Energy Systems, Inc.			X	
I-43	FLORIDA	Coral Gables	Dade County	Elementary School	C HW	PPG Industries, Inc.				X
I-44		Hallandale	Diplomat Golf & Racquet Club	Low Rise Motel	HW	Solar Engineering, Inc.			X	
I-45		Key West	Quality Inn	Low & High Rise Motel	HW	Capital Solar Heating, Inc.			X	
I-46		Lake Buena Vista	Reedy Creek Utilities Co., Inc.	Office	H C HW	AAI Corporation	X			
I-47		Nassau County	Florida Department of Commerce	Welcome Station	H C	Northrup, Inc.	X			
I-48		Atlanta	City of Atlanta	Elementary School	H C HW	PPG Industries, Inc.				X
I-49	GEORGIA	College Park	La Quinta Motor Inns, Inc.	Low Rise Motel	HW	Revere Copper & Brass, Inc.			X	
I-50		Dalton	North Georgia Area Planning & Development Commission	Office	H C HW	Revere Copper & Brass, Inc.		X		
I-51		Shenandoah	Shenandoah Development Corp.	Recreational Center	H C HW	Revere Copper & Brass, Inc.				X
I-52		Honolulu	Airport Ramada Inn	Hotel	HW	To Be Determined				X
I-53		Honolulu	Iolani School	School	C HW	Northrup, Inc.		X		
I-54		Honolulu	Metropolitan YMCA	Dorm and Shower Room	HW	Raypak, Inc.			X	
I-55	HAWAII	Kona	Hawaiian Pacific Resorts	High Rise Hotel	HW	Raypak, Inc.			X	
I-56		Waikoloa	E. W. Westgate Company	High Rise Hotel	HW	Acurex/Aerotherm			X	
I-57		Chicago	Museum of Science and Industry	Museum	H C	General Electric Company		X		
I-58		Chicago	Public Building Commission of Chicago	Office/Exhibition	H HW	Chamberlain Manufacturing Corporation				X
I-59		Chicago	Rodeway Inns of America & R.V. Development Company	High Rise Hotel	HW	Lennox Industries, Inc.			X	
I-60		St. Charles	Community Unit District 303	High School	H HW	Sunworks, Inc.		X		
I-61	INDIANA	Clarksville	Clarksville Community School Corporation	Middle School	H	Solar Development, Inc.		X		

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PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	SOLAR APPLICATION	SOLAR MANUFACTURER	PROGRAM TYPE			
							PON*	PON	HOT WATER INITIATIVE	OTHER**
1	2	3	4	5	6	7	8	9	10	11
I-62		Gary	Indiana Vocational Technical College	Vocational School	H	Owens-Illinois, Inc.		X		
I-63		Indianapolis	La Quinta Motor Inns, Inc.	Low Rise Motel	HW	Lennox Industries, Inc.			X	
I-64		Indianapolis	Rodeway Inns of America & R.V. Development Company	Low Rise Motel	HW	Lennox Industries, Inc.			X	
I-65		Merrillville	La Quinta Motor Inns, Inc.	Low Rise Motel	HW	General Electric Company				X
I-66	IOWA	Marion	Marion Independent School District	Office	H	Honeywell, Inc./Lennox Industries, Inc.		X		
I-67		West Branch	Scattergood School	School Gymnasium	H	Solaron Corporation	X			
I-68	KANSAS	Gypsum	Unified School District No. 306	Kindergarten-12th Grade School	H HW	Solar Corporation of America		X		
I-69		Kansas City	Du Cat Investments, Inc.	Warehouse/Office	H	Solaron Corporation		X		
I-70		Topeka	Kaw Valley State Bank and Trust Company	Bank	H C HW	General Electric Company		X		
I-71		Wichita	Charles F. Henning, M.D.	Medical Offices	H	Solar Services, Inc.		X		
I-72		Wichita	La Quinta Motor Inns, Inc.	Low Rise Motel	HW	Lennox Industries, Inc.			X	
I-73	KENTUCKY	Louisville	Rademaker Corporation	Office/Warehouse	H HW	Solaron Corporation/Solar Development, Inc.	X			
I-74	LOUISIANA	Baton Rouge	Louisiana State University & A&M College	Field House	H HW	Honeywell, Inc./Lennox Industries, Inc.	X			
I-75	MARYLAND	Annapolis	Ferguson Corporation	Motel	HW	Southwest Ener-Tech, Inc.	X			
I-76		Baltimore	City of Baltimore	Community Center	H HW	InterTechnology Corporation	X			
I-77		Baltimore	City of Baltimore	Fire Station	H C HW	To Be Determined		X		
I-78		Cockeysville	Baltimore County	Elementary School	H C	AAI Corporation				X
I-79		Gaithersburg	Md. National Capital Park & Planning Commission	Office	H	KTA Corporation	X			
I-80		Germantown	Montgomery Community College	Community College	H HW	PPG Industries, Inc.		X		
I-81		Timonium	Baltimore County	Elementary School	H C	AAI Corporation				X
I-82	MASSACHUSETTS	Amherst	Hampshire College	College	H C HW	Owens-Illinois, Inc.		X		
I-83		Boston	City of Boston	School	H	General Electric Company				X
I-84		Boston	Children's Hospital Medical Center	Hospital	H HW	General Electric Company		X		
I-85		Boston	Metropolitan District Commission	Community Center	H HW	Daystar Corporation		X		
I-86		Burlington	Technology Properties Trust	Office	H C HW	Daystar Corporation		X		
I-87		Concord	Town of Concord	Office/Warehouse	H	Sunworks, Inc.				X
I-88		Lenox	American Motor Inns, Inc.	Low Rise Motor Inn	HW	Sunworks, Inc.			X	
I-89	MICHIGAN	Cedar Springs	Jordan College	Residence Hall	H HW	PPG Industries, Inc.		X		
I-90		Okemos	Ingham County Board of Commissioners	Health Center/Hospital	HW	Revere Copper & Brass, Inc.	X			
I-91		Petoskey	Petoskey Motel/Leonard Sieraoski, Sr.	Low Rise Motel	HW	Southwest Ener-Tech, Inc.			X	
I-92		Traverse City	John O. Esslinger, M.D./Valentine Esslinger, M.D.	Medical Offices	H HW	Salaron Corporation		X		

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PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	SOLAR APPLICATION		SOLAR MANUFACTURER	PON* 1	PON 2	PROGRAM TYPE	
										HOT WATER INITIATIVE	OTHER**
I-93	MINNESOTA	Troy	Troy School District	Elementary School	H	HW	Libby-Owens-Ford Company			X	
I-94		Apple Valley	Minnesota Zoological Board	Zoo Ride Station	H	HW	Lennox Industries, Inc.			X	
I-95		Bloomington	Rodeway Inns of America & R.V. Development Company	High Rise Hotel		HW	Lennox Industries, Inc.				X
I-96		Blue Earth	Telex Communications, Inc.	Manufacturing Plant	H		Solar Corporation of America		X		
I-97		Brooklyn Center	Osseo School District	Junior High School	H	HW	Honeywell, Inc.				X
I-98		Duluth	Duluth YWCA	High Rise Hotel		HW	Ilse Engineering, Inc.				X
I-99		Duluth	Radisson Hotel Corporation	High Rise Hotel		HW	Lennox Industries, Inc.			X	
I-100		Hibbing	Minnesota Community College	Planetarium/Environmental Science Center	H		Sheldahl, Inc.		X		
I-101		Minneapolis	University of Minnesota	Bookstore/Office	H	C	Sheldahl SLATS				X
I-102		St. Paul	Radisson Hotel Corporation	Hotel	H	HW	Lennox Industries, Inc./ Honeywell, Inc.		X		
I-103	MISSOURI	Columbia	Stephens College	Visitors Center	H		Honeywell, Inc./Lennox Industries, Inc.		X		
I-104		Kansas City	City of Kansas City	Fire Station	H	HW	Solaron Corporation		X		
I-105		St. Louis	William Tao & Associates, Inc.	Office	H	HW	KTA Corporation			X	
I-106	MONTANA	Billings	Billings Shipping Corporation	Office	H		Lennox Industries, Inc.			X	
I-107		Lincoln	Lincoln Housing Authority	Office	H	HW	Chamberlain Manufacturing Corporation		X		
I-108	NEVADA	Las Vegas	La Quinta Motor Inns, Inc.	Low Rise Motel		HW	Revere Copper & Brass, Inc.				X
I-109		Las Vegas	Sahara Nevada Corporation	High Rise Hotel/Casino		HW	Young Energy Systems, Inc.				X
I-110	NEW HAMPSHIRE	Durham	University of New Hampshire	Chemistry Laboratory	H	HW	Sunworks, Inc.			X	
I-111		Jaffrey	Contemporary Systems, Inc.	Office/Manufacturing	H	HW	Contemporary Systems, Inc.			X	
I-112		Manchester	Kalwall Corporation	Warehouse	H		Kalwall Corporation		X		
I-113	NEW JERSEY	Basking Ridge	Somerset County Park Commission	Auditorium/Classrooms/ Office	H	C HW	General Electric Company				X
I-114		Cherry Hill	Garden State Racing Association	Hotel	H	HW	General Electric Company			X	
I-115		Long Branch	Sea Loft	Restaurant	H	C HW	Owens-Illinois, Inc.			X	
I-116		Lumberton	RKL Controls, Inc.	Manufacturing	H	C	Sunworks, Inc.		X		
I-117		Neptune	Host Motel	Low Rise Motel		HW	Sunworks, Inc.				X
I-118	NEW MEXICO	Albuquerque	City of Albuquerque (Animal Control Center)	Office/Kennel	H	HW	Albuquerque Western Solar Industries, Inc.		X		
I-119		Las Cruces	Coachlight Inn, Las Cruces Ltd.	Low Rise Motel		HW	Solar Systems, Inc.				X
I-120		Las Cruces	New Mexico State University	Office	H	C HW	American Heating & Thermal/ Northrup, Inc.				X
I-121		Nambe	Nambe Indian Pueblo	Community Center	H		Los Alamos Scientific Laboratory				X
I-122	NEW YORK	Taos	State of New Mexico Property Control Division	Office	H		Architects Taos		X		
I-123		Ballston Spa	Ballston Spa Central School District	Middle and Elementary School	H	HW	To Be Determined		X		
I-124		Bohemia	Dayton T. Brown, Inc.	Office	H		Sunworks, Inc.		X		

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SECTION I COMMERCIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS (CONTINUED)

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	SOLAR APPLICATION		SOLAR MANUFACTURER	PROGRAM TYPE			
								PON*	PON	HOT WATER	OTHER**
								1	2	INITIATIVE	
I-125		Millbrook	New York Botanical Garden	Office/Laboratory	H	HW	Chamberlain Manufacturing Corporation/KTA Corporation			X	
I-126		New Rochelle	The City of New Rochelle	Library	H	HW	Solar Corporation of America			X	
I-127		Troy	Carl Grimm	Retail	H		Lennox Industries, Inc.			X	
I-128	NORTH CAROLINA	Charlotte	Charlotte Memorial Hospital	Health Center/Office/Classroom	H	HW	General Electric Company	X			
I-129		Charlotte	Office Parks of Charlotte, Inc.	Low Rise Motel		HW	Energy Systems, Inc.				X
I-130	NORTH DAKOTA	Bismarck	Basin Electric Power Cooperative	Office	H		Sunworks, Inc.				X
I-131		Bismarck	Mid-State Investment Corporation	High Rise Hotel		HW	Lennox Industries, Inc.			X	
I-132	OHIO	Columbus	Columbus Technical Institute	Offices	H	C	Owens-Illinois, Inc.		X		
I-133		Columbus	Highlights for Children, Inc.	Office	H	C	Honeywell, Inc.		X		
I-134		Columbus	Rudeway Inns of America & R.V. Development Company	High Rise Motel		HW	General Electric Company			X	
I-135		Deer Creek Park	Ohio Department of Natural Resources	Low Rise Lodge	H	HW	Revere Copper & Brass, Inc.			X	
I-136		Troy	Troy-Miami County Public Library	Library	H		Owens-Illinois, Inc.	X			
I-137	OKLAHOMA	Kingston	Oklahoma Department of Tourism and Recreation	Low Rise Hotel		HW	Daystar Corporation			X	
I-138	PENNSYLVANIA	Lancaster	American Motor Inns, Inc.	Low Rise Motor Inn		HW	Sunworks, Inc.			X	
I-139		West Goshen	Bell Telephone Company of Pennsylvania	Office/Storage	H		Heliotherm, Inc.				X
I-140	PUERTO RICO	Canovanas	Commonwealth of Puerto Rico	Industrial Factory	C	HW	Owens-Illinois, Inc.				X
I-141	SOUTH CAROLINA	Anderson	Days Inn of America, Inc.	Low Rise Motel		HW	Gulf Thermal			X	
I-142		Greenwood	Blakedale Professional Center, Inc.	Office	H	HW	PPG Industries, Inc.	X			
I-143	SOUTH DAKOTA	Aberdeen	First Baptist Church	Church	H	HW	Solaron Corporation		X		
I-144		Keystone	National Park Service, Dept. of Interior	Visitors Center	H	C	Lennox Industries, Inc.	X			
I-145		Spearfish	Spearfish School District No. 40-2	High School	H	HW	Solaron Corporation		X		
I-146	TENNESSEE	Jackson	Coca-Cola Bottling Works of Jackson, Inc.	Soft Drink Bottling Plant	H	HW	Owens-Illinois, Inc.		X		
I-147		Nashville	La Quinta Motor Inns, Inc.	Low Rise Motel		HW	Lennox Industries, Inc.			X	
I-148		Nashville	Tennessee Building Material Association	Office	H	HW	Solar Unlimited Corporation		X		
I-149	TEXAS	Austin	Lloyd A. Bell/American Ornamental Metal Company	Factory/Office	H	C	To Be Determined		X		
I-150		Austin	Radian Corporation	Office/Laboratory	H	C	Northrup, Inc.	X			
I-151		Beaumont	La Quinta Motor Inns, Inc.	Low Rise Motel		HW	General Electric Company			X	
I-152		Dallas	City of Dallas	Recreation/Health Care	H	C	Honeywell, Inc.				X
I-153		Dallas	Lon W. Travis/Earl E. Braun, Jr. Partnership	Office	H	HW	Solargenics, Inc.		X		

KEY:

H - Heating

C - Cooling

HW - Hot Water

*Program Opportunity Notice (PON) Projects administered by DOE.

**Includes projects initiated by the National Science Foundation.

PROJECT INFORMATION

Owner/Builder: City of Huntsville
 Contractor: Dickson Associates
 Operational Date: To be determined
 Total Estimated DOE Funds: \$121,937

Building

Type: Senior Citizens Center
 Area: 12,922 sq. ft.

Location: Huntsville, Alabama

Latitude: 34.07° N

Climatic Data

Degree Days	Heating	3070	Cooling	N/A
Avg. Temp. (°F)	Winter	41	Summer	78
Avg. Insol. (Ly/d)	Winter	240	Summer	542

SOLAR ENERGY SYSTEM

Application Heating 75% Cooling 0% Hot Water 75%

Collector

Type: Liquid flat-plate
 Area (sq. ft.): 1,945
 Manufacturer: Solar Unlimited

Storage

Type: Fiberglass water tank (above ground)
 Capacity: 4,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

The renovation of this Center included design and installation of a mechanical system which would easily accept the solar system. The Center is located in the heart of downtown Huntsville. The site itself is level, well graded, landscaped, and tastefully planned. A stone-rimmed lagoon of clear spring water is situated immediately north of the building. The basic construction is of brick and concrete block-bearing walls with a steel bar joist roof frame and exposed cement fiber insulating roof deck with built-up bituminous roofing. Floors are standard concrete slab-on-grade construction. The solar system is designed to provide space heating and domestic water heating using the existing conventional system as the back-up system. The system includes 1945 sq. ft. of self-supporting solar collectors mounted on the southeast side of the building with a 30° cant to face the collectors almost due south. The absorber plate is covered with a dual pane, low iron, tempered glass. Direct heating of the domestic water is provided through a dual wall heat exchanger.

PROJECT INFORMATION

Owner/Builder: Reynolds Metals Company

Contractor: Reynolds Metals Company, Product Development Division

Operational Date: January 1978

Total Estimated DOE Funds: \$71,916

Building

Type: Industrial shower facility

Area: 3,842 sq. ft.

Location: Listerhill, Alabama

Latitude: 34.65° N

Climatic Data

Degree Days	Heating	3302	Cooling	N/A
Avg. Temp. (°F)	Winter	49.1	Summer	73.2
Avg. Insol. (Ly/d)	Winter	425	Summer	473

SOLAR ENERGY SYSTEM

Application Heating 79% Cooling 0% Hot Water 59%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,344

Manufacturer: Reynolds Metals Company

Storage

Type: Steel water tank (underground)

Capacity: 5,000 gallons

Auxiliary System Type: Electrical resistance

PROJECT DESCRIPTION

The solar system being installed at Reynolds Metals Shower and Change Facility is designed to provide approximately 79% of the annual space heating load and approximately 59% of the annual potable hot water requirement. The solar energy collection system consists of 80 Reynolds Aluminum solar collectors, a pump and a 5000-gallon unpressurized underground steel storage tank. Water is circulated through the collectors where it is heated and is stored in the underground storage tank. Space heat is provided upon demand by circulating water from the solar storage tank through a liquid-to-air heat exchanger mounted in the air duct. When there is no demand for space heat, water from the solar tank is circulated through a counterflow liquid-to-liquid heat exchanger where it heats water being circulated from a 1400-gallon potable water storage tank. A commercial fan coil is used to dump excess heat.

PROJECT INFORMATION

Owner/Builder: La Quinta Motor Inns, Inc.

Contractor: Travis-Braun & Associates, Inc.

Operational Date: Mid 1978

Total Estimated DOE Funds: \$39,307

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Mobile, Alabama

Latitude: 30° 4' N

Climatic Data

Degree Days	Heating 1600	Cooling 2700
Avg. Temp. (°F)	Winter 55	Summer 89
Avg. Insol. (Ly/d)	Winter 250	Summer 525

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 67%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,000

Manufacturer: Revere Copper & Brass, Inc.

Storage

Type: Steel water tank (underground)

Capacity: 1,600 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

A drain-down system is proposed under this grant. This system is one in which, each time the water circulation pump stops, the collector fluid water drains out of and down into the protection of an enclosed space. In this proposal, this enclosed space is the mechanical room of the motel. This system is a hybrid version of a drain-down system employing a heat exchanger. By using this heat exchanger, the buildup of minerals in the solar collector is eliminated. On the solar loop of the system, a contained amount of water is employed. As this water level drops and makeup water is introduced into the system, new minerals, acids, etc., are also introduced; however, this introduction is extremely minor in comparison to the minerals which would be constantly introduced by a direct link between the storage vessel and the solar collectors.

PROJECT INFORMATION

Owner/Builder: Alabama Power Company
Contractor: Cobb, Adams, Benton Architects, Inc.
Operational Date: November 1977
Total Estimated DOE Funds: \$265,000

Building

Type: Office
Area: 17,000 sq. ft.

Location: Montevallo, Alabama

Latitude: 33.1° N

Climatic Data

Degree Days	Heating	2665	Cooling	2059
Avg. Temp. (°F)	Winter	54.2	Summer	77.5
Avg. Insol. (Ly/d)	Winter	304	Summer	522

SOLAR ENERGY SYSTEM

Application Heating 57% Cooling 18% Hot Water 38%

Collector

Type: Liquid flat-plate/reflector
Area (sq. ft.): 2,340
Manufacturer: PPG Industries, Inc.

Storage

Type: Steel water tank (above ground, in basement)
Capacity: 8,000 gallons (hot); 8,000 gallons (chilled)

Auxiliary System Type: Electric hot water boiler

PROJECT DESCRIPTION

The two and one-half story triangular structure is designed to be energy conservative and exceeds the requirements of ASHRAE Standard 90-75. Energy efficiency is achieved through increased insulation in wall and roof areas, utilizing task-oriented lighting design concepts and innovative techniques for shading and reducing the glass areas. South-facing flat-plate double-glazed collectors with black chrome selective coating are located on the roof of the building. Separate insulated storage tanks for hot water from the collectors and chilled water produced by the solar powered absorption machine are located in the basement equipment room. The project will provide data and experience for evaluating impacts of solar energy systems and for developing rate structures for the promotion of solar energy systems.

PROJECT INFORMATION

Owner/Builder: Rodeway Inns of America & R. V. Development Company

Contractor: Charter Builders, Inc.

Operational Date: July 1978

Total Estimated DOE Funds: \$69,643

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Phoenix, Arizona

Latitude: 33° N

Climatic Data

Degree Days	Heating 1093	Cooling 4285
Avg. Temp. (°F)	Winter 56	Summer 92
Avg. Insol. (Ly/d)	Winter 421	Summer 465

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 59.5%

Collector

Type: Evacuated tubular

Area (sq. ft.): 2,500

Manufacturer: General Electric Company

Storage

Type: Insulated steel water tank

Capacity: 3,000 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

The collectors for this system will be located on the roof of the motel. The energy collected by the collectors will be transferred to a double bundle heat exchanger via a collector loop circulating pump. Through the heat exchanger, the absorbed energy will be transferred to the storage tank via the storage loop circulating pump. Utilization of the double bundle heat exchanger eliminates the danger of ethylene glycol leakage from the solar loop to the storage tank. Energy from the storage tank is utilized for the motel potable water and laundry.

PROJECT INFORMATION

Owner/Builder: City of Scottsdale

Contractor: Sullivan & Masson, Inc.

Operational Date: June 1978

Total Estimated DOE Funds: \$200,000

Building

Type: Office

Area: 6,850 sq. ft.

Location: Scottsdale, Arizona

Latitude: 33° N

Climatic Data

Degree Days	Heating	1765	Cooling	4094
Avg. Temp. (°F)	Winter	50	Summer	85
Avg. Insol. (Ly/d)	Winter	250	Summer	625

SOLAR ENERGY SYSTEM

Application Heating 100% Cooling 60% Hot Water 0%

Collector

Type: Concentrating

Area (sq. ft.): 2,700

Manufacturer: To be determined

Storage

Type: Steel water tank (underground)

Capacity: 7,000 gallons

Auxiliary System Type: Electric strip heat

PROJECT DESCRIPTION

This county courthouse is a one-story stucco/block wall, insulated steel roof facility. The collectors are mounted on the flat roof at a very slight tilt angle (less than 5°) and track the sun east to west. A high limit operating aquastat detracts the collectors if a higher than desired temperature exists on the collector energy gathering and storage system. The collectors supply solar heated hot water (220°F) which is piped to either the 25-ton absorption chiller for cooling, to the hot water heating system (180°F) or to the thermal storage tank. Controls to discriminate between heating and cooling, solar system or back-up system are of the automatic electronic type. All pumps are furnished with high temperature seals; piping pressure drops are kept low so that pump motors can be small. The solar system is expected to save \$5000-\$6000 annually, which represents 60% of the annual energy needed for heating and cooling. An economizer cycle will be retrofitted to further reduce energy consumption. Certain areas of the system are designed to accommodate a full monitoring system to be installed later.

PROJECT INFORMATION

Owner/Builder: Tempe Union High School District 213

Contractor: Mardian Construction Company

Operational Date: March 1978

Total Estimated DOE Funds: \$692,100

Building

Type: High school

Area: 264,000 sq. ft.

Location: Tempe, Arizona

Latitude: 33.5° N

Climatic Data

Degree Days	Heating	1552	Cooling	3508
Avg. Temp. (°F)	Winter	58.5	Summer	81.7
Avg. Insol. (Ly/d)	Winter	280	Summer	750

SOLAR ENERGY SYSTEM

Application Heating 83% Cooling 0% Hot Water 90%

Collector

Type: Liquid flat-plate

Area (sq. ft): 20,000

Manufacturer: Southwest Standard

Storage

Type: Insulated steel water tank (partially buried)

Capacity: 47,000 gallons

Auxiliary System Type: Electric

PROJECT INFORMATION

The Corona Del Sol High School has a solar system which will provide thermal energy required for space heating and hot water. Rooftop collectors face south at an angle of 32° from horizontal. Additional energy conservation design features include earth berming at perimeter walls, concentration of building mass, in accordance with sun angles, extensive use of insulation throughout the facility, and use of natural landscaping surrounding the perimeter and interior court of the facility. Heated water from the buried storage tank will be pumped into heat exchangers transferring the heat energy to a four-pipe heating/cooling system and air handlers. Forced air will be discharged from the air handlers as required in various locations of the building.

PROJECT INFORMATION

Owner/Builder: Rodeway Inns of America & R. V. Development Company

Contractor: Charter Builders, Inc.

Operational Date: July 1978

Total Estimated DOE Funds: \$43,704

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Tucson, Arizona

Latitude: 33° N

Climatic Data

Degree Days	Heating 2226	Cooling 2592
Avg. Temp. (°F)	Winter 56	Summer 92
Avg. Insol. (Ly/d)	Winter 421	Summer 465

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 68%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,000

Manufacturer: Raypak, Inc.

Storage

Type: Insulated steel water tank

Capacity: 2,000 gallons

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

Each time the circulation pump stops in the collection loop of this system, water drains out of the collector array into a compression tank in the enclosed mechanical room. Makeup water is provided to the system, thus introducing minerals and acids, but the quantity of these undesirable substances is very low compared to that which would be introduced with a direct link between storage and the solar collectors.

PROJECT INFORMATION

Owner/Builder: City of Cerritos/Redevelopment Agency

Contractor: Maurice H. Fleishman, Architect

Operational Date: May 1978

Total Estimated DOE Funds: \$40,000

Building

Type: City Hall

Area: 51,806 sq. ft.

Location: Cerritos, California

Latitude: 33.8°N

Climatic Data

Degree Days	Heating	1400	Cooling	N/A
Avg. Temp. (°F)	Winter	55	Summer	71
Avg. Insol. (Ly/d)	Winter	272	Summer	622

SOLAR ENERGY SYSTEM

Application Heating 60% Cooling 0% Hot Water 95%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,408

Manufacturer: Ying Manufacturing Corporation

Storage

Type: Insulated steel water tanks (below ground)

Capacity: 3,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

The proposed City Hall is a three-story structure with a lower level approximately three feet below natural grade. An estimated 60% of the building's heating load will be provided by the solar system. The system utilizes the collectors to heat water which is subsequently stored in two 1500-gallon insulated storage tanks. Water from the storage tanks is used to drive heat pumps to provide building space heating. A gas fired boiler is available to provide supplemental heat to the water. Water circulating through heat exchangers in the storage tanks and then through external heat exchangers preheats incoming domestic water. The domestic hot water is stored in conventional gas fired water heaters. The air-conditioning system will be a conventionally electrically operated refrigerator plant having no relationship to the solar heating system.

PROJECT INFORMATION

Owner/Builder: Fredricks Development Corporation

Contractor: Southern California Gas Company

Operational Date: August 1975

Total Estimated DOE Funds: \$391,900 (includes Upland Project)

Building

Type: Apartments (32 units)

Area: 57,600 sq. ft.

Location: El Toro, California

Latitude: 33.6° N

Climatic Data

Degree Days	Heating	1355	Cooling	993
Avg. Temp. (°F)	Winter	59.6	Summer	70.1
Avg. Insol. (Ly/d)	Winter	365	Summer	510

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 70%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,008

Manufacturer: Unitspan Architectural Systems, Inc.

Storage

Type: Glass lined steel water tank

Capacity: 1,200 gallons

Auxiliary System Type: Gas boiler

PROJECT DESCRIPTION

A solar-assisted gas water heater was retrofitted into two El Toro, California apartment buildings. Cost, installation, and performance data are being collected. The data will be used for technical and financial evaluations of the project. The operating costs for systems serving multiple unit buildings are more visible than those for systems serving single family homes. At the same time, multiple unit capital investments are easier to arrange. Cost data from projects such as this will be particularly valuable, helping investors to determine the favorable and unfavorable aspects of investment in multiple unit systems. This project was partially funded by the National Science Foundation. Over 50% was funded by Southern California Gas Company. DOE maintains technical cognizance.

PROJECT INFORMATION

Owner/Builder: Orange County

Contractor: Richard Brooks, Jr. and Associates (Architect)

Operational Date: June 1979

Total Estimated DOE Funds: \$117,215

Building

Type: Library

Area: 10,000 sq. ft.

Location: El Toro, California

Latitude: 33.8° N

Climatic Data

Degree Days	Heating	1867	Cooling	759
Avg. Temp. (°F)	Winter	57	Summer	67
Avg. Insol. (Ly/d)	Winter	314	Summer	559

SOLAR ENERGY SYSTEM

Application Heating 95% Cooling 60% Hot Water 0%

Collector

Type: Evacuated glass tubular

Area (sq. ft.): 1,500

Manufacturer: General Electric Company

Storage

Type: Insulated steel water tank (above ground)

Capacity: 1,500 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

The solar system provides heating, cooling, and storage with complete flexibility in operating modes. Both heating and cooling will be provided by drawing hot water from storage. In the cooling mode the hot water will be pumped to an absorption chiller. The air distribution system consists of a single roof-mounted air handler (with hot and cold water coils) plus various fan-coil units. The collectors are flush-mounted on the shake roof with all plumbing and headers (except for valves and air vents) incorporated within the roof structure. The collector slope faces 30° west of due south. Deionized water is the heat transfer fluid circulated through the collectors. Freeze protection is provided by circulation from storage, during rare periods of freezing ambient temperature. In the event of a power failure, the system automatically drains into the storage tank.

PROJECT INFORMATION

Owner/Builder: ARATEX Services, Inc. (Formerly Work Wear Corporation)

Contractor: Ying Manufacturing Corporation/Clarke Mechanical Inc.

Operational Date: September 1977

Total Estimated DOE Funds: \$165,000 (plus \$17,000 from the California State Energy Resources Conservation and Development Commission)

Building

Type: Industrial laundry

Area: 32,500 sq. ft.

Location: Fresno, California

Latitude: 36.8° N

Climatic Data

Degree Days	Heating 2650	Cooling 1671
Avg. Temp. (° F)	Winter 51.5	Summer 74.8
Avg. Insol. (Ly/d)	Winter 310	Summer 621

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 56%

Collector

Type: Liquid flat-plate

Area(sq. ft.): 6,500

Manufacturer: Ying Manufacturing Corporation

Storage

Type: Insulated fiberglass water tank (above ground)

Capacity: 12,000 gallons

Auxiliary System Type: Gas fired low pressure boiler

PROJECT DESCRIPTION

This system was designed as an integrated wastewater heat recovery and solar preheating system to supply a part of the hot water requirements of the Red Star Industrial Laundry in Fresno, California. It was estimated that the natural gas demand for hot water heating at this facility could be reduced by 56% by the implementation of these conservation measures. The site was chosen as being representative of the more than 2000 large commercial laundries in the U.S.A. The system, which was completed in September 1977, consists of a tube-and-shell wastewater heat recovery subsystem combined with a pass-through flat-plate solar collector and storage subsystem. The design output of the solar subsystem is 2×10^9 Btu/year.

PROJECT INFORMATION

Owner/Builder: Irvine Unified School District

Contractor: United Air Conditioning

Operational Date: May 1978

Total Estimated DOE Funds: \$266,680

Building

Type: Elementary school

Area: 39,500 sq. ft.

Location: Irvine, California

Latitude: 33.6° N

Climatic Data

Degree Days	Heating	1355	Cooling	993
Avg. Temp. (°F)	Winter	59.6	Summer	70.1
Avg. Insol. (Ly/d)	Winter	365	Summer	510

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling ✓ Hot Water 0%

Collector

Type: Water cooled evacuated tubular

Area (sq. ft.): 5,000

Manufacturer: Owens-Illinois, Inc.

Storage

Type: None

Capacity: Not applicable

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

This project calls for retrofit solar augmentation of the heating and cooling system of the El Camino Real Elementary School. The school is an appropriate subject for the project, because it is new and has good insulation and very few windows. Solar energy is used to drive one of the school's two ARKLA 100-ton absorption chillers. Irvine is also a good location for the project. It has 70% sunshine during daylight hours, and it is warm enough that the collectors will not require drainage to prevent freezing. The system's working fluid will be demineralized water with environmentally acceptable corrosion inhibitors as the only additives. The water will be stored in a 1500-gallon above-ground storage tank. Hot water from the boiler is fed directly to fancoil units in the various zones within the building. Cool water from the chillers is provided to cooling coils located in 7 plenums. Fresh air makeup is about 20%.

PROJECT INFORMATION

Owner/Builder: City of Long Beach

Contractor: Richard L. Poper, Architect

Operational Date: October 1978

Total Estimated DOE Funds: \$15,000

Building

Type: Fire station

Area: 8,000 sq. ft.

Location: Long Beach, California

Latitude: 34° N

Climatic Data

Degree Days	Heating	1711	Cooling	N/A
Avg. Temp. (°F)	Winter	63	Summer	69
Avg. Insol. (Ly/d)	Winter	438	Summer	460

SOLAR ENERGY SYSTEM

Application Heating 66% Cooling 0% Hot Water 60%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 277

Manufacturer: Raypak, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 500 gallons

Auxiliary System Type: Hot water boiler

PROJECT DESCRIPTION

Fire Station No. 21 was designed as a prototype for future fire stations in Long Beach. The building will house living and office space and an apparatus room. The area of the roof above the apparatus room is designed to accommodate the solar panels. While the system's primary function will be space heating, any time excess capacity exists, the system will be used to heat domestic hot water. The heating system will consist of 277 sq. ft. of solar panels, a 500-gallon storage tank, control system, and the required distribution system. The air side of the system will consist of five fan coil units with economizer cycles. The storage tank will be adjacent to the mechanical equipment room. Pumps and controls will be located in the mechanical room.

PROJECT INFORMATION

Owner/Builder: City of Los Angeles

Contractor: City of Los Angeles

Operational Date: September 1978

Total Estimated DOE Funds: \$230,215

Building

Type: Police station

Area: 24,600 sq. ft.

Location: Los Angeles, California

Latitude: 34°N

Climatic Data

Degree Days	Heating	2061	Cooling	N/A
Avg. Temp. (°F)	Winter	67	Summer	78
Avg. Insol. (Ly/d)	Winter	260	Summer	606

SOLAR ENERGY SYSTEM

Application Heating 65% Cooling 0% Hot Water 70%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 6,600

Manufacturer: Solargenics, Inc.

Storage

Type: Type: Insulated glass lined steel water tanks (underground)

Capacity: 16,630 gallons

Auxiliary System Type: Hydronic

PROJECT DESCRIPTION

The building selected for installation of a solar heating, hot water and off-peak cooling system is the Wilshire Division Station of the Los Angeles Police Department. The Venice Division Station is an identical building located four miles away and will be monitored for comparison purposes. The buildings are windowless, having solid concrete walls with a brick veneer. Both have a substantial hot water load, due to 24-hour occupancy with policemen using showers between shifts. The storage tanks will be mounted vertically to achieve a high degree of stratification.

PROJECT INFORMATION

Owner/Builder: Iris Images, Inc.

Contractor: Interactive Resources, Inc.

Operational Date: July 1976

Total Estimated DOE Funds: \$35,154

Building

Type: Film laboratory

Area: 3,700 sq. ft.

Location: Mill Valley, California

Latitude: 37.9° N

Climatic Data

Degree Days	Heating	2970	Cooling	530
Avg. Temp. (°F)	Winter	55.0	Summer	72.2
Avg. Insol. (Ly/d)	Winter	294	Summer	531

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 59%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 640

Manufacturer: Interactive Resources, Inc.

Storage

Type: Glass lined steel water tank (above ground)

Capacity: 360 gallons

Auxiliary System Type: Gas fired water heater

PROJECT DESCRIPTION

The project involves the application of a solar water heating system for an industrial film process application. The lab's photo processors require a peak 12 gallons per minute of 100°F water, and an average load of six gallons per minute is anticipated. An expected 59% of this heating requirement will be provided by the solar collectors which are fabricated on site and mounted on tilted decks atop the flat roof. The collectors are made up of water-cooled copper tubes with aluminum fins. Water is circulated from an insulated storage tank, the water circulates only when the collectors are warmer than the stored water. The solar storage tank feeds a conventional water heater under normal city water pressure. The average rate of auxiliary energy used for heating hot water should be no greater than 129,000,000 Btu/month. The system has been designed to allow for public viewing without disturbing the operation of the lab.

PROJECT INFORMATION

Owner/Builder: Rodeway Inns of America & R. V. Development Company

Contractor: Charter Builders, Inc.

Operational Date: July 1978

Total Estimated DOE Funds: \$58,922

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: North Highlands, California

Latitude: 39° N

Climatic Data

Degree Days	Heating 2971	Cooling 1654
Avg. Temp. (°F)	Winter 49.7	Summer 84
Avg. Insol. (Ly/d)	Winter 236	Summer 486

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 63.2%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 3,000

Manufacturer: Raypak, Inc.

Storage

Type: Insulated steel water tank

Capacity: 2,000 gallons

Auxiliary System Type: Gas boiler

PROJECT DESCRIPTION

Each time the circulation pump stops in the collection loop of this system, water drains out of the collector array into a compression tank in the enclosed mechanical room. Makeup water is provided to the system, thus introducing minerals and acids, but the quantity of these undesirable substances is very low compared to that which would be introduced with a direct link between storage and the solar collectors.

PROJECT INFORMATION

Owner/Builder: Norman Brock/Ridgeline Racquet Club, Inc.

Contractor: Controlco (HVAC contractor)

Operational Date: March 1978

Total Estimated DOE Funds: \$177,682

Building

Type: Clubhouse

Area: 10,650 sq. ft.

Location: Orange, California

Latitude: 34° N

Climatic Data

Degree Days	Heating	1245	Cooling	1185
Avg. Temp. (°F)	Winter	60.5	Summer	69.1
Avg. Insol. (Ly/d)	Winter	474.8	Summer	543.4

SOLAR ENERGY SYSTEM

Application Heating 95% Cooling 70% Hot Water 95%

Collector

Type: Liquid tracking concentrating

Area (sq. ft.): 3,300

Manufacturer: Northrup, Inc.

Storage

Type: Insulated steel water tank (underground)

Capacity: 5,000 gallons

Auxiliary System Type: Gas fired boiler and domestic hot water heater

PROJECT DESCRIPTION

During the summer months, this solar system provides cooling through an absorption machine located in a "sheltered" room. When the system is indexed to the heating (winter) position, the solar cooling is de-activated and the collectors begin providing space heating hot water as well as providing the requirements of the domestic hot water load. Should freezing conditions occur, a sensor in the collector arrays will override the collector pump controls and circulate water through the collectors. The collector tracking motor is controlled by two silicon cells set on a base at a 60° angle to one another facing the sun. When one cell receives more radiation than the other, the circuit becomes unbalanced and the driving motor operates in the appropriate direction until equilibrium is restored by pointing the cells (and the collectors) directly into the sun. The maximum expected temperature under no flow conditions will be (in steady state) the ambient temperature. This is primarily because the tracking device will automatically de-focus the collectors under no flow conditions.

PROJECT INFORMATION

Owner/Builder: San Diego Unified School District

Contractor: Hugh Carter Engineering

Operational Date: July 1979

Total Estimated DOE Funds: \$392,740

Building

Type: High school

Area: 185,000 sq. ft. (40,000 sq. ft. cooling only)

Location: San Diego, California

Latitude: 32.75° N

Climatic Data

Degree Days	Heating	1439	Cooling	700
Avg. Temp. (° F)	Winter	55	Summer	71
Avg. Insol. (Ly/d)	Winter	256	Summer	483

SOLAR ENERGY SYSTEM

Application Heating 75% Cooling 71% Hot Water 90%

Collector

Type: Parabolic/concentrating

Area (sq. ft.): 14,680/2,328

Manufacturer: Solartec Corporation/Northrup, Inc.

Storage

Type: Insulated steel water tanks (underground)

Capacity: 99,900 gallons

Auxiliary System Type: Convertible gas and oil fired boilers, electric cooling.

PROJECT DESCRIPTION

The school site is approximately 80 acres of land typical of the Southern California coastal terrain with arrays cutting into relatively flat mesas. The solar collector field will be located on a south facing hill which forms a backdrop for the four, one-story buildings. For maximum solar augmentation of energy requirements, the mechanical design favors a central heating and cooling plant adjacent to the solar collection field. An enthalpy controlled economizer cycle will be used at each building. Air handling units with variable volume air valves for each zone will supply air for the space heating and cooling loads. A time clock control system insures that the buildings are not heated or cooled when they are vacant. A one-half to one-hour morning preheat cycle closes outside air and recirculates 100%. The return air passes through the lighting units which lessens the light heat rejected to the space and reduces supply volume equipment size and operating costs. The solar panels are sized to provide an expected overall annual 70-80% thermal energy savings.

Photograph not available

PROJECT INFORMATION

Owner/Builder: Storek & Storek

Contractor: Berkeley Solar Group

Operational Date: October 1979

Total Estimated DOE Funds: \$138,866

Building

Type: Office

Area: 55,000 sq. ft.

Location: San Francisco, California

Latitude: 37.5° N

Climatic Data

Degree Days	Heating	3200	Cooling	130
Avg. Temp. (°F)	Winter	51	Summer	59
Avg. Insol. (Ly/d)	Winter	150	Summer	700

SOLAR ENERGY SYSTEM

Application Heating 57% (active); 23% (passive) Cooling 0%
Hot Water 100%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,800

Manufacturer: Chamberlain Manufacturing Corporation

Storage

Type: Steel water tank (on roof)

Capacity: 3,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

An obsolete downtown power generating plant built in 1916 is being reconstructed as an energy-efficient office building to be known as the San Francisco Environmental Center. The Center will be headquarters for environmental organizations and a public environmental education center serving the Bay Area. The windows supply 23% of the annual energy delivered to the building for space heating, the solar collectors 57%, and auxiliary systems 20%. Energy conservation features include lighting, HVAC, elevator, and envelope design innovations as well as lowered temperature standards. Solar space heating will be effected by flat-plate collectors and a system of variable reflective/absorbent window blinds.

PROJECT INFORMATION

Owner/Builder: Oak Grove School District

Solar System Designer: McCaughey & Smith Energy Associates

Operational Date: October 1978

Total Estimated DOE Funds: \$318,615

Building

Type: Elementary school

Area: 34,650 sq. ft.

Location: San Jose, California

Latitude: 37° N

Climatic Data

Degree Days	Heating	2416	Cooling	443
Avg. Temp. (°F)	Winter	54	Summer	65
Avg. Insol. (Ly/d)	Winter	313	Summer	570

SOLAR ENERGY SYSTEM

Application Heating 85% Cooling 55% Hot Water 0%

Collector

Type: Unevacuated glass tubular

Area (sq. ft.): 5,184

Manufacturer: KTA Corporation

Storage

Type: Insulated steel water tank (above ground)

Capacity: 2,000 gallons

Auxiliary System Type: Gas fired absorption chiller and boiler

PROJECT DESCRIPTION

The solar collectors for this building will be distributed within the space between the existing rooftop equipment. Five thousand sq. ft. of collectors can be accommodated with proper manifolding and without interfering with the existing equipment. Two of the five existing chillers will be replaced. These chillers will operate on hot water pumped directly from the collectors or alternately from storage. Chillers 1 and 2 will usually be capable of handling the in-phase load during periods of moderate to high insolation. Chillers 3, 4, and 5 will be used on demand in sequence when chillers 1 and 2 cannot meet the load due to lack of insolation or extremely high demand for cooling. Space heating will be provided from storage when the system is in the heating mode. During periods when the solar collectors are over-supplying heat, the storage tank will first accept heat to a temperature of 210°F. Any additional heat will be rejected by means of air cooled radiators. During vacation periods, the collectors will be drained into the storage tank.

PROJECT INFORMATION

Owner/Builder: City of Santa Clara
Contractor: City of Santa Clara
Operational Date: April 1977
Total Estimated DOE Funds: \$670,000

Building

Type: Community center
Area: 27,000 sq. ft.

Location: Santa Clara, California

Latitude: 37.3°N

Climatic Data

Degree Days	Heating	2943	Cooling	647
Avg. Temp. (°F)	Winter	54.6	Summer	67.6
Avg. Insol. (Ly/d)	Winter	308	Summer	545

SOLAR ENERGY SYSTEM

Application Heating 85% Cooling 65% Hot Water ✓

Collector

Type: Liquid flat-plate
Area (sq. ft.): 7,085
Manufacturer: Ametek, Inc.

Storage

Type: Insulated steel water tank (underground)
Capacity: 10,000 gallons (hot); 50,000 gallons (cold)

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

A solar-driven heating and cooling system featuring high performance flat-plate solar collectors capable of driving conventional ARKLA lithium bromide absorption chillers has been installed by the City of Santa Clara on its Community Recreation Center. The city operates its own utility (water and electric) and is concerned about the future availability of conventional fuels and the need for energy conservation. Design, construction, legal and performance reports will be prepared on the project. As a result of this project, the city has created a Solar Division in its Utility Department and leases solar energy systems to its customers. Presently 80 swimming pool heaters and five home heating systems are being leased. The solar home heating systems are limited to the existing five systems, but the swimming pool solar heating program is continuing to expand. In the near future, the program will be expanded to include domestic hot water heaters. The city believes that utility ownership and leasing is a feasible and economical means of developing and utilizing solar energy.

PROJECT INFORMATION

Owner/Builder: Renault & Handley

Contractor: Renault & Handley

Operational Date: June 1978

Total Estimated DOE Funds: \$150,834

Building

Type: Industrial buildings

Area: 105,000 sq. ft.

Location: Santa Clara, California

Latitude: 37½°N

Climatic Data

Degree Days	Heating	2950	Cooling	420
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Avg. Temp. (°F)	Winter	50	Summer	67
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Avg. Insol. (Ly/d)	Winter	225	Summer	600
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SOLAR ENERGY SYSTEM

Application Heating 85% Cooling 0% Hot Water 90%

Collector

Type: Liquid flat-plate (active); concrete wall (passive)

Area (sq. ft.): 5,006 (active); 2,800 (passive)

Manufacturer: Revere Copper & Brass, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 13,000 gallons

Auxiliary System Type: Natural gas boiler

PROJECT DESCRIPTION

Energy conservation was the starting point of the planning and architecture for this R&D/light manufacturing facility. This large demonstration project features a passive south wall collector in addition to an active system which will provide approximately 85% of the annual heating requirements from solar. The design was made compatible for a cooling absorption system which may be added later. A unique solar panel support provides a roof canopy at 45°. There will be 5006 sq. ft. of flat-plate high performance collectors and 2800 sq. ft. of passive collectors mounted on the south wall. An overhang at the south wall protects the passive collectors in the summer. The roof is highly insulated (R19) and the glass is thermopane. Landscaping complements the energy design with deciduous trees shading portions of the building from heat during the summer and allowing sun heat during the winter. Current standard construction methods were utilized for the design to keep costs competitive and insure predictability of maintenance expenses.

PROJECT INFORMATION

Owner/Builder: City of Saratoga/Mechanics Research, Inc.

Contractor: Mechanics Research, Inc.

Operational Date: June 1978

Total Estimated DOE Funds: \$88,389

Building

Type: Library

Area: 18,000 sq. ft. (total); 16,600 sq. ft. (cond.)

Location: Saratoga, California

Latitude: 37.3° N

Climatic Data

Degree Days	Heating	2794	Cooling	565
Avg. Temp. (° F)	Winter	50.8	Summer	65.6
Avg. Insol. (Ly/d)	Winter	231	Summer	554

SOLAR ENERGY SYSTEM

Application Heating 45% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,050

Manufacturer: Ying Manufacturing Corporation

Storage

Type: Insulated steel water tank (above ground)

Capacity: 3,700 gallons

Auxiliary System Type: Gas fired water boiler

PROJECT DESCRIPTION

Consideration for future solar heating was incorporated in the design of the building's heating system. The conventional heating system supplies heating hot water to commercial air handling units which, in turn, provide space heating. The solar heating system for this project will allow heating water to be supplied from an above ground hot water storage tank or from the conventional system with a controller diverting the flow as necessary. Approximately 2050 sq. ft. of flat-plate collectors will be placed on the major portion of the south-facing roof area. The panels will be attached directly to the 22° sloped roof. The collector array was designed to be mounted directly on the roof because it was felt that most western style roofs are at low slopes and that the panels should not destroy the architecture. It was also felt that a "garden" of panels in an adjacent open area was unattractive.

PROJECT INFORMATION

Owner/Builder: Lake Valley Fire District

Contractor: John Brooks Boyd Associates/William E. Harlow

Operational Date: April 1978

Total Estimated DOE Funds: \$8,783

Building

Type: Fire station

Area: 2,400 sq. ft.

Location: South Lake Tahoe, California

Latitude: 38.9° N

Climatic Data

Degree Days	Heating	8100	Cooling	492
Avg. Temp. (° F)	Winter	20	Summer	60
Avg. Insol. (Ly/d)	Winter	372	Summer	693

SOLAR ENERGY SYSTEM

Application Heating 50% Cooling 0% Hot Water 50%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 352

Manufacturer: Western Energy, Inc.

Storage

Type: Insulated fiberglass water tank (above ground)

Capacity: 1,200 gallons

Auxiliary System Type: Gas boiler/wood burning heater

PROJECT DESCRIPTION

Solar energy provides heat and hot water for the interior of the newly constructed Lake Valley Firehouse No. 2, also known as the Montgomery Estates Fire Station. This includes the firemen's living quarters and the engine room. In winter, solar-heated water is used to melt snow on the driveway of the station. Performance monitoring of the solar system is carried out by the fire station personnel. This project should result in a reduction of operational costs. If this project is successful, a retrofit system for Lake Valley's main station will be considered. There are no other public facilities currently utilizing solar energy in this region; this project will serve as a model to county, city, and special districts considering potential solar projects.

ECT INFORMATION

Owner/Builder: Stanford University

Contractor: Interactive Resources

Operational Date: August 1978

Total Estimated DOE Funds: \$57,250

Building

Type: Food service

Area: 25,562 sq. ft. (total); 2,726 sq. ft. (cond.)

Location: Stanford, California

Latitude: 37° N

Climatic Data

Degree Days	Heating	2869	Cooling	200
Avg. Temp. (°F)	Winter	49	Summer	65
Avg. Insol. (Ly/d)	Winter	185	Summer	631

SOLAR ENERGY SYSTEM

Application Heating 79% Cooling 0% Hot Water 79%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 830

Manufacturer: Solar Energy Products

Storage

Type: Cement lined steel water tank (above ground)

Capacity: 1,550 gallons

Auxiliary System Type: Natural gas boiler

PROJECT DESCRIPTION

The Central Food Service Building is a single-story complex with a flat roof. Since completion six years ago, three of the four installed heating coils have been disconnected, reducing the building's heating capacity to 87%. Only the administration wing is currently heated. The major demand on the solar system will be for hot water for cleaning the meat packing area. Potable water under city water pressure runs throughout the 1000-ft. collector system; a heat exchanger will be used to transfer heat from the solar loop to the forced air space heating system.

PROJECT INFORMATION

Owner/Builder: Fredricks Development Corporation

Contractor: Southern California Gas Company

Operational Date: April 1976

Total Estimated DOE Funds: \$391,900 (includes El Toro project)

Building

Type: Apartments (40 units)

Area: 57,600 sq. ft.

Location: Upland, California

Latitude: 34.1° N

Climatic Data

Degree Days	Heating	1282	Cooling	1215
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Avg. Temp. (°F)	Winter	59.6	Summer	76.3
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Avg. Insol. (Ly/d)	Winter	390	Summer	561
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SOLAR ENERGY SYSTEM

Application	Heating	0%	Cooling	0%	Hot Water	70%
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Collector

Type: Liquid flat-plate

Area (sq. ft.): 800

Manufacturer: Lennox Industries, Inc./Honeywell, Inc.

Storage

Type: Glass lined steel water tank

Capacity: 1,200 gallons

Auxiliary System Type: Gas boiler

PROJECT DESCRIPTION

In this project, a solar assisted gas water heater was installed during the construction of an apartment building in Upland, California. Data on system cost, installation, and performance will be used for technical and financial studies of the project, with particular emphasis being placed on determining optimum implementation procedures. The solar collectors used in this project consist of a steel absorber plate with integral copper waterways and a selective absorber coating (black chrome) with low iron single glazing. The building has copper piping to carry heat transfer fluid to and from the solar collectors. The emphasis in this project is on cost effectiveness, and system components were chosen with that in mind. Cost data from this project and others like it will be valuable, because it will help potential investors to determine the favorable and unfavorable aspects of investment in solar energy systems for multiple unit buildings. This project was partially funded by the National Science Foundation. Over 50% was funded by Southern California Gas Company. DOE maintains technical cognizance.

PROJECT INFORMATION

Owner/Builder: Adams-Arapahoe Joint School District

Contractor: Bridgers & Paxton Engineers

Operational Date: February 1978

Total Estimated DOE Funds: \$33,697

Building

Type: Elementary school

Area: 49,347 sq. ft.

Location: Aurora, Colorado

Latitude: 39° 45'N

Climatic Data

Degree Days	Heating 6283	Cooling 1500
Avg. Temp. (°F)	Winter 34.3	Summer 64.5
Avg. Insol. (Ly/d)	Winter 310	Summer 540

SOLAR ENERGY SYSTEM

Application Heating 42.4% Cooling 0% Hot Water 35.2%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,781

Manufacturer: American Heliothermal

Storage

Type: Insulated steel water tanks (underground)

Capacity: 27,800 gallons

Auxiliary System Type: Reciprocating water-to-air heat pumps with storage/hot water electric boiler

PROJECT DESCRIPTION

The sun's energy is captured in a series of solar collector panels mounted on the roof of this one-story building in two banks which face due south at an angle of approximately 53° above horizontal. A mixture of water and ethylene glycol is pumped through the panels and the energy is transferred to the liquid solution in the form of heat. The heat is transferred through a solar collector heat exchanger to the hot water storage tank. The storage tank is able to accept energy from the solar heat source; heat pumps returning heat recovered from the building; and the heat from the electric hot water boiler. The boiler is sized as a supplemental boiler to provide the energy lost by transmission, but with the heat pump in parallel total loads are met. The boiler will handle 100% of the load if necessary when the building is shut down. This system is a totally integrated one with utilization of energy generated from people and lights as well as solar. The solar energy reduces the requirement of energy output by heat pumps and boiler.

PROJECT INFORMATION

Owner/Builder: Paul Shippee

Contractor: Colorado Sunworks

Operational Date: August 1978

Total Estimated DOE Funds: \$75,000

Building

Type: High rise motel

Area: Not applicable to hot water systems

Location: Boulder, Colorado

Latitude: 40° N

Climatic Data

Degree Days	Heating 7420	Cooling 383
Avg. Temp. (° F)	Winter 38.5	Summer 66.9
Avg. Insol. (Ly/d)	Winter 292	Summer 528

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 76%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 4,488

Manufacturer: Colorado Sunworks

Storage

Type: Insulated wood tank lined with vinyl/steel tanks
(in mechanical room)

Capacity: 7,000 gallons

Auxiliary System Type: Natural gas boiler

PROJECT DESCRIPTION

The solar collection and storage system is divided into two separate and distinct systems servicing two separate boiler rooms. Twelve banks (48 collectors) are to be placed on the two-story roof of the south wing at 45° to the horizontal facing south. Fifty-six banks (224 collectors) are to be placed on the one-story roof of the service area and on the two-story roof of the west wing. The solar collectors will automatically drain down each time the solar pump turns off, thus providing freeze protection and eliminating the need for antifreeze and collector loop heat exchanger. The solar tank is interfaced with the service hot water tank by routing the city main water through a series of pressurized stainless steel tanks immersed in the open solar collection water storage. This scheme allows city pressure to drive the heat exchanger flow in the demand loop thereby eliminating the need for pumps and controls.

PROJECT INFORMATION

Owner/Builder: Jefferson County School District

Contractor: Jefferson County

Operational Date: August 1978

Total Estimated DOE Funds: \$176,240

Building

Type: School for the retarded

Area: 42,000 sq. ft.

Location: Lakewood, Colorado

Latitude: 39.8° N

Climatic Data

Degree Days	Heating	6283	Cooling	625
Avg. Temp. (°F)	Winter	37	Summer	66
Avg. Insol. (Ly/d)	Winter	218	Summer	471

SOLAR ENERGY SYSTEM

Application Heating 62.5% Cooling 0% Hot Water 100%

Collector

Type: Liquid flat-plate

Area(sq. ft.): 4,595

Manufacturer: Rocky Mountain Products

Storage

Type: Insulated steel water tank (in mechanical room)

Capacity: 9,000 gallons

Auxiliary System Type: Natural gas fired hot water boiler

PROJECT DESCRIPTION

The existing building will be retrofitted with a solar system. The solar portion of this project is a custom-built flat-plate liquid-cooled collector with the necessary piping, pumps, heat exchangers, storage, and controls that are needed to tie into the existing mechanical system. The mechanical system of this building is very adaptable to a solar system, because the major portion of the building is served by a unitary water-to-air heat pump system. The advantage of this system is its low operating water temperature, in the range of 60°F to 90°F. Lower fluid temperatures in the collector allow for greater efficiency in converting incident radiation into thermal energy. The ventilation air is provided by air handlers that mix outside air with return air from the occupied space. Such a system puts to use the thermal energy generated by lights and people into the tempering of the outside air. Heat for the building is presently provided by a natural gas fired hot water boiler.

PROJECT INFORMATION

Owner/Builder: City of Littleton

Contractor: Bridgers & Paxton Engineers

Operational Date: December 1977

Total Estimated DOE Funds: \$184,455

Building

Type: City Hall

Area: 56,000 sq. ft.

Location: Littleton, Colorado

Latitude: 39° 5'N

Climatic Data

Degree Days	Heating	6283	Cooling	625
Avg. Temp. (° F)	Winter	37.6	Summer	65.9
Avg. Insol. (Ly/d)	Winter	292	Summer	471

SOLAR ENERGY SYSTEM

Application Heating 89.2% Cooling 0% Hot Water 80%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 8,360

Manufacturer: Sunworks, Inc.

Storage

Type: Insulated steel water tanks (underground)

Capacity: 27,800 gallons

Auxiliary System Type: Electric hot water boiler and heater

PROJECT DESCRIPTION

The proposed solar energy system consists of flat-plate solar collectors, storage tanks, heat exchangers, pumps, piping and appurtenances required for the solar-assisted internal heat recovery pump system. The two-story brick center is a new building and will be open 24 hours a day. The project has been designed with an internal heat recovery heat pump system as the basic system for the heating, ventilating, and air conditioning systems, with the solar collector system to provide an additional heat source. The flat-plate collectors are installed on the roof of the building facing due south and have an elevation of 60° to horizontal. Collected solar energy will be stored outside in two underground insulated storage tanks. Solar heat is transferred from the ethylene glycol-water solar loop circuit to the water in the tanks by heat exchangers. Water in the tanks is used for domestic hot water heating, direct building heating, and as a heat source for the heat pumps to heat the building (when tank temperatures are not adequate for direct heating).

PROJECT INFORMATION

Owner/Builder: Town of Vail

Contractor: InterTechnology, Inc.

Operational Date: August 1978

Total Estimated DOE Funds: \$18,717

Building

Type: Bus stop shelter

Area: 250 sq. ft.

Location: Vail, Colorado

Latitude: 39.6° N

Climatic Data

Degree Days	Heating 8426	Cooling 400
Avg. Temp. (° F)	Winter 10	Summer 60
Avg. Insol. (Ly/d)	Winter 290	Summer 525

SOLAR ENERGY SYSTEM

Application Heating 100% Cooling 0% Hot Water 0%

Collector

Type: Pyramidal Optics

Area (sq. ft.): 250

Manufacturer: Wormser Scientific Corporation

Storage

Type: Insulated steel water tank (in ceiling)

Capacity: 500 gallons

Auxiliary System Type: None

PROJECT DESCRIPTION

Glass partitions for this 16' x 16' solar heated bus stop will act as windbreaks without obstructing the view of oncoming vehicles. The electricity which is normally supplied to the bus stop will be used to activate the controls and control motors in this system. The system uses concentrating optics that direct the solar rays onto the storage tank. The rays pass through the Plexiglas, 55° tilted roof, strike either the interior glass window or the reflector surfaces. The interior, water-white, tempered glass window covers the storage tank to prevent excessive convection losses from the tank. The tank is coated on the solar side with a black-chrome, selective surface. On the opposite side, the tank is coated with a flat black paint so it can radiate the occupied space below. There is no circulation of fluid since the storage tank acts as absorber, storer, and radiator of the solar energy. The optical arrangement is designed with a movable shutter that compensates for changes in solar declination with season. This same shutter has been modified so it can close over the tank, thereby preventing large night heat losses through the roof.

PROJECT INFORMATION

Owner/Builder: John R. McColl, Jr./ William H. Wade

Contractor: McColl-Wade, Inc.

Operational Date: February 1978

Total Estimated DOE Funds: \$62,788

Building

Type: Commercial/industrial

Area: 7,135 sq. ft. (total); 6,367 sq. ft. (cond.)

Location: Branford, Connecticut

Latitude: 41°N

Climatic Data

Degree Days	Heating	5804	Cooling	800
Avg. Temp. (°F)	Winter	31.9	Summer	70.8
Avg. Insol. (Ly/d)	Winter	225	Summer	425

SOLAR ENERGY SYSTEM

Application Heating 65% Cooling 0% Hot Water 85%

Collector

Type: Air flat-plate

Area (sq. ft.): 1,950

Manufacturer: Solaron Corporation

Storage

Type: Rock bed (above ground, inside building)

Capacity: 975 cu. ft. (pebble bed)

Auxiliary System Type: Gas fired warm air

PROJECT DESCRIPTION

A solar assisted heating system (gas fired auxiliary) utilizing warm air for space heating and domestic hot water heating via a finned coil and pebble bed storage is used in this thoroughly insulated wood-frame building. Because the office portion of the building is rental space and public space, there are five zones, each with a separate system incorporating five separate storage bins. All domestic hot water heating will be provided by the shop zone system; each individual system will provide its own space heating. The zone concept will minimize storage volumes and duct sizes. The design utilizes 100 panels, located on the steep (51°) south-facing roof.

SCHEMATIC NOT AVAILABLE

PROJECT INFORMATION

Owner/Builder: Danbury Hospital

Contractor: Danbury Hospital

Operational Date: June 1978

Total Estimated DOE Funds: \$436,641

Building

Type: Hospital

Area: 423,500 sq. ft.

Location: Danbury, Connecticut

Latitude: 41.3°N

Climatic Data

Degree Days	Heating	5754	Cooling	800
Avg. Temp. (°F)	Winter	31	Summer	73
Avg. Insol. (Ly/d)	Winter	146	Summer	443

SOLAR ENERGY SYSTEM

Application Heating 92% Cooling 0% Hot Water 8%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 19,000

Manufacturer: Libbey-Owens-Ford Company

Storage

Type: Rubber lined reinforced concrete water tank
(in mechanical room)

Capacity: 47,000 gallons

Auxiliary System Type: Electric boiler (heating); oil generated steam (hot water)

PROJECT DESCRIPTION

The solar system will incorporate 19000 sq. ft. of double-glazed, selective surfaced flat-plate collectors for heating and domestic hot water supplementation of the acute medical care facilities. The hospital has a large demand for this low-grade heat 24 hours a day, all year. The present conventional system has a 47000-gallon water storage tank which will be tied in with the solar system. The collectors are mounted on the three-stepped lower balconies and on the roof and penthouse. There are two sets of two "piggyback" heat exchangers on the solar loop which will supply heat to the boilers, storage tank, and domestic water incoming from the main.

PROJECT INFORMATION

Owner/Builder: American Motor Inns, Inc.

Contractor: To be determined

Operational Date: October 1978

Total Estimated DOE Funds: \$32,475

Building

Type: High rise motor inn

Area: Not applicable to hot water systems

Location: East Hartford, Connecticut

Latitude: 41°N

Climatic Data

Degree Days	Heating	5707	Cooling	819
Avg. Temp. (°F)	Winter	28	Summer	71
Avg. Insol. (Ly/d)	Winter	250	Summer	450

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 58%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,491

Manufacturer: Sunworks, Inc.

Storage

Type: Insulated steel water tanks (in mechanical room)

Capacity: 2,000 gallons

Auxiliary System Type: Boiler fired by natural gas

PROJECT DESCRIPTION

This proposed system consists of two distinct systems. One system, consisting of 16 collectors and a new 500-gallon storage tank, will provide hot water to the kitchen, dining area and managerial offices located in the commercial building. The existing 250-gallon hot water heater will provide any auxiliary energy. The other system, consisting of 55 collectors and the existing 1000-gallon storage tank will provide hot water to the 131 guest unit building and laundry. An additional 500-gallon storage tank will be connected to the discharge of the existing boiler. This boiler will provide any auxiliary energy required.

PROJECT INFORMATION

Owner/Builder: Hamden Connecticut Housing Authority
Contractor: State of Connecticut, Dept. of Community Affairs
Operational Date: March 1978
Total Estimated DOE Funds: \$389,200
Building
Type: Multifamily elderly housing
Area: 16,800 sq. ft. (total); 8,400 sq. ft. (cond.)
Location: Hamden, Connecticut
Latitude: 41.4° N

Climatic Data

Degree Days	Heating	5555	Cooling	825
Avg. Temp. (°F)	Winter	33.0	Summer	68.0
Avg. Insol. (Ly/d)	Winter	150	Summer	550

SOLAR ENERGY SYSTEM

Application Heating 75% Cooling 0% Hot Water 85%

Collector

Type: Liquid flat-plate
Area (sq. ft.): 2,600
Manufacturer: Solar Products Manufacturing Corporation

Storage

Type: Insulated concrete water tank (underground)
Capacity: 8,000 gallons

Auxiliary System Type: Electric fan coil

PROJECT DESCRIPTION

This experiment will test the practicality and economy of using solar energy and other energy conservation techniques in housing for the elderly. The proposed project will consist of 40 housing units in low-rise structures. All will be designed for energy conservation. One-half of the 40 units will be equipped with solar space and water heating and one-half will serve as a control in order that accurate conclusions on life cycle costs and performance may be drawn. A questionnaire will be used to determine how effective the tenants consider the solar energy system. The application will be a prototype for future state-assisted projects. The design and construction process will be integrated as closely as possible into the guidelines and procedures of Connecticut's Department of Community Affairs' (DCA) ongoing elderly housing program. As with all DCA elderly projects, the site will be acquired, the construction contract will be let, and the project will be owned and managed by a local housing authority.

PROJECT INFORMATION

Owner/Builder: Albie Booth Memorial Boys Club

Contractor: Albie Booth Memorial Boys Club

Operational Date: September 1978

Total Estimated DOE Funds: \$325,354

Building

Type: Boys club and community center

Area: 35,000 sq. ft.

Location: New Haven, Connecticut

Latitude: 41.25°N

Climatic Data

Degree Days	Heating	5896	Cooling	584
Avg. Temp. (°F)	Winter	43.5	Summer	71.9
Avg. Insol. (Ly/d)	Winter	300	Summer	475

SOLAR ENERGY SYSTEM

Application Heating 40.3% Cooling 0% Hot Water 56.6%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 6,300

Manufacturer: Solar Heating Systems Corporation

Storage

Type: Insulated steel water tanks (above ground)

Capacity: 16,000 gallons

Auxiliary System Type: Oil/gas fired boiler

PROJECT DESCRIPTION

This solar system will be used in conjunction with the oil/gas fired conventional system and will supply approximately 40% of the annual heating load and 56% of the domestic hot water load. Thus, the conventional heating system is not an "auxiliary" or "back-up" but shares a co-role or complementary relationship with the solar system as designed. The conventional system is capable of supplying the entire building heating and hot water load by itself if necessary. There will be 240, 3' x 8.75' collectors facing true south at an elevation angle of 50° retrofitted to the flat roof. The thermal energy collected will be transferred to two tanks containing 7500 gallons of water each, mounted vertically in an enclosure adjacent to the building. Transfer will be accomplished via a closed circulating loop containing a heat transfer fluid. An additional feature, the conversion of an existing roof-mounted air conditioning unit to a heat pump, will be added. The heat pump will heat a specific portion of the building and will use solar assist whenever possible and practical.

PROJECT INFORMATION

Owner/Builder: Lutz-Sotire Partnership
Contractor: Wormser Scientific Corporation
Operational Date: November 1977
Total Estimated DOE Funds: \$357,100

Building

Type: Office
Area: 25,000 sq. ft. (cond.)

Location: Stamford, Connecticut

Latitude: 41.1° N

Climatic Data

Degree Days	Heating	5461	Cooling	735
Avg. Temp. (°F)	Winter	42.8	Summer	70.2
Avg. Insol. (Ly/d)	Winter	284	Summer	489

SOLAR ENERGY SYSTEM

Application Heating 50% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate
Area (sq. ft.): 2,561
Manufacturer: Sunworks, Inc.

Storage

Type: Steel water tank (partially buried)
Capacity: 6,000 gallons

Auxiliary System Type: Electric Boiler

PROJECT DESCRIPTION

For this project, the conventional space heating system of an office building in Stamford, Connecticut is supplemented by a solar energy heating system. The building has three floors and is partially heated by electricity. The building offers two particular advantages for the project. First, its closed loop, multiple heat pump system was easily adapted for use with a solar energy source. Second, detailed records of energy consumption had been kept for the building for three years. These records will be used in comparing energy costs for the building before and after the installation of the solar energy system. The building is also physically suited to the installation of such a system. Two major pieces of equipment were necessary, a solar collector and a storage tank. The building roof is flat and unobstructed; the solar collectors and reflectors were installed there without difficulty. The storage tank was easily installed partially below ground in the rear parking lot of the building.

PROJECT INFORMATION

Owner/Builder: Marriott Corporation

Contractor: Marriott Corporation

Operational Date: January 1978

Total Estimated DOE Funds: \$308,000

Building

Type: Restaurant

Area: 45,000 sq. ft.

Location: Washington, D.C.

Latitude: 38.9° N

Climatic Data

Degree Days	Heating	4100	Cooling	1500
Avg. Temp. (°F)	Winter	36.9	Summer	74.2
Avg. Insol. (Ly/d)	Winter	204	Summer	507

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 55%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 6,300

Manufacturer: Sunworks, Inc.

Storage

Type: Glass lined steel water tanks (underground)

Capacity: 10,000 gallons

Auxiliary System Type: Gas fired water heater

PROJECT DESCRIPTION

Three hundred 3' x 7' panels were placed on the roof of the restaurant as a retrofit. The system is designed to supplement the gas fired water heaters which furnish 10000 gallons of hot water per day for consumption. The collector array was designed around the existing roof configuration which did not allow for the optimum tilt angle. The structural support system for the array is totally enclosed in compliance with the Fine Arts Commission mandate. The system is designed so that a nontoxic antifreeze solution is pumped through the panels and the heat that is absorbed is released in two single-wall heat exchangers. Domestic water is circulated through the heat exchangers, down to two 5000-gallon storage tanks in the below-grade parking level, and then through a gas fired water heater to pick up additional heat as required for the hot water service.

PROJECT INFORMATION

Owner/Builder: Brandon Swimming Association

Contractor: Independent Living, Inc.

Operational Date: November 1977

Total Estimated DOE Funds: \$208,080

Building

Type: Sports/medical center

Area: 18,440 sq. ft.

Location: Brandon, Florida

Latitude: 27° 58'N

Climatic Data

Degree Days	Heating 718	Cooling 3366
Avg. Temp. (°F)	Winter 62	Summer 82
Avg. Insol. (Ly/d)	Winter 400	Summer 500

SOLAR ENERGY SYSTEM

Application Heating 90.5% Cooling 59% Hot Water 89%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 5,301

Manufacturer: Revere Copper & Brass, Inc.

Storage

Type: Steel water tanks (above ground)

Capacity: 5,500 gallons (hot); 9,000 gallons (chilled)

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

This new sports/medical facility includes a gymnasium and supporting facilities, medical laboratories, and office space. The solar design incorporates tube-in-strip modular solar collectors on the 28° south-facing slope of the gymnasium roof to provide hot water for space heating, domestic hot water, heating for the swimming pool, and to drive the ARKLA-Servel Solaire-300 25-ton air conditioning unit. No glycol solutions or heat exchangers are used in the space heating and air conditioning systems. Hot water for space heating is stored in a 5500-gallon welded steel tank and chilled water is stored in a 9000-gallon tank for cooling. If there is no demand for either space heating or hot water, the pool can be heated. In the low range of insolation, the collectors are used for pool heating only. An auxiliary boiler will be used to operate the system whenever available solar heat is inadequate. Auxiliary air conditioning is provided by the existing electrically operated chiller.

PROJECT INFORMATION

Owner/Builder: Florida Solar Energy Center

Contractor: To be determined

Operational Date: September 1978

Total Estimated DOE Funds: \$191,870

Building

Type: Office

Area: 5,200 sq. ft. (cooling); 16,000 sq. ft. (heating)

Location: Cape Canaveral, Florida

Latitude: 28.4° N

Climatic Data

Degree Days	Heating	683	Cooling	2200
Avg. Temp. (°F)	Winter	61	Summer	82
Avg. Insol. (Ly/d)	Winter	315	Summer	490

SOLAR ENERGY SYSTEM

Application Heating 49% Cooling 70% Hot Water 0%

Collector

Type: Evacuated glass tubular

Area (sq. ft.): 1,781

Manufacturer: General Electric Company

Storage

Type: Steel water tanks (above ground)

Capacity: 3,000 gallons (hot); 6,000 gallons (chilled)

Auxiliary System Type: Oil fired boiler, vapor compression A/C

PROJECT DESCRIPTION

The proposed building is a single-story cement block construction on a concrete slab, with a flat roof of built-up tar and gravel composition. The roof has 6' overhangs on the east, west, and south sides. The proposed retrofit solar air conditioning and heating system would be operated by heat from tubular type collectors with evacuated spaces around the heat collecting surfaces. For air conditioning, stored heat drives a lithium bromide water absorption chiller. Hot water storage will be placed between the collectors and the absorption chiller and the heating coil, and there will be chilled water storage between the chiller and the cooling coil. This system will be able to provide heat to all three of the office buildings in the complex, but cooling to only one building. The retrofit system will be completely backed up by the existing HVAC system.

PROJECT INFORMATION

Owner/Builder: Days Inn of America, Inc.

Contractor: Solar Engineering and Equipment Company

Operational Date: June 1978

Total Estimated DOE Funds: \$167,037

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Clermont, Florida

Latitude: 30° N

Climatic Data

Degree Days	Heating	733	Cooling	3226
Avg. Temp. (°F)	Winter	62	Summer	81
Avg. Insol. (Ly/d)	Winter	366	Summer	534

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 90%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 8,073

Manufacturer: Energy Systems, Inc.

Storage

Type: Glass-ceramic lined steel water tanks (above ground)

Capacity: 14,500 gallons

Auxiliary System Type: Electric hot water heaters

PROJECT DESCRIPTION

The solar system is designed to collect 90% of the total hot water requirements for one 24-hour day during one complete solar day. The solar collector loop is completely closed, utilizing an antifreeze solution with corrosion inhibitors for the heat transfer fluid. Cold city water will be introduced into the tank and will be heated by hot solar heated water through a heat exchanger. Circulation pressure developed by a thermo-mainwater syphon will force the solar heated water into the building system through the building's existing hot water system. The storage tanks will have a capacity equal to the 24-hour daily requirement.

PROJECT INFORMATION

Owner/Builder: Dade County

Contractor: School Board of Dade County, Florida

Operational Date: October 1978

Total Estimated DOE Funds: \$869,770

Building

Type: Elementary school

Area: 70,000 sq. ft.

Location: Coral Gables, Florida

Latitude: 25.8° N

Climatic Data

Degree Days	Heating 206	Cooling 4038
Avg. Temp. (°F)	Winter 67.8	Summer 78.0
Avg. Insol. (Ly/d)	Winter 357	Summer 480

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 70% Hot Water 90%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 20,000

Manufacturer: PPG Industries, Inc.

Storage

Type: Insulated steel water tanks (underground)

Capacity: 60,000 gallons

Auxiliary System Type: Centrifugal chiller and gas water heater

PROJECT DESCRIPTION

The project consists of the design, construction, and operational testing of elementary school "K" in Southwest Dade County at S.W. 128 Street and 109 Avenue. The two-story school will utilize solar energy to provide domestic hot water and cooling from roof-mounted flat-plate collectors and three steel storage tanks. The tanks will be buried in earth berms adjacent to the first floor perimeter walls. These berms will have a 20% gradient and will be sodded. Cooling will be derived from four, 25-ton Arkla chillers operated in unison or from a 125-ton centrifugal chiller. The cooling from the absorption units will be dependent upon solar energy, since the auxiliary energy will be supplied to the centrifugal unit as the back-up cooling system. Energy conservation measures will include earth berms, minimal fenestration, and a 7030 ft³/min desiccant wheel.

PROJECT INFORMATION

Owner/Builder: Diplomat Golf & Racquet Club

Contractor: High Mechanical Contractors, Inc./Solar Engineering, Inc.

Operational Date: September 1978

Total Estimated DOE Funds: \$74,420

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Hallandale, Florida

Latitude: 25.7° N

Climatic Data

Degree Days	Heating 200	Cooling 4400
Avg. Temp. (° F)	Winter 66.5	Summer 89
Avg. Insol. (Ly/d)	Winter 204	Summer 265

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 65%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 3,658

Manufacturer: Solar Engineering, Inc.

Storage

Type: Insulated phenolic-lined steel water tanks
(above ground)

Capacity: 4,000 gallons

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

This retrofit two-story structure has 151 guest suites, lobby, recreation area, dining room, kitchen and laundry. The solar system consists of two arrays of collectors. One collector system consists of 82 collectors and two 2000-gallon storage tanks. A circulating pump maintains circulation between the collectors and one of the storage tanks. The second storage tank is used when the temperature in the first tank reaches 150°F. This system provides domestic hot water to the building. The second system consists of 36 collectors which are connected to the existing pool water circulating system in order to heat the swimming pool water.

Photograph not available

PROJECT INFORMATION

Owner/Builder: Quality Inn

Contractor: Capital Solar Heating, Inc.

Operational Date: March 1978

Total Estimated DOE Funds: \$12,000

Building

Type: Low and high rise motel

Area: Not applicable to hot water systems

Location: Key West, Florida

Latitude: 24.6° N

Climatic Data

Degree Days	Heating 64	Cooling 4888
Avg. Temp. (° F)	Winter 74	Summer 82.7
Avg. Insol. (Ly/d)	Winter 459	Summer 451

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 46.9%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,392

Manufacturer: Capital Solar Heating, Inc.

Storage

Type: Insulated and lined steel water tank (above ground)

Capacity: 1,000 gallons

Auxiliary System Type: Oil fired burner

PROJECT DESCRIPTION

The collectors will be roof-mounted, at a tilt angle of 34° above horizontal. The remaining equipment will be housed in the existing boiler room. The system will preheat the water supply to the existing hot water system, and is designed to supply all required hot water, without additional heat from the oil fired boiler, when the motel is 50% occupied. Domestic hot water will circulate directly through the solar collectors. The flat-plate collectors will be single-glazed and will have an aluminum absorber plate with copper tubing imbedded in the plate. The absorber coating will be flat black paint.

PROJECT INFORMATION

Owner/Builder: Reedy Creek Utilities Co., Inc. (WALT DISNEY WORLD)

Contractor: Buena Vista Construction Company

Operational Date: February 1978

Total Estimated DOE Funds: \$344,747

Building

Type: Office

Area: 6,400 sq. ft. (cond.)

Location: Lake Buena Vista, Florida

Latitude: 28.4° N

Climatic Data

Degree Days	Heating	733	Cooling	3226
Avg. Temp. (°F)	Winter	61.1	Summer	75.3
Avg. Insol. (Ly/d)	Winter	315	Summer	475

SOLAR ENERGY SYSTEM

Application Heating 99% Cooling 80% Hot Water 100%

Collector

Type: Modular cylindrical concentrator

Area (sq. ft.): 3,800

Manufacturer: AAI Corporation

Storage

Type: Steel water tanks (above ground)

Capacity: 10,000 gallons (hot); 10,000 gallons (chilled)

Auxiliary System Type: Electric

PROJECT DESCRIPTION

The project involves a two-story concrete and block office addition to Disney World's Central Energy Plant. This insulated building contains a solar equipment room which will be showcased for high visibility. Sixteen modular solar collectors are joined together along the ridge lines to form the insulated roof. The longitudinal axes of the reflective surface run in an east-west direction. The solar roof replaces the usual trusses, corrugated decking, and insulated concrete roof. This reduces the costs associated with conventional roofing. Each 8' x 32' modular collector is a solar concentrator that consists of a concave cylindrical reflective surface and an absorber. The absorber uses water as a heat transfer medium and is kept in focus with the reflective surface by a linear actuator controlled by a sun sensor/focusing device.

PROJECT INFORMATION

Owner/Builder: Florida Department of Commerce
Contractor: Florida Department of General Services/
Tompkins-Beckwith, Inc.

Operational Date: October 1977

Total Estimated DOE Funds: \$280,000

Building

Type: Welcome station
Area: 3,300 sq. ft. (cond.)

Location: Nassau County, Florida

Latitude: 30.7° N

Climatic Data

Degree Days	Heating	1327	Cooling	2596
Avg. Temp. (°F)	Winter	57.7	Summer	76.0
Avg. Insol. (Ly/d)	Winter	308	Summer	496

SOLAR ENERGY SYSTEM

Application Heating 99% Cooling 88% Hot Water 0%

Collector

Type: Fresnel lens, concentrating and tracking
Area (sq. ft.): 2,840
Manufacturer: Northrup, Inc.

Storage

Type: Steel water tanks (above ground)
Capacity: 6,000 gallons (hot); 6,000 gallons (chilled)

Auxiliary System Type: Oil fired furnace

PROJECT DESCRIPTION

This Florida Welcome Station, located on Interstate 95 two miles south of the Florida-Georgia line, is expected to accommodate a large number of visitors. To conserve energy, the one-story building utilizes a poured, light-weight, aggregate roof-deck, a suspended insulating tile ceiling, and windows that are protected from direct sunlight. Key system components include a 25-ton ARKLA WF-300 absorption chiller, a field of concentrating collectors, a hot water storage tank and a cooling tower that will provide condensing water. An oil fired hot water heater, a vapor compression air exchange air conditioner, and an oil fired furnace will be the auxiliary systems. The building's energy system (solar and conventional) will be controlled by a single set of valves and sensors. Automatic switching between the two systems will be possible, manual operation being necessary only for selecting the heating or cooling mode.

PROJECT INFORMATION

Owner/Builder: City of Atlanta

Contractor: Westinghouse Electric Company

Operational Date: September 1975

Total Estimated DOE Funds: \$912,000

Building

Type: Elementary school

Area: 32,000 sq. ft.

Location: Atlanta, Georgia

Latitude: 33.8° N

Climatic Data

Degree Days	Heating	3095	Cooling	1589
Avg. Temp. (°F)	Winter	51.0	Summer	74.5
Avg. Insol (Ly/d)	Winter	312	Summer	508

SOLAR ENERGY SYSTEM

Application Heating 50% Cooling 60% Hot Water 80%

Collector

Type: Liquid flat-plate/reflector

Area:(sq. ft.): 10,360/10,800

Manufacturer: PPG Industries, Inc.

Storage

Type: Steel water tanks (underground)

Capacity: 45,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

In this project, the George A. Towns Elementary School in Atlanta, Georgia was provided with a solar energy system for space heating and cooling as well as for hot water heating. The school's original heating and cooling system was retrofitted for use with a solar energy source. The solar energy system included a collector/reflector array mounted on the school's roof, three 15000-gallon thermal storage tanks, and a 100-ton ARKLA absorption chiller. Performance was monitored by the contractor for one year; the system was accepted by the Atlanta Public Schools administration.

PROJECT INFORMATION

Owner/Builder: La Quinta Motor Inns, Inc.

Contractor: Travis-Braun & Associates, Inc.

Operational Date: Late 1978

Total Estimated DOE Funds: \$39,329

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: College Park, Georgia

Latitude: 33° 4' N

Climatic Data

Degree Days	Heating	2960	Cooling	N/A
Avg. Temp. (° F)	Winter	51.7	Summer	80
Avg. Insol. (Ly/d)	Winter	230	Summer	480

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 58%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,000

Manufacturer: Revere Copper & Brass, Inc.

Storage

Type: Steel water tank (above ground)

Capacity: 1,600 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

A drain-down system is proposed under this grant. This system is one in which, each time the water circulation pump stops, the collector fluid water drains out and down into the protection of an enclosed space. In this proposal, this enclosed space is the mechanical room of the motel. This system is a hybrid version of a drain-down system employing a heat exchanger. By using this heat exchanger, the buildup of minerals in the solar collector is eliminated. On the solar loop of the system, a contained amount of water is employed. Even as this water level drops and makeup water is introduced into the system, new minerals, acids, etc., are also introduced; however, this introduction is extremely minor in comparison to the minerals which would be constantly introduced by a direct link between the storage vessel and the solar collectors.

PROJECT INFORMATION

Owner/Builder: North Georgia Area Planning and Development Commission

Contractor: Independent Living, Inc.

Operational Date: April 1978

Total Estimated DOE Funds: \$113,777

Building

Type: Office

Area: 7,455 sq. ft.

Location: Dalton, Georgia

Latitude: 34.5°N

Climatic Data

Degree Days	Heating	3300	Cooling	1460
Avg. Temp. (°F)	Winter	43	Summer	77
Avg. Insol. (Ly/d)	Winter	242.3	Summer	542.9

SOLAR ENERGY SYSTEM

Application Heating 80% Cooling 65% Hot Water 100%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,001

Manufacturer: Revere Copper & Brass, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 9,000 gallons

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

The solar collectors for this office building will consist of 115 modules arranged in five rows. The collector array, supported by a steel frame, will face south at an angle of 45°. The augmented array of 2000 sq. ft. of solar collectors and 2400 sq. ft. of reflectors will heat and cool the 7455 sq. ft. of office space. The system will employ an automatic drain-down system. Through an exchange system, the solar-heated water will be used directly to heat the building and domestic hot water. Heated water not used during the daylight period will be stored in an insulated 3000-gallon hot water storage tank for use at night and cloudy days. Cooling will be accomplished by a solar hot water powered Arkla absorption chiller. The chiller will deliver cool water at 45°F to directly cool the building or be held in an insulated 6000-gallon storage tank for later use.

PROJECT INFORMATION

Owner/Builder: Shenandoah Development Corporation

Contractor: Georgia Institute of Technology

Operational Date: April 1977

Total Estimated DOE Funds: \$778,253

Building

Type: Recreational center

Area: 59,000 sq. ft. (total); 58,000 sq. ft. (cond.)

Location: Shenandoah, Georgia

Climatic Data

Degree Days	Heating	3095	Cooling	1589
Avg. Temp. (°F)	Winter	51.0	Summer	74.6
Avg. Insol. (Ly/d)	Winter	312	Summer	508

SOLAR ENERGY SYSTEM

Application Heating 90% Cooling 60% Hot Water 90%

Collector

Type: Liquid flat-plate/reflector

Area (sq. ft.): 11,213/23,000

Manufacturer: Revere Copper & Brass, Inc.

Storage

Type: Steel water tank (underground)

Capacity: 15,000 gallons (hot); 60,000 gallons (chilled)

Auxiliary System Type: Gas and electric

PROJECT DESCRIPTION

The Georgia Institute of Technology has designed, installed, evaluated, and computer-modeled this multipurpose community center for the new town of Shenandoah, approximately 25 miles south of Atlanta. The building is partially underground incorporating numerous energy conserving features. Twenty-three thousand square feet of polished aluminum reflectors augment the rooftop solar collectors for additional heat input during the summer months. The individual 21' x 8' solar collector modules are factory-assembled for low-cost rooftop installation. Air conditioning is provided by a 100-ton lithium bromide absorption chiller. In the autumn and spring, heat from the solar collectors, which is not needed for space heating, cooling, or hot water is used to heat an outdoor olympic-sized swimming pool.

PROJECT INFORMATION

Owner/Builder: Airport Ramada Inn
 Contractor: Bortles, Gates & Associates
 Operational Date: June 1978
 Total Estimated DOE Funds: \$126,000

Building

Type: Hotel
 Area: To be determined

Location: Honolulu, Hawaii

Latitude: 21°21'N

Climatic Data

Degree Days	Heating N/A	Cooling 4395
Avg. Temp. (°F)	Winter 73	Summer 79
Avg. Insol. (Ly/d)	Winter 450	Summer 575

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 70%

Collector

Type: Liquid flat-plate
 Area (sq. ft.): 3,000
 Manufacturer: To be determined

Storage

Type: Insulated steel water tank (on roof)
 Capacity: 2,000 gallons

Auxiliary System Type: Natural gas

PROJECT DESCRIPTION

The objective of this project is the demonstration of solar water heating in Honolulu, Hawaii in an existing Ramada Inn using 3000 sq. ft. of flat-plate collectors. A principal use of energy in tropical Hawaii is hot water. This project will provide a means of evaluating the economics of solar energy in an area where conventional energy is expensive.

PROJECT INFORMATION

Owner/Builder: Iolani School

Contractor: Northrup, Inc.

Operational Date: July 1978

Total Estimated DOE Funds: \$201,828

Building

Type: School

Area: 12,000 sq. ft.

Location: Honolulu, Hawaii

Latitude: 21°N

Climatic Data

Degree Days	Heating	N/A	Cooling	4221
Avg. Temp. (°F)	Winter	73	Summer	80
Avg. Insol. (Ly/d)	Winter	434	Summer	614

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 70% Hot Water 70%

Collector

Type: Tracking concentrating

Area (sq. ft.): 3,000

Manufacturer: Northrup, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 5,000 gallons

Auxiliary System Type: Gas boiler

PROJECT DESCRIPTION

Three hundred and eight Northrup tracking, concentrating collectors will be installed on the flat roof of the main part of the school and the terraced roof of the auditorium. The primary function of the solar system is to augment existing water chillers, which will be retained as back-up. The absorption chiller and pumps will be installed in a new equipment room with a cooling tower on the roof. An expansion tank will be located nearby, above the ground. Air conditioning will serve the library, 12 classrooms, and a small auditorium. Water heating will serve showers in the gymnasium and athletic facilities.

PROJECT INFORMATION

Owner/Builder: Metropolitan YMCA

Contractor: Cody Company

Operational Date: July 1978

Total Estimated DOE Funds: \$66,622

Building

Type: Dorm and shower room

Area: Not applicable to hot water systems

Location: Honolulu, Hawaii

Latitude: 21° 30' N

Climatic Data

Degree Days	Heating	N/A	Cooling	4395
Avg. Temp. (° F)	Winter	75	Summer	80
Avg. Insol. (Ly/d)	Winter	542	Summer	542

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 85%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 3,131

Manufacturer: Raypak, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 3,800 gallons

Auxiliary System Type: Gas or oil fired boilers

PROJECT DESCRIPTION

This is a retrofit solar water heating system designed to meet approximately 85% of the annual hot water usage. It will preheat water for the existing oil and gas fired boiler system, and for the oil fired steam generator for the steam room. At press time, the option of plumbing the system into a combination pump and thermosyphon flow was being investigated. Design decisions will be based on data received from the Banyan Street Manor thermosyphon solar project, located approximately one-half mile away.

PROJECT INFORMATION

Owner/Builder: Hawaiian Pacific Resorts

Contractor: Hirano Brothers, Ltd.

Operational Date: May 1978

Total Estimated DOE Funds: \$125,000

Building

Type: High rise hotel

Area: Not applicable to hot water systems

Location: Kona, Hawaii

Latitude: 21°N

Climatic Data

Degree Days	Heating	N/A	Cooling	3930
Avg. Temp. (°F)	Winter	80	Summer	80
Avg. Insol. (Ly/d)	Winter	467	Summer	510

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 34%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 5,000

Manufacturer: Raypak, Inc.

Storage

Type: Insulated steel water tank (on roof)

Capacity: 7,500 gallons

Auxiliary System Type: Liquid propane gas

PROJECT DESCRIPTION

Five thousand square feet of collectors will collect the solar energy and transfer it into the 7500-gallon storage tank. This preheated water will be delivered to the existing gas fired water heater. This heater will turn on if the temperature of the water from the solar storage tank is below the required water temperature. No freeze protection is required for this system, due to high ambient temperatures throughout the year.

PROJECT INFORMATION

Owner/Builder: E.W. Westgate Company

Contractor: Acurex Corporation

Operational Date: June 1979

Total Estimated DOE Funds: \$647,480

Building

Type: High rise hotel

Area: Not applicable to hot water systems

Location: Waikoloa, Hawaii

Latitude: 20°N

Climatic Data

Degree Days	Heating	N/A	Cooling	4200
Avg. Temp. (°F)	Winter	70	Summer	70
Avg. Insol. (Ly/d)	Winter	679	Summer	776

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 86%

Collector

Type: Concentrating-single axis tracking

Area (sq. ft.): 22,720

Manufacturer: Acurex/Aerotherm

Storage

Type: Plastic lined steel water tanks

Capacity: 30,000 gallons

Auxiliary System Type: Oil fired boilers

PROJECT DESCRIPTION

This solar hot water heating system is divided into two parts. Collector arrays of 7224 sq. ft. will provide hot water to the kitchen service at 180°F. A second array of 15496 sq. ft. collectors will provide 140°F water for guest rooms and other kitchen services. Two storage tanks of 8000 and 22000 gallons are provided for each system. These tanks will fill when the solar supply exceeds the demand. Due to the nonfreezing weather conditions no freeze protection is required. Solar collectors will be fed directly from the city water supply.

PROJECT INFORMATION

Owner/Builder: Museum of Science and Industry

Contractor: Scavo & Associates

Operational Date: August 1978

Total Estimated DOE Funds: \$364,165

Building

Type: Museum

Area: 608,000 sq. ft. (total); 71,333 sq. ft. (heating);
65,133 sq. ft. (cooling)

Location: Chicago, Illinois

Latitude: 41° 50'N

Climatic Data

Degree Days	Heating	6155	Cooling	830
Avg. Temp. (°F)	Winter	38	Summer	69
Avg. Insol. (Ly/d)	Winter	172	Summer	414

SOLAR ENERGY SYSTEM

Application Heating 45% Cooling 47% Hot Water 0%

Collector

Type: Evacuated tubular

Area (sq. ft.): 7,072

Manufacturer: General Electric Company

Storage

Type: Insulated steel water tank (above ground)

Capacity: 3,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

The Museum of Science and Industry is a three-story, three-building complex which opened in 1933. It will be retrofitted with roof-mounted collectors in rows on a structural frame. The energy storage tank, pumps, heating and cooling coils, absorption water cooler, and controls are located in the ground floor equipment room. A 40% glycol solution is used as collector fluid for freeze protection. This same solution is circulated in the absorption unit, heating coils and storage tank. A flexible control system (integrated with the existing heating and air conditioning components) will utilize automatic and manual control methods to provide a variety of heating and cooling modes.

PROJECT INFORMATION

Owner/Builder: Public Building Commission of Chicago

Contractor: City of Chicago

Operational Date: January 1978

Total Estimated DOE Funds: \$564,656

Building

Type: Office/exhibition

Area: 36,000 sq. ft.

Location: Chicago, Illinois

Latitude: 42° N

Climatic Data

Degree Days	Heating 5882	Cooling 1017
Avg. Temp. (°F)	Winter 27.0	Summer 71.5
Avg. Insol. (Ly/d)	Winter 217	Summer 517

SOLAR ENERGY SYSTEM

Application Heating 33% Cooling 0% Hot Water 100%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 8,000

Manufacturer: Chamberlain Manufacturing Corporation

Storage

Type: Insulated steel water tank (in mechanical room)

Capacity: 15,000 gallons

Auxiliary System Type: Gas fired hydronic boiler

PROJECT DESCRIPTION

A solar space and hot water heating system is being retrofitted into a 60-year old building complex located on Chicago's downtown lakefront. Construction costs will be approximately \$800,000, with joint funding by DOE and the City of Chicago. Unit costs are expected to be initially higher than those for conventional solar installations; however, the direct incorporation of the solar collectors as a part of the recycled building enclosure represents maximum utilization of the panels, (window-wall system, as well as thermal energy collection hardware) and is expected to result in long-term economies. Thermal upgrade of the object building during forthcoming tenant development will result in a higher (in excess of 50%) solar contribution to seasonal space heating load. An information center, located on the ground level pedestrian promenade of this public recreational and cultural facility, will provide visitors with a close-up view of interface hardware and static collector displays.

PROJECT INFORMATION

Owner/Builder: Rodeway Inns of America & R. V. Development

Contractor: Charter Builders, Inc. Company

Operational Date: July 1978

Total Estimated DOE Funds: \$99,777

Building

Type: High rise hotel

Area: Not applicable to hot water systems

Location: Chicago, Illinois

Latitude: 42°N

Climatic Data

Degree Days	Heating	6000	Cooling	1000
Avg. Temp. (°F)	Winter	33	Summer	77
Avg. Insol. (Ly/d)	Winter	267	Summer	438

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 63%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 4,000

Manufacturer: Lennox Industries, Inc.

Storage

Type: Insulated steel water tank

Capacity: 4,000 gallons

Auxiliary System Type: Gas boiler

PROJECT DESCRIPTION

The collectors for this system will be located on the roof of the motel. The energy collected by the collectors will be transferred to a double bundle heat exchanger via a collector loop circulating pump. Through the heat exchanger, the absorbed energy will be transferred to the storage tank via the storage loop circulating pump. Utilization of the double bundle heat exchanger eliminates the danger of ethylene glycol leakage from the solar loop to the storage tank. Energy from the storage tank is utilized for the motel potable water and laundry.

PROJECT INFORMATION

Owner/Builder: Community Unit District 303

Contractor: Community Unit District 303

Operational Date: January 1979

Total Estimated DOE Funds: \$524,683

Building

Type: High school

Area: 221,000 sq. ft.

Location: St. Charles, Illinois

Latitude: 42° N

Climatic Data

Degree Days	Heating	6639	Cooling	N/A
Avg. Temp. (°F)	Winter	44.5	Summer	66
Avg. Insol. (Ly/d)	Winter	209	Summer	486

SOLAR ENERGY SYSTEM

Application Heating 67% Cooling 0% Hot Water 65%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 15,000

Manufacturer: Sunworks, Inc.

Storage

Type: Insulated steel water tanks (in basement)

Capacity: 30,000 gallons

Auxiliary System Type: Heat recovery chiller; electric boiler; gas fired domestic water heater

PROJECT DESCRIPTION

The building is a high school containing, in addition to air conditioned classrooms, a 1000-seat performing hall, a gymnasium with spectator seating for 2700 and vocational education facilities. The building was occupied in September 1977 and was designed and built with solar storage tanks and piping to facilitate the solar retrofit. The building is cooled by two rotary compression water chillers serving variable volume, dual duct and single zone fan systems. One of the chillers has a double bundle condensing section for heat recovery. Separate storage capacity is provided for recovered heat and solar heat. Heat from either storage section can be used directly to heat the building or serve as a heat source when operating the chiller in the heat pump mode. Some of the storage tanks will be used to store chilled water in off peak hours during the summer to reduce peak demand while the remaining tanks will store solar heated water for domestic water preheating.

PROJECT INFORMATION

Owner/Builder: Clarksville Community School Corporation

Contractor: To be determined

Operational Date: May 1978

Total Estimated DOE Funds: \$129,505

Building

Type: Middle school

Area: 145,200 sq. ft.

Location: Clarksville, Indiana

Latitude: 38° N

Climatic Data

Degree Days	Heating	4660	Cooling	N/A
Avg. Temp. (°F)	Winter	44	Summer	N/A
Avg. Insol. (Ly/d)	Winter	278	Summer	N/A

SOLAR ENERGY SYSTEM

Application Heating 100% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 6,520

Manufacturer: Solar Development, Inc.

Storage

Type: Insulated steel water tank (underground)

Capacity: 10,000 gallons

Auxiliary System Type: Electric resistance heat

PROJECT DESCRIPTION

The Clarksville Middle School will retrofit the heating of two gymnasiums from electric resistance heat to solar heat. At the present time the two gyms have a chilled water system for cooling. This system will be converted to a hot water solar heating system. The building is 11 years old and has few windows. It is well insulated and will be easy to retrofit. The existing air handlers will be used and controls can be adjusted for the new solar system. Storage for the solar system will be provided by means of a buried steel storage tank. The flat-plate solar collectors will be installed on the roof of each gymnasium.

PROJECT INFORMATION

Owner/Builder: Indiana Vocational Technical College

Contractor: To be determined

Operational Date: December 1978

Total Estimated DOE Funds: \$109,883

Building

Type: Vocational school

Area: 24,104 sq. ft.

Location: Gary, Indiana

Latitude: 41° N

Climatic Data

Degree Days	Heating	6350	Cooling	N/A
Avg. Temp. (°F)	Winter	25	Summer	N/A
Avg. Insol. (Ly/d)	Winter	150	Summer	N/A

SOLAR ENERGY SYSTEM

Application Heating 80% Cooling 0% Hot Water 0%

Collector

Type: Evacuated tubular

Area (sq. ft.): 3,800

Manufacturer: Owens-Illinois, Inc.

Storage

Type: Insulated steel water tanks (in basement)

Capacity: 5,000 gallons

Auxiliary System Type: Oil fired water boiler

PROJECT DESCRIPTION

Incorporated in this project will be an Environmental Training Center for the education of students in the waste water treatment plant operation and maintenance. The solar energy system proposed for this institution will allow the additional instruction in solar energy technical assistance and maintenance. On-site equipment and monitoring instrumentation would provide a field application for all class students. A variable flow pump will be used to circulate water through the collectors. Storage for the total energy collected on a clear day will be provided in the four storage tanks. A storm water holding pond (lagoon) is necessary for this project to provide on-site storage. This lagoon is located to the south of the proposed building where it also serves to reflect energy to the collectors.

PROJECT INFORMATION

Owner/Builder: La Quinta Motor Inns, Inc.

Contractor: Travis-Braun & Associates, Inc.

Operational Date: September 1978

Total Estimated DOE Funds: \$43,353

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Indianapolis, Indiana

Latitude: 39° 4' N

Climatic Data

Degree Days	Heating	5699	Cooling	N/A
Avg. Temp. (°F)	Winter	39.6	Summer	N/A
Avg. Insol. (Ly/d)	Winter	176	Summer	390

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 66%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,000

Manufacturer: Lennox Industries, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 1,600 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

A freeze protected system is proposed under this grant. The collector circulating fluid is a water buffered ethylene glycol solution. This mixture prevents the occurrence of freezing in the collector. Even though many codes do not require a double separation insulating the potable water system, provisions for such a separation are included. The mixture of antifreeze and water can be further buffered to include corrosion inhibitors, thus prolonging the collector life. The antifreeze solution protects a collector from damage which could occur from low temperatures. Mineral buildup problems are eliminated by the contained, relatively nonchanging solution.

PROJECT INFORMATION

Owner/Builder: Rodeway Inns of America & R. V. Development Company

Contractor: Charter Builders, Inc.

Operational Date: To be determined

Total Estimated DOE Funds: \$49,934

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Indianapolis, Indiana

Latitude: 40° N

Climatic Data

Degree Days	Heating 5588	Cooling 1046
Avg. Temp. (°F)	Winter 32.6	Summer 77
Avg. Insol. (Ly/d)	Winter 255	Summer 438

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 73%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,500

Manufacturer: Lennox Industries, Inc.

Storage

Type: Insulated steel water tank

Capacity: 2,000 gallons

Auxiliary System Type: Electric/boiler

PROJECT DESCRIPTION

The collectors for this system will be located on the roof of the motel. The energy collected by the collectors will be transferred to a double bundle heat exchanger via a collector loop circulating pump. Through the heat exchanger, the absorbed energy will be transferred to the storage tank via the storage loop circulating pump. Utilization of the double bundle heat exchanger eliminates the danger of ethylene glycol leakage from the solar loop to the storage tank. Energy from the storage tank is utilized for the motel potable water and laundry.

PROJECT INFORMATION

Owner/Builder: La Quinta Motor Inns, Inc.

Contractor: Travis-Braun & Associates, Inc.

Operational Date: September 1978

Total Estimated DOE Funds: \$53,570

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Merrillville, Indiana

Latitude: 42° N

Climatic Data

Degree Days	Heating	5700	Cooling	800
Avg. Temp. (°F)	Winter	42	Summer	76
Avg. Insol. (Ly/d)	Winter	165	Summer	430

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 60%

Collector

Type: Evacuated tubular

Area (sq. ft.): 2,000

Manufacturer: General Electric Company

Storage

Type: Insulated steel water tank (above ground)

Capacity: 1,600 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

A freeze protected system is proposed under this grant. The collector circulating fluid is a water buffered ethylene glycol solution. This mixture prevents the occurrence of freezing in the collector. Even though many codes do not require a double separation insulating the potable water system, provisions for such a separation are included. The mixture of antifreeze and water can be further buffered to include corrosion inhibitors, thus prolonging the collector life. The antifreeze solution protects a collector from damage which could occur from low temperatures. Mineral buildup problems are eliminated by the contained, relatively nonchanging solution.

PROJECT INFORMATION

Owner/Builder: Marion Independent School District
 Contractor: Engineering Associates — Bouse, Bradley, Hynes
 Operational Date: July 1978
 Total Estimated DOE Funds: \$223,400

Building

Type: Office
 Area: 11,762 sq. ft.

Location: Marion, Iowa

Latitude: 41.5°N

Climatic Data

Degree Days	Heating	6900	Cooling	N/A
Avg. Temp. (°F)	Winter	38.3	Summer	N/A
Avg. Insol. (Ly/d)	Winter	289.7	Summer	N/A

SOLAR ENERGY SYSTEM

Application Heating 74% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate
 Area (sq. ft.): 4,896
 Manufacturer: Honeywell, Inc./Lennox Industries, Inc.

Storage

Type: Insulated steel water tank (above ground)
 Capacity: 8,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

This project is a retrofit application on a twenty-two-year-old elementary school now used as administration offices. A 50% glycol solution is used as the collector fluid for freeze protection with a heat exchanger interposed between the collectors and storage. To allow use of a low pressure storage tank, a heat exchanger is also interposed between the storage tank and existing boiler. The 8000-gallon storage tank is urethane insulated and is above ground. The existing hot water heating system is a one-pipe "mono-flo" system with three pumped zones with perimeter radiation only. "Purge" will be through a convertor for city water cooling to the sewer. Drain down tanks are included on each collector row for summer shut down. Collectors will be mounted on the ground on painted steel angle frames set on concrete piers connected to headers with flexible silicone hoses. Building conservation measures such as window replacement, added roof insulation, boiler water reset, and night set-back are being studied.

PROJECT INFORMATION

Owner/Builder: Scattergood School

Contractor: Modern Metals, Inc.

Operational Date: June 1977

Total Estimated DOE Funds: \$82,898

Building

Type: School gymnasium

Area: 7,966 sq. ft.

Location: West Branch, Iowa

Latitude: 41.8° N

Climatic Data

Degree Days	Heating	7255	Cooling	800
Avg. Temp. (°F)	Winter	41.0	Summer	71.7
Avg. Insol. (Ly/d)	Winter	298	Summer	545

SOLAR ENERGY SYSTEM

Application Heating 75% Cooling 0% Hot Water 75%

Collector

Type: Air flat-plate

Area (sq. ft.): 2,496

Manufacturer: Solaron Corporation

Storage

Type: Rock bed (above ground)

Capacity: 1,250 cu. ft.

Auxiliary System Type: Gas fired unit heaters, gas furnace

PROJECT DESCRIPTION

The selected solar energy system for this school gymnasium is based on a prototype model which has been in continuous successful operation since 1957. The collector array, located against the south wall, is a combination of factory preassembled modules 36" x 78". Each module has double tempered glass covers and a sheet steel absorber, with an air duct below the permanent black absorber surface. At the site, these modular collector panels were plugged into each other with a minimum of installation time. The metal building was pre-engineered with 6900 sq. ft. in the main portion and a 1066 sq. ft. utility storage and locker room addition. The structural heating/cooling load is approximately 56000 Btu per degree day.

PROJECT INFORMATION

Owner/Builder: Unified School District No. 306

Contractor: Wilson & Company Engineers & Architects

Operational Date: December 1977

Total Estimated DOE Funds: \$181,411

Building

Type: Kindergarten through 12th grade school

Area: 138,000 sq. ft.

Location: Gypsum, Kansas

Latitude: 39° N

Climatic Data

Degree Days	Heating	5211	Cooling	N/A
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Avg. Temp. (° F)	Winter	46	Summer	77
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Avg. Insol. (Ly/d)	Winter	350	Summer	598
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SOLAR ENERGY SYSTEM

Application Heating 52% Cooling 0% Hot Water 84%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 5,125

Manufacturer: Solar Corporation of America

Storage

Type: Steel water tanks (above ground)

Capacity: 11,800 gallons

Auxiliary System Type: Electric resistance heaters/water-to-air heat pumps

PROJECT DESCRIPTION

This project is a new school building to replace four other facilities at four different locations within the school district. This one-story, rectangular shaped building consists of a lecture room, shop areas, administrative offices, theater, two-story gymnasium, and miscellaneous other areas. The solar system will utilize ground mounted, internally manifolded flat-plate collectors with a reverse return flow system to provide supplemental heat for the building's closed loop water-to-air heat pump system and for domestic hot water. All subsystem equipment will be located in the mechanical equipment room, with piping routed to the solar collectors installed near the south side of the building. The thermal energy storage tanks will be located inside the building to reduce installation costs and to make use of the heat loss from the tanks for building heating. If the thermal storage tanks are fully "charged," a heat rejector is used to dissipate excess heat.

PROJECT INFORMATION

Owner/Builder: Du Cat Investments, Inc.

Contractor: Du Cat Investments, Inc.

Operational Date: June 1978

Total Estimated DOE Funds: \$282,123

Building

Type: Warehouse/office

Area: 48,800 sq. ft. (total); 39,000 sq. ft. (cond.)

Location: Kansas City, Kansas

Latitude: 39° N

Climatic Data

Degree Days	Heating	4711	Cooling	N/A
Avg. Temp. (° F)	Winter	31.4	Summer	75.2
Avg. Insol. (Ly/d)	Winter	198	Summer	563

SOLAR ENERGY SYSTEM

Application Heating 40.4% Cooling 0% Hot Water 0%

Collector

Type: Air flat-plate

Area (sq. ft.): 7,800 sq. ft.

Manufacturer: Solaron Corporation

Storage

Type: Passive (Warehouse contents store heat)

Capacity: Utilizes building enclosure and warehouse contents

Auxiliary System Type: Electric unit heaters

PROJECT DESCRIPTION

This office and leasable warehouse is a 100' x 488' steel framed building with precast double tees for an exterior wall. Heat loss is reduced by insulating the building to a greater extent than the typical warehouse and by utilizing insulated dock doors. The solar system heats air which is directly utilized in the space with no diversion to a storage rock bed. The factory assembled solar air heating collectors containing a flat absorber/heat exchanger and internal manifolding, are located on the roof, on 24' centers, and oriented 3° east of true south at a tilt of 53°. The air handling module consists of a set of automatic dampers, blower, and motor. The air handler is custom-engineered for on-site integration into the conventional HVAC system. The automatic system controller, activated by a conventional thermostat, is designed to continually monitor and regulate the operating modes of the system. It includes the sensors and controls necessary to automatically maintain the desired comfort level.

PROJECT INFORMATION

Owner/Builder: Kaw Valley State Bank and Trust Company
Contractor: Slemmons & Assocs. Architects/Burgess Engineering Inc.
Operational Date: May 1978
Total Estimated DOE Funds: \$78,160

Building

Type: Bank
Area: 6,588 sq. ft. (total); 5,600 sq. ft. (cond.)

Location: Topeka, Kansas

Latitude: 39° N

Climatic Data

Degree Days	Heating	5243	Cooling	1309
Avg. Temp. (°F)	Winter	43.3	Summer	73.4
Avg. Insol. (Ly/d)	Winter	275	Summer	509

SOLAR ENERGY SYSTEM

Application Heating 47% Cooling 74% Hot Water 95%

Collector

Type: Vacuum tubular
Area (sq. ft.): 1,068
Manufacturer: General Electric Company

Storage

Type: Insulated steel water tank (above ground, in basement)
Capacity: 1,100 gallons

Auxiliary System Type: Gas boiler

PROJECT DESCRIPTION

The bank design includes a south-facing roof with a 45° slope to accommodate 72 GE TC-100 vacuum tube solar collectors, representing a total active area of 1068 sq. ft. The solar energy system (SES) will include a 1100-gallon hot water storage tank designed for operation at 250°F maximum temperature point and sized according to the summer-winter cost/performance trade-off. The delivery side of the system is basically a hydronic central air unit divided into two main ducts which distribute the forced air to two variable volume zones defined by the basement and ground floor areas. The SES will further include four three-ton advanced ARKLA absorption chillers to accommodate peak load conditions. All control save summer-winter switchover will be automatic including the sequential staging of the ARKLA units. The conventional system will be a single gas boiler. Heating and cooling thermal energy requirements will be fully satisfied by the gas boiler when no solar energy is available.

PROJECT INFORMATION

Owner/Builder: Charles F. Henning, M.D.

Contractor: Solar Services, Inc.

Operational Date: June 1978

Total Estimated DOE Funds: \$75,166

Building

Type: Medical offices

Area: 4,764 sq. ft.

Location: Wichita, Kansas

Latitude: 37.5° N

Climatic Data

Degree Days	Heating 4620	Cooling N/A
Avg. Temp. (° F)	Winter 35	Summer 80
Avg. Insol. (Ly/d)	Winter 200	Summer 575

SOLAR ENERGY SYSTEM

Application Heating 85% Cooling 0% Hot Water 0%

Collector

Type: Air flat-plate

Area (sq. ft.): 1,059

Manufacturer: Solar Services, Inc.

Storage

Type: Eutectic salt in trays (above ground, inside building)

Capacity: 624 cu. ft. (8,632 trays)

Auxiliary System Type: Electric resistance forced air furnaces

PROJECT DESCRIPTION

A major criteria imposed by the building owner was that the project not appear substantially different from any conventional office building. As a result, the solar collector panels were placed vertically on the south wall in such a way that they appear to be a conventional window wall system. Each collector panel, partially assembled by the manufacturer, is made up of two separate black painted galvanized sheet metal absorber plates, spaced about 2" apart, with double glazing about 2" in from the front absorber plate. The back absorber plate is nailed, on the job site, to the plywood sheathing of the south building wall and thereby includes the insulated wall construction as the back of the collector. Air is passed between the absorber plates to transport the solar energy collected to storage for later use. The heat storage system utilizes a heat-of-fusion eutectic salt material which is factory sealed in black trays of high density polyethylene plastic. The eutectic salt, or "Glauber's Salt" as it is commonly called, is a mixture of sodium sulfate decahydrate and borax.

PROJECT INFORMATION

Owner/Builder: La Quinta Motor Inns, Inc.

Contractor: Travis-Braun & Associates, Inc.

Operational Date: May 1978

Total Estimated DOE Funds: \$44,954

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Wichita, Kansas

Latitude: 38° N

Climatic Data

Degree Days	Heating	4700	Cooling	1500
Avg. Temp. (°F)	Winter	38	Summer	74
Avg. Insol. (Ly/d)	Winter	285	Summer	540

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 75%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,000

Manufacturer: Lennox Industries, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 1,600 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

A freeze protected system is proposed under this grant. The collector circulating fluid is a water buffered ethylene glycol solution. This mixture prevents the occurrence of freezing in the collector. Even though many codes do not require a double separation insulating the potable water system, provisions for such a separation are included. The mixture of antifreeze and water can be further buffered to include corrosion inhibitors, thus prolonging the collector life. The antifreeze solution protects a collector from damage which could occur from low temperatures. Mineral buildup problems are eliminated by the contained, relatively nonchanging solution.

PROJECT INFORMATION

Owner/Builder: Rademaker Corporation

Contractor: Rademaker Corporation

Operational Date: July 1977

Total Estimated DOE Funds: \$20,729

Building

Type: Office/warehouse

Area: 10,000 sq. ft. (total); 1,080 sq. ft. (cond.)

Location: Louisville, Kentucky

Latitude: 38.2° N

Climatic Data

Degree Days	Heating	4645	Cooling	1268
Avg. Temp. (°F)	Winter	46.2	Summer	73.2
Avg. Insol. (Ly/d)	Winter	287	Summer	504

SOLAR ENERGY SYSTEM

Application Heating 50% Cooling 0% Hot Water 50%

Collector

Type: Air flat-plate/liquid flat-plate

Area (sq. ft.): 195/240

Manufacturer: Solaron Corporation/Solar Development, Inc.

Storage

Type: Rock bed/steel tank(above ground)

Capacity: 110 cu. ft./560 gallons

Auxiliary System Type: Natural gas

PROJECT DESCRIPTION

Solar energy provides heat for office space within a prefabricated steel building. Waste energy produced in excess of that demanded by office areas can be passed into the warehouse or second floor drafting room. Two systems are employed, a liquid heating system employing ethylene glycol through south facing collectors inclined at 53°, and an air collector system employing ten panels of 19 1/2 sq. ft. The liquid system employs a heat exchanger built into the hot water storage tank, the exchanger allowing ethylene glycol to pump through the collectors when solar radiation is available. This introduces heat into the stored water. The air collector system employs eight motor-operated dampers and a booster fan to introduce the air to the collectors and/or the rock storage bin. The air is then moved to the respective air handling system for distribution to the space.

PROJECT INFORMATION

Owner/Builder: Louisiana State University & A&M College

Contractor: Bernhard Mechanical Contractors, Inc.

Operational Date: May 1978

Total Estimated DOE Funds: \$276,741

Building

Type: Field house

Area: 101,200 sq. ft. (cond.)

Location: Baton Rouge, Louisiana

Latitude: 30.7° N

Climatic Data

Degree Days	Heating	1560	Cooling	2585
Avg. Temp. (°F)	Winter	55.2	Summer	76.2
Avg. Insol. (Ly/d)	Winter	287	Summer	490

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water ✓

Collector

Type: Liquid flat-plate

Area (sq. ft.): 5,700

Manufacturer: Lennox Industries, Inc./Honeywell, Inc.

Storage

Type: Insulated steel water tanks (above ground)

Capacity: 10,000 gallons

Auxiliary System Type: Gas fired boilers

PROJECT DESCRIPTION

An existing field house used year round by students and faculty for indoor athletics will be retrofitted with the proposed solar energy system. The field house consists of a one-story center wing, a two-story south wing, and a two-story north wing. Exterior walls are 8" concrete, except the upper part of the center wing, which is plywood sheathing on light gage steel framing with glass fiber blanket insulation. Ceilings are insulated with brown cellulose acoustical-thermal insulation. Collectors are located on the roof of the south wing. The maximum domestic hot water requirement is 1600 gallons per hour. The solar system is designed to provide storage of heat equivalent to two days of peak solar radiation. The yearly sunshine received by Baton Rouge is approximately 57%.

PROJECT INFORMATION

Owner/Builder: Ferguson Corporation

Contractor: Anthony F. Musolino/John E. Lawrence and
Associates/Solar Energy Scientific Technical Services

Operational Date: May 1978

Total Estimated DOE Funds: \$90,357

Building

Type: Motel

Area: 100 rooms and laundry

Location: Annapolis, Maryland

Latitude: 39.0° N

Climatic Data

Degree Days	Heating	4729	Cooling	1108
Avg. Temp. (°F)	Winter	45.9	Summer	73.1
Avg. Insol. (Ly/d)	Winter	288	Summer	488

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 60%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,792

Manufacturer: Southwest Ener-Tech, Inc.

Storage

Type: Insulated steel water tanks (above ground)

Capacity: 3,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

In this project, the present water heating facilities of the Thr-Rift Inn in Annapolis, Md. will be supplemented by a solar energy system. The motel currently uses electricity to heat its water, but a more economical system has become increasingly desirable. The motel offers two special challenges for a solar energy system. First, the demand in the rooms for hot water during nondaylight hours is quite high. Second, the motel has a laundry, which also has a very high hot water requirement. The proposed solar energy system uses solar collectors, a heat exchanger, and a storage tank. It will provide water heated to 120°F for the occupant use. The solar system will be supplemented by an electrical water heater for the laundry. The electric heater will raise the temperature of the water from 120°F to 180°F, the temperature required by Maryland State health codes.

PROJECT INFORMATION

Owner/Builder: City of Baltimore
 Contractor: Ingleside Contractors of Maryland
 Operational Date: January 1979
 Total Estimated DOE Funds: \$150,345

Building

Type: Community center
 Area: 17,000 sq. ft.

Location: Baltimore, Maryland

Latitude: 39.2° N

Climatic Data

Degree Days	Heating	4729	Cooling	1108
Avg. Temp. (°F)	Winter	45.9	Summer	73.1
Avg. Insol. (Ly/d)	Winter	288	Summer	488

SOLAR ENERGY SYSTEM

Application Heating 64% Cooling 0% Hot Water ✓

Collector

Type: Liquid flat-plate
 Area (sq. ft.): 3,100
 Manufacturer: InterTechnology Corporation

Storage

Type: Insulated steel water tank (in mechanical room)
 Capacity: 20,000 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

Located in the Upton Urban Renewal Area immediately northwest of the central business district of Baltimore, this building houses a daycare and recreation facility. The core of the facility is a steel-framed gymnasium with the single plane solar collector being integrated into the single-pitch roof structure. Hallway skylights provide light and passive solar heating. Thermal energy storage is accomplished with a built-in-place compartment concrete tank. Recessed double glazed windows and an air-lock entry improve the thermal performance of the building. Freeze protection for the system will be through automatic drainage of the water when the collector temperature is either less than 60°F or 10°F less than the storage tank temperature for a period of two hours.

PROJECT INFORMATION

Owner/Builder: City of Baltimore

Contractor: To be determined

Operational Date: June 1978

Total Estimated DOE Funds: \$231,709

Building

Type: Fire station

Area: 8,500 sq. ft. (heated); 2,410 sq. ft. (cooled)

Location: Baltimore, Maryland

Latitude: 39° N

Climatic Data

Degree Days	Heating	4101	Cooling	1491
Avg. Temp. (°F)	Winter	46.2	Summer	71.2
Avg. Insol. (Ly/d)	Winter	304	Summer	390

SOLAR ENERGY SYSTEM

Application Heating 77.6% Cooling 58.9% Hot Water 100%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,000

Manufacturer: To be determined

Storage

Type: Insulated steel water tank (in mechanical room)

Capacity: 6,000 gallons

Auxiliary System Type: Heating - oil fired boiler; cooling - reciprocating chiller; hot water - electric heater

PROJECT DESCRIPTION

This new fire station has been designed specifically to integrate normal building functions with the visual drama of the solar energy collector array. The bank of 320 solar collectors faces due south and is mounted at a 45° angle from horizontal. The 60' high structure for the collectors will be highly visible in a neighborhood of low-lying commercial structures. The main storage tank will provide sufficient thermal capacity to store the maximum amount of excess solar energy generated. Potable hot water is isolated with a double wall heat exchanger from the solar energy transport loop to prevent possible contamination even though water is used as the heat transfer medium. Major materials for this firehouse will include insulated industrial corrugated metal exterior panels over concrete block walls; exposed steel structure and spiral mechanical HVAC ducts; high intensity, low voltage lighting; a pre-engineered skylight of acrylic plastic; and, exposed steel trusses supporting the bank of collectors.

...OJECT INFORMATION

Owner/Builder: Baltimore County

Contractor: AAI Corporation

Operational Date: February 1978

Total Estimated DOE Funds: \$616,166

Building

Type: Elementary school

Area: 45,000 sq. ft. (total); 10,000 (cond.)

Location: Cockeysville, Maryland

Latitude: 39.9° N

Climatic Data

Degree Days	Heating	4729	Cooling	1108
Avg. Temp. (°F)	Winter	45.9	Summer	73.1
Avg. Insol. (Ly/d)	Winter	288	Summer	488

SOLAR ENERGY SYSTEM

Application Heating 75% Cooling 75% Hot Water 0%

Collector

Type: Concentrator/reflector

Area (sq. ft.): 400/3,350

Manufacturer: AAI Corporation

Storage

Type: Steel water tank

Capacity: 10,000 gallons (hot); 10,000 gallons (chilled)

Auxiliary System Type: Oil and electric

PROJECT DESCRIPTION

The project encompasses the design, manufacture, retrofit installation, and testing of a solar concentrator for the one-story Padonia Elementary School. The concentrator provides most of the heating and cooling required for the cafetorium, library and administrative suite. The solar concentrator system consists of fixed parabolic reflector mirrors mounted on the south end of the school, a liquid collector with an electronic sun-sensing control mechanism, hot and cold water storage, and an absorption chiller. The performance of the collector will be closely monitored and compared with the performance of the flat-plate collector installation at the Timonium Elementary School located only two miles away.

PROJECT INFORMATION

Owner/Builder: Maryland National Capital Park and Planning Commission

Contractor: Greenhorne & O'Mara, Inc.

Operational Date: July 1978

Total Estimated DOE Funds: \$49,016

Building

Type: Office

Area: 3,000 sq. ft.

Location: Gaithersburg, Maryland

Latitude: 39.0° N

Climatic Data

Degree Days	Heating 4211	Cooling 1415
Avg. Temp. (°F)	Winter 42.2	Summer 69.9
Avg. Insol. (Ly/d)	Winter 262	Summer 483

SOLAR ENERGY SYSTEM

Application Heating: 50% Cooling 0% Hot Water 0%

Collector

Type: Liquid tubular

Area (sq. ft.): 1,500

Manufacturer: KTA Corporation

Storage

Type: Steel water tank (above ground)

Capacity: 3,000 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

For this project, a solar energy system will provide heat to a one-story office building. The solar system will use collectors on the building's roof, a heat exchanger, pump, and storage tank. It should provide 50% of the building's space heating requirement during peak demand periods and 100% of the requirement when the demand is lowest. The building has 9" of insulation in the roof and 6" in the walls. Wall insulation is further improved by 6' earth berms. All windows are double insulated; windows on the northern side of the building have been minimized. The use of glass in walls and skylights should significantly reduce electric lighting demands. The abundance of existing trees and shrubs around the building will significantly reduce heating demands during the winter and cooling demands in the summer.

PROJECT INFORMATION

Owner/Builder: Montgomery Community College

Contractor: Silver, Schwartz and Associates

Operational Date: May 1978

Total Estimated DOE Funds: \$22,379

Building

Type: Community college (Science and Technology Building)

Area: 14,000 sq. ft.

Location: Germantown, Maryland

Latitude: 40° N

Climatic Data

Degree Days	Heating	4224	Cooling	1415
Avg. Temp. (° F)	Winter	41.8	Summer	78.6
Avg. Insol. (Ly/d)	Winter	385	Summer	430

SOLAR ENERGY SYSTEM

Application Heating 60% Cooling 0% Hot Water 88%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 4,500

Manufacturer: PPG Industries, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 7,500 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

A solar energy collection system has been incorporated into the mechanical systems of the building to heat the domestic hot water required for the facility and warm the water circulated to perimeter zone water source heat pumps which are used for space heating. The facility will be used primarily for classroom and laboratory instruction. Careful attention has been given to the orientation of the building and its effect on both heating and cooling. Overhangs have been incorporated at virtually all windows to provide substantial shielding from direct sunlight.

PROJECT INFORMATION

Owner/Builder: Baltimore County

Contractor: AAI Corporation

Operational Date: March 1974 (heating); May 1975 (cooling)

Total Estimated DOE Funds: \$1,151,020

Building

Type: Elementary school

Area: 60,000 sq. ft. (total); 8,580 (cond.)

Location: Timonium, Maryland

Latitude: 39.5° N

Climatic Data

Degree Days	Heating	4729	Cooling	1108
Avg. Temp. (°F)	Winter	45.9	Summer	73.1
Avg. Insol. (Ly/d)	Winter	288	Summer	488

SOLAR ENERGY SYSTEM

Application Heating 60% Cooling 90% Hot Water 0%

Collector

Type: Liquid flat-plate/reflector

Area (sq. ft.): 5,040/5,300

Manufacturer: AAI Corporation

Storage

Type: Insulated steel water tank (above ground)

Capacity: 15,000 gallons (hot); 40,000 gallons (chilled)

Auxiliary System Type: Oil boiler

PROJECT DESCRIPTION

This project provided for the design, fabrication, and installation of a retrofit solar heating and cooling system for one wing of the Timonium Elementary School. The solar system consists of liquid honeycomb construction flat-plate collectors with fixed mirrors, hot and cold storage tank, and a 150-ton York absorption chiller. Two principal modifications were made. A cooling tower was added and a condensate drain line was run to convectors in the classrooms. This was the first school in the U.S. to have solar heating and cooling. The project also called for studies of the feasibility of installing systems similar to this in other buildings. This project was partially funded by the National Science Foundation and is one of the four early proof-of-concept experiments started in 1974.

PROJECT INFORMATION

Owner/Builder: Hampshire College
Contractor: Hampshire College
Operational Date: Mid 1978
Total Estimated DOE Funds: \$355,027

Building

Type: College
Area: 50,000 sq. ft.

Location: Amherst, Massachusetts

Latitude: 42.3° N

Climatic Data

Degree Days	Heating	7578	Cooling	N/A
Avg. Temp. (°F)	Winter	30	Summer	70
Avg. Insol. (Ly/d)	Winter	280	Summer	500

SOLAR ENERGY SYSTEM

Application Heating 65% Cooling 95% Hot Water 100%

Collector

Type: Evacuated tubular
Area (sq. ft.): 5,000
Manufacturer: Owens-Illinois, Inc.

Storage

Type: Insulated fiberglass water tanks (underground)
Capacity: 10,000 gallons (hot); 10,000 gallons (cold)

Auxiliary System Type: Electric resistance

PROJECT DESCRIPTION

Construction began in 1975 on a Practicing Arts Village at Hampshire College. There are some 5000 sq. ft. of Owens-Illinois evacuated tubular collectors mounted on a canopy over the central walkway of the Village, making them a dominant architectural element. Eight-foot high earth berms enclose the Village and insulate the buildings to one-half their height. These berms along with the siding of the buildings modify the microclimate of the project by deflecting winds, insulating the building, and capturing the sun for the courts. The solar system incorporates an Arkla WFB 25-ton absorption chiller with an electric Trane Model CG40D reciprocating chiller as back-up. For summer operation, a high temperature tank stores 210° to 230°F water and supplies the generator. Water flows to a lower temperature tank, then to the collectors. In this way, the generator sees a fairly consistent water temperature. Cool water is stored in two 10000-gallon tanks which protrude from a berm.

PROJECT INFORMATION

Owner/Builder: City of Boston (Dorchester)

Contractor: General Electric Company

Operational Date: March 1974

Total Estimated DOE Funds: \$600,236

Building

Type: School

Area: 61,000 sq. ft. (total); 21,000 (cond.)

Location: Boston (Dorchester), Massachusetts

Latitude: 42.4° N

Climatic Data

Degree Days	Heating 5621	Cooling 661
Avg. Temp. (°F)	Winter 42.3	Summer 70.9
Avg. Insol. (Ly/d)	Winter 248	Summer 479

SOLAR ENERGY SYSTEM

Application Heating 65% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 4,600

Manufacturer: General Electric Company

Storage

Type: Insulated water tank (above ground)

Capacity: 2,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

In 41 days this 144 collector, rooftop solar heating system was designed, fabricated, and installed on the Grover Cleveland School in Boston. This was followed by an operation and evaluation period during which the system provided about 50% of the heating needs for the 21000 sq. ft. area of the school. In the fall of 1974, the system provided all the heat until early December, when it was discovered that the conventional electric resistant heating had been inadvertently left off following summer servicing. Early in 1976, the system was refurbished, the control system simplified, and the ethylene glycol heat transfer fluid replaced with silicone oil. Since then, the system has performed well in a fully automatic mode without maintenance. The city of Boston accepted ownership of the installation in 1977. This project was partially funded by the National Science Foundation and is one of the four early proof-of-concept experiments started in 1974.

PROJECT INFORMATION

Owner/Builder: Children's Hospital Medical Center

Contractor: Balco, Inc.

Operational Date: April 1978

Total Estimated DOE Funds: \$148,150

Building

Type: Hospital

Area: 180,000 sq. ft. (total); 24,000 sq. ft. (heating);
96,000 sq. ft. (domestic hot water)

Location: Boston, Massachusetts

Latitude: 42° N

Climatic Data

Degree Days	Heating	5634	Cooling	N/A
Avg. Temp. (°F)	Winter	42	Summer	70
Avg. Insol. (Ly/d)	Winter	265	Summer	492

SOLAR ENERGY SYSTEM

Application Heating 12.5% Cooling 0% Hot Water 11.9%

Collector

Type: Evacuated tubular

Area (sq. ft.): 2,294

Manufacturer: General Electric Company

Storage

Type: Insulated steel water tank (hung from mechanical room ceiling)

Capacity: 2,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

This fourteen-story building is constructed of a concrete pan and reinforced concrete frame. Exterior walls are poured concrete with precast concrete panels between the windows. The two tall towers at opposite corners of the roof pose a difficult design problem to eliminate collector shading. The proposed solar installation will provide preheat capability to one ventilation/air conditioning unit. Located directly above the existing mechanical area, which permits tie-in with minimum piping runs, are 155 solar collectors. Because the solar system will operate 12 months of the year, the collectors will be tilted up 42° from the local horizontal to match the latitude angle of the Boston area. In addition to space air preheating during the heating season, the solar system will assist the existing equipment in meeting the very heavy domestic hot water demand that continues during the summer months. A simple solar control system will operate independently of the existing equipment controls. The collector loop is closed and pressurized. The working fluid is a 35% glycol-water solution.

PROJECT INFORMATION

Owner/Builder: Metropolitan District Commission

Contractor: Massachusetts Design

Operational Date: July 1978

Total Estimated DOE Funds: \$91,489

Building

Type: Community, conference, teaching and referral center

Area: 5,776 sq. ft.

Location: Boston, Massachusetts

Latitude: 42°N

Climatic Data

Degree Days	Heating	5621	Cooling	N/A
Avg. Temp. (°F)	Winter	30.9	Summer	70.8
Avg. Insol. (Ly/d)	Winter	115	Summer	486

SOLAR ENERGY SYSTEM

Application Heating 61% Cooling 0% Hot Water 51%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,200

Manufacturer: Daystar Corporation

Storage

Type: Insulated steel glycerol/water tank (underground)

Capacity: 4,560 gallons

Auxiliary System Type: Oil fired hot air

PROJECT DESCRIPTION

This project proposes to retrofit the Herter Center, a two-story steel-frame landmark, with a combined space and hot water heating system. The building will be modified to incorporate the solar collectors on the facade. This is a flat-plate, high-efficiency, liquid antifreeze collection system. Domestic hot water is preheated by circulating stored water through a coil immersed in the lower region of an electrical hot water heater. Collection pumping is controlled by a pair of temperature sensors, one on a collector absorber panel and the other in the heat store, both feeding signals to a differential temperature controller which controls the circulator pump.

PROJECT INFORMATION

Owner/Builder: Technology Properties Trust

Contractor: Wormser Scientific Corporation

Operational Date: April 1978

Total Estimated DOE Funds: \$180,411

Building

Type: Office

Area: 18,300 sq. ft.

Location: Burlington, Massachusetts

Latitude: 42.5° N

Climatic Data

Degree Days	Heating	5791	Cooling	800
Avg. Temp. (°F)	Winter	42	Summer	70
Avg. Insol. (Ly/d)	Winter	265	Summer	452

SOLAR ENERGY SYSTEM

Application Heating 79% Cooling 80% Hot Water 90%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,965

Manufacturer: Daystar Corporation

Storage

Type: Insulated steel water tanks (in mechanical room)

Capacity: 6,000 gallons

Auxiliary System Type: Electric resistance heaters

PROJECT DESCRIPTION

A reciprocating chiller will use well water in both heating and cooling modes and will be assisted by the solar system which includes 1872 sq. ft. of reflector enhanced Daystar Corporation collectors tilted at 60° to horizontal with two thermal storage tanks. The reflectors are movable and act as collector covers in summer to avoid heat rejection. Two collectors will be utilized year-round for hot water. The existing building's location and structural system predicated the 21° east of south collector orientation. If 87°F water is available from the solar system, it is used directly through deep coil units manufactured by the Trane Company. Solar energy will assist the evaporator of the reciprocating chiller if the available temperature is between 70°F and 87°F. Well water is used as the heat source at lower temperatures. In summer, well water is used as condensing water and returned to the ground through percolating catch basins. The well water will have a near constant temperature of 55°F and can supply a large part of the cooling load directly.

PROJECT INFORMATION

Owner/Builder: Town of Concord

Contractor: Worcester Air Conditioning Company, Inc.

Operational Date: March 1978

Total Estimated DOE Funds: \$145,000

Building

Type: Office/warehouse

Area: 9,300 sq. ft.

Location: Concord, Massachusetts

Latitude: 42.3° N

Climatic Data

Degree Days	Heating	7517	Cooling	500
Avg. Temp. (°F)	Winter	32	Summer	65
Avg. Insol. (Ly/d)	Winter	250	Summer	475

SOLAR ENERGY SYSTEM

Application Heating 75% Cooling 0% Hot Water 0%

Collector

Type: Air flat-plate

Area (sq. ft.): 1,932

Manufacturer: Sunworks, Inc.

Storage

Type: Rock bed (above ground)

Capacity: 1,210 cu. ft.

Auxiliary System Type: Radiant electric heat

PROJECT DESCRIPTION

An air space heating system is being retrofitted at the town's municipal light plant building. It will heat 8400 sq. ft. of office and warehouse space (volume: 118,695 cu. ft.). The air system was selected to determine the efficiency of air as a medium in a large volume space heating application. The design requirements are to maintain a temperature of 68°F in the office area and 50°F in the warehouse area. The design philosophy included adding insulation to the existing roof and walls to maximize the efficiency/performance of the solar system. Public visibility will be provided. The system will be instrumented to monitor performance and efficiency and will be transmitting data by the end of January.

PROJECT INFORMATION

Owner/Builder: American Motor Inns, Inc.

Contractor: To be determined

Operational Date: October 1978

Total Estimated DOE Funds: \$32,863

Building

Type: Low rise motor inn

Area: Not applicable to hot water systems

Location: Lennox, Massachusetts

Latitude: 42° N

Climatic Data

Degree Days	Heating	N/A	Cooling	N/A
Avg. Temp. (°F)	Winter	26	Summer	68
Avg. Insol. (Ly/d)	Winter	475	Summer	607

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 59%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,533

Manufacturer: Sunworks, Inc.

Storage

Type: Insulated steel water tanks (in mechanical room)

Capacity: 2,000 gallons

Auxiliary System Type: Boiler, fired by natural gas

PROJECT DESCRIPTION

The proposed system consists of two distinct systems. One system, consisting of 22 collectors and a 500-gallon storage tank, will provide hot water to the kitchen, dining areas and managerial offices located in the commercial building. The other system, consisting of 51 collectors arranged in three arrays, a new 1000-gallon storage tank and an existing 500-gallon storage tank, will provide hot water to the 120 guest units and the laundry. The existing hot water heaters in each building will provide any back-up energy necessary.

PROJECT INFORMATION

Owner/Builder: Jordan College

Contractor: Fair, Brother, Gunther and Company

Operational Date: December 1977

Total Estimated DOE Funds: \$98,660

Building

Type: Residence hall

Area: 6,700 sq. ft. (total); 6,200 sq. ft. (cond.)

Location: Cedar Springs, Michigan

Latitude: 42° 7'N

Climatic Data

Degree Days	Heating	6801	Cooling	N/A
Avg. Temp. (°F)	Winter	46.5	Summer	70.4
Avg. Insol. (Ly/d)	Winter	2354	Summer	1553

SOLAR ENERGY SYSTEM

Application Heating 52% Cooling 0% Hot Water 52%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,520

Manufacturer: PPG Industries, Inc.

Storage

Type: Insulated steel water tanks (above ground)

Capacity: 5,300 gallons

Auxiliary System Type: Gas boiler and gas water heater

PROJECT DESCRIPTION

This building, located on a mostly tree-free rolling farm land, is a one-story, slab on grade, frame construction with a flat roof. The building provides dormitory space with 13 student rooms, a guest room, house parents apartment, lounge, bathrooms, laundry and other support facilities. Because the hot water heating system is designed for 180°F water, the solar system must provide 180°F water in the quickest and most efficient manner. This is accomplished by utilization of a day tank which floats in the system. Heat from the collectors is transported to the day tank and is concentrated to the desired temperature. From the day tank, heat is extracted and utilized for space heating and domestic water heating. If a surplus of heat is available in the day tank, it is transferred to a larger underground storage tank. During periods of no solar insolation, heat energy is transferred from the underground storage tank to the day tank for use as required.

PROJECT INFORMATION

Owner/Builder: Ingham County Board of Commissioners

Contractor: Manyam and Associates and Michigan State University

Operational Date: May 1978

Total Estimated DOE Funds: \$336,700

Building

Type: Health center/hospital

Area: To be determined

Location: Okemos, Michigan

Latitude: 42.7° N

Climatic Data

Degree Days	Heating	6904	Cooling	535
Avg. Temp. (°F)	Winter	40.2	Summer	69.2
Avg. Insol. (Ly/d)	Winter	267	Summer	526

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 25%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 10,000

Manufacturer: Revere Copper & Brass, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 5,000 gallons

Auxiliary System Type: Oil

PROJECT DESCRIPTION

The solar energy water heating system will help to meet the hot water demands of a 204-bed hospital and geriatric facility. The water heating system will be supplemented by systems for solid waste combustion and thermal energy recycling. Since much of the demand for hot water occurs during daylight hours, the storage facility requirement will be minimized and the preheated water will be used almost immediately. A conventional oil heating system will be used to raise the temperature of the preheated water to its required level, between 140°F and 180°F. The use of the solar energy system should result in an annual reduction of 25% in fuel oil cost. The successful operation of such a system is especially important for relatively energy poor states such as Michigan, which currently depend almost entirely on out-of-state sources for their fuel and energy supply.

PROJECT INFORMATION

Owner/Builder: Petoskey Motel/Leonard Sieraoski, Sr.

Contractor: Sunrise Energy Products, Inc.

Operational Date: October 1978

Total Estimated DOE Funds: \$69,931

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Petoskey, Michigan

Latitude: 45.37° N

Climatic Data

Degree Days	Heating	8162	Cooling	N/A
Avg. Temp. (° F)	Winter	21.7	Summer	63.3
Avg. Insol. (Ly/d)	Winter	210	Summer	485

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 84%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 3,048

Manufacturer: Southwest Ener-Tech, Inc.

Storage:

Type: Insulated steel water tank (underground)

Capacity: 3,000 gallons

Auxiliary System Type: Natural gas

PROJECT DESCRIPTION

This is a unique solar energy system designed especially as a model for northern latitude sites. An essential design criteria was to develop a system to provide greater than 75% of the post-addition motel domestic hot water needs. The system includes a hot laundry waste water heat exchanger for reclaiming up to 20% of the energy contained in the motel laundry waste water discharge. Thus normally lost energy will serve to pre-heat the incoming cold water from 40°F to 80°F. The 3048 sq. ft. solar collector array will be integrated with a collector support structure to form the roof and enclosure for the existing motel swimming pool. The insulation necessary for the solar collector will also provide the insulation required for the cathedral ceiling over the pool area. A 3000-gallon stainless steel storage tank will be used for hot water storage and a 300-gallon stainless steel tank will provide thermal expansion and drain-down volume for freeze protection. A by-pass loop will allow the 40000-gallon pool volume to be circulated through a spare heat exchanger in the 300-gallon tank to provide over temperature protection.

PROJECT INFORMATION

Owner/Builder: John O. Esslinger, M.D./Valentine Esslinger, M.D.

Contractor: G.M. Design, Inc.

Operational Date: January 1978

Total Estimated DOE Funds: \$25,280

Building

Type: Medical offices

Area: 2,468 sq. ft.

Location: Traverse City, Michigan

Latitude: 46.5° N

Climatic Data

Degree Days	Heating	9048	Cooling	N/A
Avg. Temp. (°F)	Winter	17	Summer	61
Avg. Insol. (Ly/d)	Winter	152.87	Summer	540.33

SOLAR ENERGY SYSTEM

Application Heating 22% Cooling 0% Hot Water 67%

Collector

Type: Air flat-plate

Area (sq. ft.): 663

Manufacturer: Solaron Corporation

Storage

Type: Pebble bed (partially buried)

Capacity: 342 cu. ft.

Auxiliary System Type: Gas fired, forced air furnace

PROJECT DESCRIPTION

This northern Michigan medical office facility is equipped to solar assist its gas fired forced air heating system as well as providing domestic hot water preheat. Cost, installation, and performance data will be used for technical and financial evaluation of the project. The structure is designed to express the nature of a solar structure, and employ insulative, structural, and reflective characteristics to maximize energy efficiency for solar application.

PROJECT INFORMATION

Owner/Builder: Troy School District

Contractor: TMP Associates

Operational Date: September 1978

Total Estimated DOE Funds: \$206,770

Building

Type: Elementary school

Area: 50,000 sq. ft. (total); 56,000 sq. ft. (cond.)

Location: Troy, Michigan

Latitude: 42° N

Climatic Data

Degree Days	Heating	6232	Cooling	731
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Avg. Temp. (°F)	Winter	35	Summer	72
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Avg. Insol. (Ly/d)	Winter	187	Summer	518
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SOLAR ENERGY SYSTEM

Application Heating 40% Cooling 0% Hot Water 33%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 5,000

Manufacturer: Libbey-Owens-Ford Company

Storage

Type: Concrete water tank (underground)

Capacity: 40,000 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

Three identical highly energy efficient schools will be built, one with solar and the other two with the option for future solar systems. Heating is provided by water-to-air heat pumps. Heat is added to the condenser loop from the storage tank, solar collectors, heat recovered from lights and people in interior zones, or by the back-up electric boiler. Each heat pump is provided with outdoor air and return air dampers and is capable of utilizing 100% outdoor air for cooling when conditions permit. Domestic hot water is preheated by a thermosyphon coil in the water storage tank. Solar collection and storage is provided by flat-plate, single-glazed collectors at 45° tilt, a glycol solar loop to a shell and tube water-to-water converter, storage tank and necessary pumps and piping. For additional energy conservation, the building's HVAC system will be connected to the school system's city-wide central environmental control system to control outdoor air damper positions and day/night programming.

PROJECT INFORMATION

Owner/Builder: Minnesota Zoological Board

Contractor: Minnesota Zoological Board

Operational Date: August 1978

Total Estimated DOE Funds: \$313,458

Building

Type: Zoo ride station

Area: 14,160 sq. ft.

Location: Apple Valley, Minnesota

Latitude: 44.08° N

Climatic Data

Degree Days	Heating	8382	Cooling	N/A
Avg. Temp. (°F)	Winter	28.3	Summer	70.3
Avg. Insol. (Ly/d)	Winter	213.2	Summer	526

SOLAR ENERGY SYSTEM

Application Heating 22.2% Cooling 0% Hot Water 32.7%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 9,018

Manufacturer: Lennox Industries, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 9,240 gallons

Auxiliary System Type: Electric space heaters/steam boiler for domestic hot water

PROJECT DESCRIPTION

The solar system will provide heating energy to distinct areas of the zoo. During the winter the system will provide space heating and temper incoming ventilation air for the Zoo Ride Transit Station and Rest Stop. During the nonspace heating months, approximately April 1 to October 1, the solar system will preheat incoming main water for the main building complex.

PROJECT INFORMATION

Owner/Builder: Rodeway Inns of America & R. V. Development Company

Contractor: Charter Builders, Inc.

Operational Date: July 1978

Total Estimated DOE Funds: \$94,492

Building

Type: High rise hotel

Area: Not applicable to hot water systems

Location: Bloomington, Minnesota

Latitude: 45° N

Climatic Data

Degree Days	Heating	8382	Cooling	800
Avg. Temp. (° F)	Winter	16	Summer	71
Avg. Insol. (Ly/d)	Winter	212	Summer	357

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 45%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 4,000

Manufacturer: Lennox Industries, Inc.

Storage

Type: Insulated steel water tank

Capacity: 5,000 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

The collectors for this system will be located on the roof of the motel. The energy collected by the collectors will be transferred to a double bundle heat exchanger via a collector loop circulating pump. Through the heat exchanger, the absorbed energy will be transferred to the storage tank via the storage loop circulating pump. Utilization of the double bundle heat exchanger eliminates the danger of ethylene glycol leakage from the solar loop to the storage tank. Energy from the storage tank is utilized for the motel potable water and laundry.

PROJECT INFORMATION

Owner/Builder: Telex Communications, Inc.

Contractor: InterTechnology Corporation

Operational Date: November 1977

Total Estimated DOE Funds: \$350,000

Building

Type: Manufacturing plant

Area: 97,000 sq. ft.

Location: Blue Earth, Minnesota

Latitude: 44.9° N

Climatic Data

Degree Days	Heating	8154	Cooling	585
Avg. Temp. (°F)	Winter	35.6	Summer	69.7
Avg. Insol (Ly/d)	Winter	269	Summer	516

SOLAR ENERGY SYSTEM

Application Heating 60% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 10,550

Manufacturer: Solar Corporation of America

Storage

Type: Steel water tank (above ground)

Capacity: 20,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

This solar energy system employs ground mounted solar collectors adjacent to the building and a thermal storage tank buried beneath the collectors. The tank is below the frost line. Stored heat is relayed to hot water heating coils that provide heat for the building. The building has two sources of "free heat" that are also used, a soldering machine, and an air compressor. This equipment is operated daily in the assembly plant but had not previously been used as an energy source.

PROJECT INFORMATION

Owner/Builder: Osseo School District

Contractor: Honeywell, Inc.

Operational Date: April 1974

Total Estimated DOE Funds: \$509,633

Building

Type: Junior high school

Area: 165,583 sq. ft. (total); one room (cond.)

Location: Brooklyn Center, Minnesota

Latitude: 45.1°N

Climatic Data

Degree Days	Heating	8159	Cooling	585
Avg. Temp. (°F)	Winter	35.6	Summer	69.7
Avg. Insol. (Ly/d)	Winter	269	Summer	516

SOLAR ENERGY SYSTEM

Application Heating 54% Cooling 0% Hot Water 21%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 5,000

Manufacturer: Honeywell, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 3,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

This project provides for the design, installation, and testing of a solar energy system for the North View Junior High School. The system meets a part of the space and hot water heating requirements of the school's indoor swimming pool. During the first year of system operation, the performance of the system was evaluated, and a heat exchanger was installed in the swimming pool's recirculation system. The Tedlar film on one-sixth of the collectors was replaced with a second antireflective cover glass, and collector performance has been reevaluated. Besides reducing energy consumption, this system should provide useful data on solar collection and system performance. The data can be used in designing similar systems for other schools and in future research and development work. This project was partially funded by the National Science Foundation and is one of the early proof-of-concept experiments started in 1974.

PROJECT INFORMATION

Owner/Builder: Duluth YWCA

Contractor: Bob Bean

Operational Date: May 1978

Total Estimated DOE Funds: \$47,565

Building

Type: High rise hotel

Area: Not applicable to hot water systems

Location: Duluth, Minnesota

Latitude: 46° 5'N

Climatic Data

Degree Days	Heating	10000	Cooling	225
Avg. Temp. (°F)	Winter	26	Summer	68
Avg. Insol. (Ly/d)	Winter	212	Summer	493

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 56%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,500

Manufacturer: Ilse Engineering, Inc.

Storage

Type: Insulated steel water tank (underground)

Capacity: 5,000 gallons

Auxiliary System Type: Steam from oil fired central plant

PROJECT DESCRIPTION

The energy provided by the collectors of this system will be used primarily to preheat the water for the existing domestic hot water system. The solar hot water system consists of three distinct circulation systems. These include a collection loop which takes heat from the solar collectors and transfers it to the storage tank via heat exchanger. Water from the existing hot water tank is circulated and preheated through another heat exchanger coil located in the solar storage tank. The oil fired steam system will boost the water temperature to 140°F if required.

Photograph not available

PROJECT INFORMATION

Owner/Builder: Radisson Hotel Corporation

Contractor: Foster, Jacobs & Johnson

Operational Date: June 1978

Total Estimated DOE Funds: \$43,033

Building

Type: High rise hotel

Area: Not applicable to hot water systems

Location: Duluth, Minnesota

Latitude: 47° N

Climatic Data

Degree Days	Heating	10000	Cooling	225
Avg. Temp. (° F)	Winter	26	Summer	68
Avg. Insol. (Ly/d)	Winter	212	Summer	493

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 53%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,016

Manufacturer: Lennox Industries, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 2,000 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

The proposed solar system consists of 2016 sq. ft. of hydronic flat-plate solar collectors mounted above the swimming pool area on the Radisson Duluth Hotel, Duluth, Minnesota. The solar collector array will preheat incoming service water, held in a storage tank, and supplied from that tank as make-up water to the conventional electric water heater. This preheater concept will enable the solar system to operate at lower average temperatures, thereby increasing its operating efficiency. The conventional water heating system consists of a 480 kW electric boiler and a storage tank which provides approximately 3500 gallons of 125°F water per day. The proposed solar preheater system will provide approximately 53% of that load.

PROJECT INFORMATION

Owner/Builder: Minnesota Community College

Contractor: Mesaba Mechanical Company; Malton Electric Company;
Max Gray Construction Company

Operational Date: November 1978

Total Estimated DOE Funds: \$145,500

Building

Type: Planetarium/environmental science center

Area: 4,850 sq. ft.

Location: Hibbing, Minnesota

Latitude: 47.4°

Climatic Data

Degree Days	Heating	10,000	Cooling	200
Avg. Temp. (°F)	Winter	12.4	Summer	76.1
Avg. Insol. (Ly/d)	Winter	184	Summer	666

SOLAR ENERGY SYSTEM

Application Heating 100% Cooling 0% Hot Water 0%

Collector

Type: Concentrating

Area (sq. ft.): 3,600

Manufacturer: Sheldahl, Inc.

Storage

Type: Insulated concrete water tank (underground)

Capacity: 225,000 gallons

Auxiliary System Type: Fuel fired hot water

PROJECT DESCRIPTION

The main floor of the facility consists of the planetarium hyposphere, museum and display area, room for Foucault pendulum, lobby, offices, bathrooms, etc. The below-grade floor will be used as a mechanical equipment area and will house the 225,000-gallon insulated concrete water storage tank. The below-grade walls are poured concrete; the above-grade walls will be of concrete block and all floors will be of poured concrete. The roof structure is steel with metal roofing. All interior surfaces above grade will be sprayed with urethane insulation with fireproof vapor barrier over 6" on walls and 8" on ceiling. All below-grade areas will be insulated with 2" perimeter insulation on exterior surfaces. There is no fenestration in the building because the planetarium function requires maximum light control. The exterior design consists of a north sloping "shed" roof to receive the solar collectors. Roof orientation is due south to receive maximum solar insolation.

PROJECT INFORMATION

Owner/Builder: University of Minnesota

Contractor: Depts. of Mechanical Engineering, Civil & Mineral Engineering, University of Minnesota

Operational Date: Spring 1978

Total Estimated DOE Funds: \$92,000 (design)

Building

Type: Bookstore/office

Area: 83,000 sq. ft.

Location: Minneapolis, Minnesota

Latitude: 44.9° N

Climatic Data

Degree Days	Heating	8159	Cooling	585
Avg. Temp. (°F)	Winter	35.6	Summer	69.7
Avg. Insol. (Ly/d)	Winter	269	Summer	516

SOLAR ENERGY SYSTEM

Application Heating/Cooling 50% Hot Water 0%

Collector

Type: Concentrating

Area (sq. ft.): 6,600

Manufacturer: Sheldahl SLATS

Storage

Type: Insulated steel water tank (underground)

Capacity: 8,000 gallons

Auxiliary System Type: Central steam system

PROJECT DESCRIPTION

A solar assisted heating and cooling system has been designed and will be installed in a large building constructed on the Minneapolis campus of the University of Minnesota. The building, Williamson Hall, houses a bookstore and records and admissions offices, and was built 95% below ground. The underground construction should provide energy savings of about 60%, the exact figure depending on the thermal characteristics of the surrounding rock and soil. The building fits effectively into its surroundings and disrupts as little as possible the space occupied. A flat-plate collector system was compared to a concentrator system. On the basis of useful energy collected per unit area and on the cost effectiveness in \$/kwh/yr, the concentrator system was selected for this project.

PROJECT INFORMATION

Owner/Builder: Radisson Hotel Corporation

Contractor: Michaud, Cooley, Hallberg, & Erickson

Operational Date: July 1980

Total Estimated DOE Funds: \$360,000

Building

Type: Hotel

Area: 193,770 sq. ft.

Location: St. Paul, Minnesota

Latitude: 44.9° N

Climatic Data

Degree Days	Heating	8159	Cooling	585
Avg. Temp. (° F)	Winter	35.6	Summer	69.7
Avg. Insol. (Ly/d)	Winter	269	Summer	516

SOLAR ENERGY SYSTEM

Application Heating 35% Cooling 0% Hot Water 25%

Collector

Type: Hydronic flat-plate/air flat-plate

Area (sq. ft.): 5,000/3,000

Manufacturer: Lennox Industries, Inc./Honeywell, Inc.

Storage

Type: To be determined

Capacity: 8,000 gallons

Auxiliary System Type: Steam

PROJECT DESCRIPTION

A two-hundred fifty room high-rise hotel with convention facilities will be constructed in a downtown location. The collector panels of two solar systems are integrated into the exterior building wall and roof system. Hydronic flat-plate collectors tilted at 51° will provide hot water heating. Vertically-mounted air flat-plate collectors will provide heating of ventilation air. Two 4000-gallon storage tanks are located on the ground floor. Hot air from the air panels is interjected directly into guest room ventilation or used to heat water in the storage tanks. A central municipal steam plant will provide high-pressure steam to the site when auxiliary energy is needed.

PROJECT INFORMATION

Owner/Builder: Stephens College

Contractor: Sövik, Mathre, Sathrum, Quanbeck Architects

Operational Date: October 1978

Total Estimated DOE Funds: \$83,358

Building

Type: Visitors center

Area: 13,900 sq. ft.

Location: Columbia, Missouri

Latitude: 38.97° N

Climatic Data

Degree Days	Heating	5046	Cooling	1100
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Avg. Temp. (°F)	Winter	43	Summer	72.1
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Avg. Insol. (Ly/d)	Winter	245	Summer	515
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SOLAR ENERGY SYSTEM

Application	Heating 47%	Cooling 0%	Hot Water 0%
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Collector

Type: Liquid flat-plate

Area (sq .ft.): 3,168

Manufacturer: Honeywell, Inc./Lennox Industries, Inc.

Storage

Type: Steel water tank (above ground)

Capacity: 5,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

The visitors center will house the admissions office, the faculty lounge, and rooms for guests of the college. The collectors are integrated into the roof in a series/parallel arrangement with one in-line pump circulating a 50/50 glycol-water solution through the heat-exchanger coil in the storage tank. The heating system will be mainly fan-coil units and air handlers with hot/chilled water coils. Water for this system will be circulated through a closed loop by one or more pumps receiving energy from the immersed heat exchanger coil in storage. If the system water temperature drops below design conditions, a gas fired boiler will supply the supplemental heat through a shell-and-tube heat exchanger to the system loop.

PROJECT INFORMATION

Owner/Builder: City of Kansas City

Contractor: Midgley, Shaughnessy, Fickle & Scott/Cahill Const.

Operational Date: October 1978

Total Estimated DOE Funds: \$143,101

Building

Type: Fire station

Area: 8,200 sq. ft.

Location: Kansas City, Missouri

Latitude: 39.3° N

Climatic Data

Degree Days	Heating 5161	Cooling 1421
Avg. Temp. (° F)	Winter 41.7	Summer 72.8
Avg. Insol. (Ly/d)	Winter 266	Summer 528

SOLAR ENERGY SYSTEM

Application Heating 45% Cooling 0% Hot Water 75%

Collector

Type: Air flat-plate

Area (sq. ft.): 2,808

Manufacturer: Solaron Corporation

Storage

Type: Rock bed

Capacity: 1,400 cu. ft.

Auxiliary System Type: Electric furnaces

PROJECT DESCRIPTION

The fire station which has 3 apparatus bays and living quarters for 14 firemen, is located in a residential area in eastern Kansas City. The total project, with the exception of the solar provisions, is currently funded through Kansas City Fire Protection Bonds. The factory-assembled solar collectors are located on the roof and are oriented 15° west of true south. Heat loss is reduced by the addition of extra insulation and by utilizing insulating glass. A concrete box insulated and filled with 50 pounds of rock per sq. ft. of collector area serves as the storage medium for solar heat. Solar heated air is routed through the storage unit, thereby heating the rocks, and returns to the collector for reheating.

PROJECT INFORMATION

Owner/Builder: William Tao & Associates, Inc.

Contractor: William Tao & Associates, Inc.

Operational Date: August 1977

Total Estimated DOE Funds: \$9,512

Building

Type: Office

Area: 1,007 sq. ft.

Location: St. Louis, Missouri

Latitude: 38.8° N

Climatic Data

Degree Days	Heating	4900	Cooling	1475
Avg. Temp. (° F)	Winter	43.1	Summer	70.9
Avg. Insol. (Ly/d)	Winter	275	Summer	475

SOLAR ENERGY SYSTEM

Application Heating 45% Cooling 0% Hot Water 50%

Collector

Type: Concentrating glass tubular

Area (sq. ft.): 244

Manufacturer: KTA Corporation

Storage

Type: Steel water tank (underground)

Capacity: 1,000 gallons

Auxiliary System Type: Electric resistance heating/gas fired hot water

PROJECT DESCRIPTION

This is a 1-story addition with the east wall attached to the existing office building. The major part of the new building consists of a single office space for drafting, meetings, and conferences. The addition will be solar heated with conventional back-up units providing auxiliary heating and cooling. The solar system consists of a roof-mounted variable tilt collector array linked to an underground hot water storage tank by a shell and tube heat exchanger. In-line centrifugal pumps circulate fluids through the collector circuit and storage/heating circuit. Preheat of incoming city water is provided by a coil inserted in the storage tank. The conventional back-up unit is a roof-mounted air handler with electric resistance heating and DX cooling. The solar hot water coil is placed at the return air side of the unit.

PROJECT INFORMATION

Owner/Builder: Billings Shipping Corporation

Contractor: CTA Architects

Operational Date: March 1978

Total Estimated DOE Funds: \$60,900

Building

Type: Office

Area: 46,976 sq. ft. (total); 4,900 sq. ft. (cond.)

Location: Billings, Montana

Latitude: 45° 5'N

Climatic Data

Degree Days	Heating	7049	Cooling	N/A
Avg. Temp. (°F)	Winter	34.5	Summer	71.3
Avg. Insol. (Ly/d)	Winter	227	Summer	588.3

SOLAR ENERGY SYSTEM

Application Heating 52% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq .ft.): 1,848

Manufacturer: Lennox Industries, Inc.

Storage

Type: Insulated steel water tank (underground)

Capacity: 2,500 gallons

Auxiliary System Type: Natural gas, indirect heat exchanger

PROJECT DESCRIPTION

Water-to-water flat-plate solar collectors will be used to provide space heating for this new office building. The collectors will furnish heated water to an air handling unit if the occupied space requires heating or to a water storage tank if the space temperature is satisfied. An outdoor heat rejection unit will be used to prevent the water-antifreeze solution circulated through the collectors from exceeding 200°F. Heat from the storage tank will be used when the collectors are not operating.

= PUMP

PROJECT INFORMATION

Owner/Builder: Lincoln Housing Authority

Contractor: Clark Enerson Partners

Operational Date: March 1978

Total Estimated DOE Funds: \$13,787

Building

Type: Office

Area: 14,653 sq. ft. (total); 13,533 sq. ft. (cond.)

Location: Lincoln, Nebraska

Latitude: 41° N

Climatic Data

Degree Days	Heating	5864	Cooling	1148
Avg. Temp. (°F)	Winter	37.9	Summer	71.1
Avg. Insol. (Ly/d)	Winter	269.6	Summer	510.1

SOLAR ENERGY SYSTEM

Application Heating 50% Cooling 0% Hot Water 97%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,297

Manufacturer: Chamberlain Manufacturing Corporation

Storage

Type: Insulated steel water tank (in mechanical room)

Capacity: 5,330 gallons

Auxiliary System Type: Natural gas boiler

PROJECT DESCRIPTION

The solar system for this two story masonry office building will consist of a solar space heating system and a solar domestic water heating system. The two systems will be completely independent. The solar space heating system will consist of an array of flat-plate solar collectors on the roof of the building, connected by a piping system to a hot water storage tank located in the lower level mechanical equipment room. The collectors are arranged in six east-west rows, facing due south, tilted 56° above the horizontal. The heated water in the tank will be circulated to the building hot water equipment by separate pumps. The building will be heated by finned tube radiators at the perimeter of the building and cabinet unit heaters at building entrances. A heating coil in the variable volume air distribution system is used to warm the building after night setback. The solar domestic water heating system will consist of two roof-mounted, flat-plate solar collectors connected by a piping system to the hot water storage tank. The collectors will be mounted on the same racks as the solar space heating system collectors.

PROJECT INFORMATION

Owner/Builder: La Quinta Motor Inns, Inc.

Contractor: Travis-Braun & Associates, Inc.

Operational Date: September 1978

Total Estimated DOE Funds: \$34,660

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Las Vegas, Nevada

Latitude: 36° 1'N

Climatic Data

Degree Days	Heating	2709	Cooling	2900
Avg. Temp. (°F)	Winter	53.5	Summer	86.0
Avg. Insol. (Ly/d)	Winter	312	Summer	570

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 56%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,200

Manufacturer: Revere Copper & Brass, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 1,600 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

A drain-down system is proposed under this grant. This system is one in which, each time the water circulation pump stops, the collector fluid water drains out of and down into the protection of an enclosed space. In this proposal, this enclosed space is the mechanical room of the motel. This system is a hybrid version of a drain-down system employing a heat exchanger. By using this heat exchanger, the buildup of minerals in the solar collector is eliminated. On the solar loop of the system, a contained amount of water is employed. Even as this water level drops and makeup water is introduced into the system, new minerals, acids, etc., are also introduced; however, this introduction is extremely minor in comparison to the minerals which would be constantly introduced by a direct link between the storage vessel and the solar collectors.

PROJECT INFORMATION

Owner/Builder: Sahara Nevada Corporation

Contractor: Young/Rochester Corporation

Operational Date: August 1978

Total Estimated DOE Funds: \$104,880

Building

Type: High rise hotel/casino

Area: Not applicable to hot water systems

Location: Las Vegas, Nevada

Latitude: 36° 05' N

Climatic Data

Degree Days	Heating 2601	Cooling 2946
Avg. Temp. (°F)	Winter 48	Summer 86
Avg. Insol. (Ly/d)	Winter 360	Summer 683

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 58.4%

Collector

Type: Air flat-plate

Area (sq. ft.): 15,200

Manufacturer: Young Energy Systems, Inc.

Storage

Type: Insulated steel water tank (in mechanical room)

Capacity: 60,000 gallons

Auxiliary System Type: Steam boilers

PROJECT DESCRIPTION

The solar system will function as a preheater for cold water entering the existing domestic hot water system. The solar system will consist of 15200 sq. ft. of collectors with an equal area of reflectors to enhance performance at solar altitudes in excess of 35°. The collectors utilized were designed for large applications; nominal collector length is 100 feet, and represents a considerable improvement in cost effectiveness. The collectors are single-glazed with an acrylic material. The collector absorber is also made from an acrylic material. Air type collectors were chosen to eliminate any requirement for protective chemicals in the solar system. An air-to-water heat transfer coil will transfer heat from the solar air loops to the domestic hot water storage system. During the portion of the year of peak ambient temperatures and insolation, the system is sized to produce preheated hot water at sufficient temperatures to allow 100% solar contribution to the heating of domestic hot water for nearly 24 hours. At all times, the storage capacity is sufficient to store 125% of one day's solar energy production.

PROJECT INFORMATION

Owner/Builder: University of New Hampshire

Contractor: University of New Hampshire

Operational Date: June 1978

Total Estimated DOE Funds: \$192,156

Building

Type: Chemistry laboratory

Area: 54,380 sq. ft. (total); 48,750 sq. ft. (cond.)

Location: Durham, New Hampshire

Latitude: 43° 08'N

Climatic Data

Degree Days	Heating	7612	Cooling	315
Avg. Temp. (°F)	Winter	32.6	Summer	61.8
Avg. Insol. (Ly/d)	Winter	640.81	Summer	775.46

SOLAR ENERGY SYSTEM

Application Heating 63% Cooling 0% Hot Water 37%

Collector

Type: Liquid flat-plate

Area (sq.ft.): 3,500

Manufacturer: Sunworks, Inc.

Storage

Type: Vented steel water tank (in basement floor)

Capacity: 4,179 gallons

Auxiliary System Type: Existing oil fired boiler district system

PROJECT DESCRIPTION

The solar system proposed for this two-story building will be a roof-mounted, double-glazed, flat-plate collector system with the storage tank located in the mechanical equipment room. The solar system will serve the space (hot water) heating system and will provide approximately 100% of the annual requirement. When excess solar energy is produced beyond the needs of the building hot water heating system, the campus low-temperature "district" hot water heating system will be served. Under certain surplus conditions, available solar energy will be provided to supplement the domestic water heating system. The collectors will be mounted to face due south and tilted at an angle of 53° from the horizontal. They will be secured to steel frames which will diagonally span the building. The frames will keep the bottom edge of the collectors about 10' above the classroom roof to prevent unwanted snow drifting.

Photograph not available

PROJECT INFORMATION

Owner/Builder: Contemporary Systems, Inc.

Contractor: Contemporary Systems, Inc.

Operational Date: July 1978

Total Estimated DOE Funds: \$75,938

Building

Type: Office/manufacturing

Area: 4,560 sq. ft.

Location: Jaffrey, New Hampshire

Latitude: 42°N

Climatic Data

Degree Days	Heating	7400	Cooling	N/A
Avg. Temp. (°F)	Winter	31	Summer	72
Avg. Insol. (Ly/d)	Winter	200	Summer	450

SOLAR ENERGY SYSTEM

Application Heating 57% Cooling 0% Hot Water 65%

Collector

Type: Air flat-plate

Area (sq. ft.): 1,500 (active); 300 (passive)

Manufacturer: Contemporary Systems, Inc.

Storage

Type: Rock bed (underground)

Capacity: 2,900 cu. ft.

Auxiliary System Type: Oil fired warm air system

PROJECT DESCRIPTION

The Contemporary Systems solar demonstration project consists of a highly solar sufficient commercial structure, utilizing both active and passive solar heating techniques. The building will serve as the engineering, administrative, and production facility for Contemporary Systems. The building will be used for the development and production of solar components. The active array will consist of 1500 sq. ft. of active low temperature air collectors. This will inter-connect through an air transport system to the distribution and storage subsystems. The passive system will consist of four elements. The entrance foyer will be a greenhouse type passive collection area. Excess heat will be removed via the active air handling system. Clerestory lighting over the engineering area and window surface in the office space will provide controlled passive heat and light. This will be coupled to the air transport system to control excess heat gain. Solar skylights in the production shop will admit controlled solar radiation for space heating and general lighting.

PROJECT INFORMATION

Owner/Builder: Kalwall Corporation

Contractor: Kalwall Corporation

Operational Date: September 1976

Total Estimated DOE Funds: \$28,600

Building

Type: Warehouse

Area: 8,640 sq. ft.

Location: Manchester, New Hampshire

Latitude: 43.0°N

Climatic Data

Degree Days	Heating	7360	Cooling	349
Avg. Temp. (°F)	Winter	38.5	Summer	68.5
Avg. Insol. (Ly/d)	Winter	266	Summer	488

SOLAR ENERGY SYSTEM

Application Heating 50% Cooling 0% Hot Water 0%

Collector

Type: Vertical wall panels (passive system)

Area (sq. ft.): 1,750

Manufacturer: Kalwall Corporation

Storage

Type: Concrete floor

Capacity: N/A

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

Approximately 90% of the south-facing wall of a wood post and beam construction commercial warehouse has been retrofitted with an insulated solar window panel system which permits maximum insolation, yet is highly insulated to reduce heat losses. The concrete floors and exposed surfaces of adjacent fixtures inside the warehouse have been painted black. The inside area acts as part of the collector, trapping both heat radiation and convection. This area could have an overall absorption factor of 98% or 99% even though the same paint used in a flat-plate collector might have an inherent absorption coefficient of only 95%. The warehouse currently houses a retail building materials center. A 5000-sq. ft. area has been partitioned off for retail sales, and this area will continue to be heated by the existing hot water boiler.

SUNWALL AS PASSIVE SYSTEM COLLECTOR COVER

PROJECT DESCRIPTION

Owner/Builder: Somerset County Park Commission

Contractor: Somerset County Park Commission

Operational Date: October 1976

Total Estimated DOE Funds: \$725,236

Building

Type: Auditorium/classrooms/office

Area: 18,000 sq. ft. (total); 18,000 sq. ft. (heat); 9,500 sq. ft. (cool)

Location: Basking Ridge, New Jersey

Latitude: 40.8° N

Climatic Data

Degree Days	Heating	4897	Cooling	1021
Avg. Temp. (°F)	Winter	51.6	Summer	72.5
Avg. Insol. (Ly/d)	Winter	300	Summer	466

SOLAR ENERGY SYSTEM

Application Heating 50-60% Cooling 70-75% Hot Water 100%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 3,105

Manufacturer: General Electric Company

Storage

Type: Steel water tank (underground)

Capacity: 6,000 gallons

Auxiliary System Type: Oil fired boiler, electric

PROJECT INFORMATION

This project incorporates "an aesthetically and environmentally pleasing" solar system into an Environmental Education Center which opened January 3, 1977. Single glazed collectors are contained within the roof, covered by plastic panels. The collector array provides energy to heat the building directly and cool it through an absorption air conditioner. Hot water is stored in underground tanks to provide storage and retrieval capability for excess energy. A pond acts as a cooling sink for the 25-ton absorption air conditioner instead of a standard cooling tower. The system is fully instrumented to evaluate performance. An instrumentation console provides for data display and recording and a display panel graphically illustrates system operation. This equipment is part of an overall energy conservation display available to visitors to the Environmental Center as part of its educational program.

PROJECT INFORMATION

Owner/Builder: Garden State Racing Association

Contractor: Colm Engineering/The Franklin Institute

Operational Date: October 1978

Total Estimated DOE Funds: \$315,491

Building

Type: Hotel

Area: 70,000 sq. ft.

Location: Cherry Hill, New Jersey

Latitude: 40° N

Climatic Data

Degree Days	Heating	4600	Cooling	700
Avg. Temp. (°F)	Winter	42	Summer	70
Avg. Insol. (Ly/d)	Winter	357	Summer	522

SOLAR ENERGY SYSTEM

Application Heating 31.5% Cooling 0% Hot Water 29.8%

Collector

Type: Liquid evacuated tubes

Area (sq. ft.): 5,700

Manufacturer: General Electric Company

Storage

Type: Insulated steel water tank (above ground)

Capacity: 7,500 gallons

Auxiliary System Type: Oil fired steam boilers

PROJECT DESCRIPTION

Cherry Hill Inn offers accommodations for 600 guests and has facilities to host 4000 people in 15 meeting rooms. The proposed system would assist the existing space heating system which is a main air handler fan coil unit and individual room heater coils. It is intended to preheat domestic hot water in spring, summer, and fall. The collectors will be mounted on an aluminum framework on the roof in five rows at a 40° tilt. Storage temperatures are expected to reach 200°F.

PROJECT INFORMATION

Owner/Builder: Sea Loft

Contractor: Stephen Giddio Construction Company/Smith Hinchman
and Grylls Associates, Inc./Harvey Myers, AIA

Operational Date: January 1979

Total Estimated DOE Funds: \$184,757

Building

Type: Restaurant

Area: 24,700 sq. ft. (total); 13,600 sq. ft. (heating);
11,100 sq. ft. (cooling)

Location: Long Branch, New Jersey

Latitude: 42.3°N

Climatic Data

Degree Days	Heating	4859	Cooling	1024
Avg. Temp. (°F)	Winter	42	Summer	68
Avg. Insol. (Ly/d)	Winter	187	Summer	408

SOLAR ENERGY SYSTEM

Application Heating 43% Cooling 28% Hot Water 50%

Collector

Type: Glass evacuated tube

Area (sq. ft.): 2,808

Manufacturer: Owens-Illinois, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 4,000 gallons

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

The Sea Loft Restaurant is to operate as a contemporary seafood restaurant, with lounge and catering on the oceanfront in Long Branch, New Jersey. The restaurant and lounge will sit on top of an 18' elevation giving diners an unobstructed ocean front view at its southern orientation. The collectors (85 panels at 40° tilt, 19 panels at 0° tilt) are to be used as a primary source for space heating, cooling, and domestic hot water heating. Solar-heated water will be used whenever available during the cooling season to provide an energy source to operate a 25-ton absorption chiller. The chilled water produced will pre-cool the main chilled water loop. During the heating season, a finned tube radiation terminal subsystem will use solar heated water as available via a water-to-water heat exchanger. A solar assist will help provide 100°F domestic hot water which will be boosted locally as required for kitchen equipment. Reclamation of available heat generated within the building will be optimized for instantaneous and/or later use.

PROJECT INFORMATION

Owner/Builder: RKL Controls, Inc.

Contractor: RKL Controls, Inc.

Operational Date: June 1978

Total Estimated DOE Funds: \$541,605

Building

Type: Manufacturing

Area: 40,000 sq. ft.

Location: Lumberton, New Jersey

Latitude: 40.0° N

Climatic Data

Degree Days	Heating	4865	Cooling	1104
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Avg. Temp. (°F)	Winter	45.4	Summer	73.0
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Avg. Insol. (Ly/d)	Winter	290	Summer	486
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SOLAR ENERGY SYSTEM

Application	Heating 90%	Cooling 80%	Hot Water 0%
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Collector

Type: Liquid flat-plate

Area (sq. ft.): 6,000

Manufacturer: Sunworks, Inc.

Storage

Type: Stainless steel water tank (above ground)

Capacity: 50,000 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

The building is a conventional one-story, cinderblock, steel post, bar joist, metal deck construction to be used for light industrial manufacturing. Heat loss is reduced by external insulation, the use of air locks on all entrances, and the use of energy recovery systems. The flat-plate, double glazed, liquid collectors are arranged between earthen berms on three separate seasonably trackable arrays adjacent to the manufacturing building. A nearby man-made pond serves as a catch basin for rain runoff and as a cooling facility to supply the basin chiller with low temperature condensing water.

PROJECT INFORMATION

Owner/Builder: Joseph Broda

Contractor: Solar Engineering Group

Operational Date: June 1978

Total Estimated DOE Funds: \$44,750

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Neptune, New Jersey

Latitude: 40° N

Climatic Data

Degree Days	Heating	4418	Cooling	1053
Avg. Temp. (°F)	Winter	40.8	Summer	67.2
Avg. Insol. (Ly/d)	Winter	295	Summer	404

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 46.4%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,205

Manufacturer: Sunworks, Inc.

Storage

Type: Insulated steel water tank

Capacity: 4,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

The proposed system consists of 105 Sunworks flat-plate collectors mounted on the roof. Hot water is stored in a 4000-gallon tank surrounded by crushed rock in an insulated container above ground in order to provide thermal mass. The system is designed to provide 46% of the annual Btu requirements of this 78-unit motel.

PROJECT INFORMATION

Owner/Builder: City of Albuquerque (Animal Control Center)

Contractor: Burns/Peters, Architects

Operational Date: March 1978

Total Estimated DOE Funds: \$39,250

Building

Type: Office/kennel

Area: 6,520 sq. ft.

Location: Albuquerque, New Mexico

Latitude: 35.05° N

Climatic Data

Degree Days	Heating 4350	Cooling 1300
Avg. Temp. (°F)	Winter 47.5	Summer 89.5
Avg. Insol. (Ly/d)	Winter 275	Summer 700

SOLAR ENERGY SYSTEM

Application Heating 64% Cooling 0% Hot Water 95%

Collector

Type: Tracking, concentrating, parabolic (active/passive)

Area (sq. ft.): 1,469 (active)/1,500 (passive)

Manufacturer: Albuquerque Western Solar Industries, Inc.

Storage

Type: Insulated steel water tank (underground)

Capacity: 2,000 gallons

Auxiliary System Type: Natural gas fired boiler

PROJECT DESCRIPTION

This is a new building to be located on the grounds of the City of Albuquerque Animal Control Center. The building will provide office space and additional kennels for the Center. There are approximately 4980 sq. ft. of office and nonkennel area and 1540 sq. ft. of new kennel area. A passive heating system for the kennels and an active system (5:1 concentrating collectors with azimuth tracking and hydronic distribution system) for the nonkennel area are proposed. The selected construction site allows the building to take maximum advantage of a southern exposure, which is necessary for "sun-tempering" the kennels and correct orientation for the active solar collector banks.

PROJECT INFORMATION

Owner/Builder: Coachlight Inn, Las Cruces, Ltd.

Contractor: Terry's Interstate, Inc.

Operational Date: April 1978

Total Estimated DOE Funds: \$23,204

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Las Cruces, New Mexico

Latitude: 32° N

Climatic Data

Degree Days	Heating	2952	Cooling	1965
Avg. Temp. (°F)	Winter	51.6	Summer	77.1
Avg. Insol. (Ly/d)	Winter	438	Summer	663

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 75%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,054

Manufacturer: Solar Systems, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 1,050 gallons

Auxiliary System Type: Gas fired hot water heater

PROJECT DESCRIPTION

This system is a single domestic hot water system. Three systems are used on each of the three units composing the 108 unit motel. A drain back system is used for freeze protection. Solenoid valves isolate the city water from the collectors. The system is designed to produce 3000 gallons per day at the peak on an average solar day. The collectors are supported on treated wood frames.

PROJECT INFORMATION

Owner/Builder: New Mexico State University

Contractor: Wooten Construction Company

Operational Date: September 1975

Total Estimated DOE Funds: \$155,000

Building

Type: Office

Area: 25,535 sq. ft.

Location: Las Cruces, New Mexico

Latitude: 32.3° N

Climatic Data

Degree Days	Heating	2952	Cooling	1965
Avg. Temp. (°F)	Winter	51.6	Summer	77.1
Avg. Insol. (Ly/d)	Winter	438	Summer	663

SOLAR ENERGY SYSTEM

Application Heating 100% Cooling 50% Hot Water 100%

Collector

Type: Flat-plate/concentrating

Area (sq. ft.): 6,190/540

Manufacturer: American Heating & Thermal/Northrup, Inc.

Storage

Type: Insulated steel water tank (underground)

Capacity: 28,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

The performance of an existing building's solar heating and cooling system is being evaluated. An automated data acquisition system has been designed and installed, and is collecting historical performance data on the facility. Analysis includes evaluation of flow sensors installed in the system, performance testing of the prototype multiplexer/analog to digital conversion equipment and pyranometer comparison testing. The building project and its solar system design were funded by the legislature of the State of New Mexico. The building was occupied on October 15, 1975. The solar system utilizes a large York absorption chiller which is derated to provide the required 55-ton building load. It also uses a portion of the roof collectors which are 10:1 concentrators with Fresnel lens covers and selective absorber surfaces.

PROJECT INFORMATION

Owner/Builder: Nambe Indian Pueblo

Contractor: Los Alamos Scientific Laboratory

Operational Date: November 1977

Total Estimated DOE Funds: \$113,000

Building

Type: Community center

Area: 3,000 sq. ft.

Location: Nambe, New Mexico

Latitude: 35.9° N

Climatic Data

Degree Days	Heating	5760	Cooling	1098
Avg. Temp. (°F)	Winter	43.7	Summer	70.3
Avg. Insol. (Ly/d)	Winter	394	Summer	645

SOLAR ENERGY SYSTEM

Application Heating 55% Cooling 0% Hot Water 0%

Collector

Type: Air cooled flat-plate

Area (sq. ft.): 440

Manufacturer: Los Alamos Scientific Laboratory

Storage

Type: Rock bed

Capacity: Unknown

Auxiliary System Type: Gas furnace

PROJECT DESCRIPTION

The community center building accommodates two meeting rooms and tribal offices. The architecture is in the Southwest Pueblo style and the construction is of traditional adobe. As adobe is characteristically a high mass material, the structure per se will provide considerable thermal storage. The design incorporates appropriate passive elements and a solar-assisted hot water heater. The collectors are of LASL design combining collector, insulation, and a water-tight roof into one structure. The building and solar systems are sufficiently instrumented to observe the hourly thermal response. The design analysis, building performance, and modeling results will be published in the technical press and presented at appropriate seminars and workshops.

PROJECT INFORMATION

Owner/Builder: State of New Mexico Property Control Division

Contractor: Architects Taos, Architect

Operational Date: March 1978

Total Estimated DOE Funds: \$45,000

Building

Type: Office

Area: 12,500 sq. ft. (total); 12,000 sq. ft. (cond.)

Location: Taos, New Mexico

Latitude: 36.5° N

Climatic Data

Degree Days	Heating	7000	Cooling	300
Avg. Temp. (°F)	Winter	31	Summer	60
Avg. Insol. (Ly/d)	Winter	284	Summer	491

SOLAR ENERGY SYSTEM

Application Heating 50% Cooling 0% Hot Water 0%

Collector

Type: Direct gain to storage (passive)

Area (sq. ft.): 2,450

Manufacturer: Architects Taos

Storage

Type: Steel water drums (on overhead racks)

Capacity: 14,500 gallons

Auxiliary System Type: Electric resistance forced air furnace

PROJECT DESCRIPTION

This nearly square, one-story structure will be used to house employees of the New Mexico Department of Health and Social Services. The solar system is passive, utilizing roof collectors which input energy and light to the office spaces and to water-filled thermal storage tanks suspended at ceiling level. System gain is increased by approximately 20% by the use of reflective surfaces on the roofing between collector apertures. Collection rates and night heat losses are controlled by servo-operated shutters which are located immediately inside of the collection windows. It is estimated that the solar system will contribute 50% of the annual heating required. Energy conserving design has reduced the heating energy requirements to less than 35000 Btu per sq. ft. per year, with solar gain supplying approximately one-half of this amount.

PROJECT INFORMATION

Owner/Builder: Ballston Spa Central School District

Contractor: Ballston Spa Central School District

Operational Date: September 1979

Total Estimated DOE Funds: \$470,000

Building

Type: Middle and elementary school

Area: 144,000 sq. ft.

Location: Ballston Spa, New York

Latitude: 42.4°N

Climatic Data

Degree Days	Heating	6875	Cooling	574
Avg. Temp. (°F)	Winter	37.5	Summer	67.8
Avg. Insol. (Ly/d)	Winter	388	Summer	385

SOLAR ENERGY SYSTEM

Application Heating 63.9% Cooling 0% Hot Water 87.8%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 18,000

Manufacturer: To be determined

Storage

Type: Insulated steel water tank (above ground)

Capacity: 30,000 gallons

Auxiliary System Type: Resistance heaters in the storage tank

PROJECT DESCRIPTION

The collectors are ground-mounted in this retrofit application. The building has a slab floor and concrete block walls with a brick veneer. Urethane insulating board under a metal panel is included on the interior walls. Energy conservation measures such as window reglazing and construction of vestibules are planned. The solar system will provide space heating from storage utilizing existing fan coil units. The control system is simplified by installing the auxiliary heater in the storage tank of this all-electric school.

PROJECT INFORMATION

Owner/Builder: Dayton T. Brown, Inc.

Contractor: Dayton T. Brown, Inc.

Operational Date: April 1978

Total Estimated DOE Funds: \$129,725

Building

Type: Office

Area: 6,600 sq. ft.

Location: Bohemia, New York

Latitude: 40° N

Climatic Data

Degree Days	Heating	5000	Cooling	N/A
Avg. Temp. (°F)	Winter	48	Summer	N/A
Avg. Insol. (Ly/d)	Winter	250	Summer	N/A

SOLAR ENERGY SYSTEM

Application Heating 70% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,700 sq. ft.

Manufacturer: Sunworks, Inc.

Storage

Type: Glass lined steel water tank (underground)

Capacity: 5,000 gallons

Auxiliary System Type: Oil fired hot water boiler

PROJECT DESCRIPTION

The existing engineering offices are presently heated by hot water coils located in the air distribution system. The system will be converted to a primary source of solar energy by the installation of coils in the air distribution system which uses solar heated water. The solar design was done by Dayton T. Brown, Inc., and consists of three piping loops. A heat exchanger transfers the collected solar energy from a glycol working fluid to water, which is then stored. The stored energy is transferred to the space upon demand. A differential thermostat controls the operation of the collection/transfer loop. Proportional thermostats control the amount used from the primary and auxiliary energy sources.

PROJECT INFORMATION

Owner/Builder: New York Botanical Garden

Contractor: John Lowry, Inc.

Operational Date: February 1978

Total Estimated DOE Funds: \$122,229

Building

Type: Office/laboratory

Area: 27,400 sq. ft.

Location: Millbrook, New York

Latitude: 41°N

Climatic Data

Degree Days	Heating	5800	Cooling	2800
Avg. Temp. (°F)	Winter	32	Summer	68
Avg. Insol. (Ly/d)	Winter	254	Summer	530

SOLAR ENERGY SYSTEM

Application Heating 85% Cooling 0% Hot Water 60%

Collector

Type: Liquid flat-plate/concentrating glass tubular

Area (sq. ft.): 3,050/2,595

Manufacturer: Chamberlain Manufacturing Corporation/
KTA Corporation

Storage

Type: Insulated concrete water tanks (partially buried)

Capacity: 15,000 gallons

Auxiliary System Type: Heat pump/well water/electric generator/
waste heat

PROJECT DESCRIPTION

This two-story structure is of massive construction to provide thermal inertia. It is partly buried underground to minimize exposed surfaces. Daylight enters the building through windows facing a covered courtyard and through "light tubes" through the sawtooth roof. The solar collector system consists of 3050 sq. ft. of collectors supplied by Chamberlain and 2595 sq. ft. of collectors provided by KTA. The seven 110' long rows of collectors are mounted on the roof of the building. Approximately 126 sq. ft. of collector area is dedicated to the domestic hot water system with the remainder for space heating. For frost protection of the collectors, a heat exchanger is installed between the collector and the storage tanks. The primary (collector) side contains an antifreeze solution of propylene glycol and water and the secondary (storage) side contains water. To use available solar energy most effectively, hot water coils in the heating units operate with a supply temperature of 100°F and the chiller has been designed to operate as both a heat pump and a chiller.

PROJECT INFORMATION

Owner/Builder: The City of New Rochelle

Contractor: InterTechnology Corporation

Operational Date: December 1978

Total Estimated DOE Funds: \$274,855

Building

Type: Library

Area: 64,020 sq. ft.

Location: New Rochelle, New York

Latitude: 40°46' N

Climatic Data

Degree Days	Heating	4909	Cooling	1048
Avg. Temp. (°F)	Winter	40.5	Summer	69
Avg. Insol. (Ly/d)	Winter	248	Summer	456

SOLAR ENERGY SYSTEM

Application Heating 42.26% Cooling 0% Hot Water 83.9%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 6,500

Manufacturer: Solar Corporation of America

Storage

Type: Steel water tanks (underground)

Capacity: 15,000 gallons

Auxiliary System Type: Oil fired boiler/electric back-up domestic water heater

PROJECT DESCRIPTION

This public library is located in a downtown area of the City of New Rochelle called Lawton Square which is planned to be an urban activity center. The library will include art, music, and book collections. Heating and air conditioning are provided by a conventional system which includes boilers located in the basement of the building. The solar system is a pressurized drain-down water system which interfaces with the conventional system to provide primarily preheating for domestic water and hot water for space heating. Solar water storage is provided by two pressurized tanks located underground adjacent to the mechanical room. Roof-mounted collectors face 30° east of south at a tilt angle of 55° to maximize for collection of heat during the winter months.

PROJECT INFORMATION

Owner/Builder: Carl Grimm

Contractor: Carl Grimm

Operational Date: October 1978

Total Estimated DOE Funds: \$141,632

Building

Type: Retail

Area: 140,000 sq. ft.

Location: Troy, New York

Latitude: 45° N

Climatic Data

Degree Days	Heating	6875	Cooling	N/A
Avg. Temp. (°F)	Winter	34.6	Summer	69
Avg. Insol. (Ly/d)	Winter	167	Summer	428

SOLAR ENERGY SYSTEM

Application Heating 52.3% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 10,050

Manufacturer: Lennox Industries, Inc.

Storage

Type: Glass lined water tank (above ground)

Capacity: 20,000 gallons

Auxiliary System Type: Hot water boiler

PROJECT DESCRIPTION

The solar collectors will be mounted on the roof of this two-story shopping mall located in downtown Troy. The proposed solar installation provides space heating through a solar assisted heat pump system. Potable water load will be determined when the mall is occupied and provisions have been made to couple this loop to the storage tank. If a restaurant occupies space in the mall, a full collector array can be used to meet its requirements. Covers for the collectors will be employed during warm months to avoid excessive temperatures in the array.

PROJECT INFORMATION

Owner/Builder: Charlotte Memorial Hospital and Medical Center

Contractor: FWA Engineers, Inc.

Operational Date: July 1977

Total Estimated DOE Funds: \$204,515

Building

Type: Health center/office/classroom

Area: 65,000 sq. ft.

Location: Charlotte, North Carolina

Latitude: 35.2° N

Climatic Data

Degree Days	Heating	3218	Cooling	1596
Avg. Temp. (°F)	Winter	50.4	Summer	74.6
Avg. Insol. (Ly/d)	Winter	318	Summer	444

SOLAR ENERGY SYSTEM

Application Heating 40% Cooling 0% Hot Water 79%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 3,950

Manufacturer: General Electric Company

Storage

Type: Steel water tank (underground)

Capacity: 6,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

Solar collectors are mounted on the roof of the Area Health and Education Facility constructed on the grounds of Charlotte Memorial Hospital. The building is a compact, six-story high-rise structure with external shading on limited glass areas designed to reduce the heat loss and gain. The mechanical system is designed to make maximum use of the heat generated by the lights and people within the structure. The use of solar energy was not included in the original building concept. Site orientation was dictated by topography and surrounding structures. The orientation is not the best possible for the installation of a solar energy system. However, excellent insulation offered by the structure, the selection of superior solar components, and the judicious placement of solar collectors have together nullified the apparent reduction in overall solar efficiency caused by the building's orientation.

PROJECT INFORMATION

Owner/Builder: Office Parks of Charlotte, Inc.

Contractor: Solar Engineering and Equipment Company

Operational Date: March 1978

Total Estimated DOE Funds: \$120,929

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Charlotte, North Carolina

Latitude: 35°N

Climatic Data

Degree Days	Heating	3345	Cooling	1486
Avg. Temp. (°F)	Winter	45	Summer	76
Avg. Insol. (Ly/d)	Winter	245	Summer	531

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 95%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 6,318

Manufacturer: Energy Systems, Inc.

Storage

Type: Glass lined steel water tank (underground)

Capacity: 8,000 gallons

Auxiliary System Type: To be determined

PROJECT DESCRIPTION

The system consists of a series of flat-plate collectors designed for total hot water energy supply. An antifreeze solution will transfer heat, through a closed loop, to an insulated storage tank having a one day hot water requirement capacity. A differential thermostat activates the system. Cold city water is introduced into a storage tank where it will be heated via a heat exchanger. Thermo-mainwater siphon circulation pressure forces the solar-heated water into the building system.

PROJECT INFORMATION

Owner/Builder: Basin Electric Power Cooperative

Contractor: Cofells Plumbing & Heating

Operational Date: February 1978

Total Estimated DOE Funds: \$380,000

Building

Type: Office

Area: 75,000 sq. ft.

Location: Bismarck, North Dakota

Latitude: 46° 5' N

Climatic Data

Degree Days	Heating	8851	Cooling	500
Avg. Temp. (° F)	Winter	26.6	Summer	65
Avg. Insol. (Ly/d)	Winter	252	Summer	550

SOLAR ENERGY SYSTEM

Application Heating 34% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 5,000

Manufacturer: Sunworks, Inc.

Storage

Type: Insulated steel water tank (underground)

Capacity: 20,000 gallons

Auxiliary System Type: Electric heat pump

PROJECT DESCRIPTION

This is a four story building which was built in a hillside allowing all four stories to have a southerly exposure and causing only the top story to be exposed to prevailing northwesterly winter wind. This facility will be retrofitted with solar collectors designed to operate in conjunction with an electric centrifugal, water-to-water heat pump. The solar energy collected and stored will supplement existing heat storage to provide a heat sink for the heat pumps. The stored solar energy can be used either directly by the heating system or can be introduced into the low temperature side of the heat pumps. Ethylene glycol/water solution is used as the heat transfer medium. Operating and cost data from this project will be helpful in demonstrating the practicability of solar use in severe northern climates.

PROJECT INFORMATION

Owner/Builder: Mid-State Investment Corporation

Contractor: Mid-State Investment Corporation

Operational Date: June 1978

Total Estimated DOE Funds: \$40,000

Building

Type: High rise hotel

Area: Not applicable to hot water systems

Location: Bismarck, North Dakota

Latitude: 46° N

Climatic Data

Degree Days	Heating	8851	Cooling	491
Avg. Temp. (°F)	Winter	10	Summer	85
Avg. Insol. (Ly/d)	Winter	147	Summer	574

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 80%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 3,300

Manufacturer: Lennox Industries, Inc.

Storage

Type: Glass lined steel water tank (underground)

Capacity: 2,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

Patterson Hotel was built in 1910 as an European Plan Railroad hotel. The ten-story concrete structure, the first of its kind in the upper midwest, encompasses an entire quarter city block. In June 1977 it was purchased by Mid-State Investment Corp., of Bismarck, with plans for 100% rehabilitation. It has been renamed "Patterson Place" related to a new concept; "a place to stay, eat, drink, visit, and shop." Architecturally, the concept is to demonstrate the cost advantages of rehabilitating older buildings verses new construction. With a new solar domestic hot water heating system, two new 400-ft/min exterior glass elevators, a system-efficient monitored mechanical system, energy efficient designed kitchen and banquet areas, the complex is bringing much interest in the local community. Since the unveiling of the Patterson Project, it has been a catalyst for the rehabilitation of downtown Bismarck to "old town Bismarck."

PROJECT INFORMATION

Owner/Builder: Columbus Technical Institute

Contractor: Columbus Technical Institute

Operational Date: December 1978

Total Estimated DOE Funds: \$334,985

Building

Type: Offices

Area: 47,900 sq. ft. (total); 33,830 sq. ft. (cond.)

Location: Columbus, Ohio

Latitude: 40.0°N

Climatic Data

Degree Days	Heating	5660	Cooling	800
Avg. Temp. (°F)	Winter	45	Summer	73
Avg. Insol. (Ly/d)	Winter	278	Summer	525

SOLAR ENERGY SYSTEM

Application Heating 77% Cooling 38% Hot Water 0%

Collector

Type: Evacuated glass tube

Area (sq. ft.): 4,096 sq. ft.

Manufacturer: Owens-Illinois, Inc.

Storage

Type: Insulated steel water tank (underground)

Capacity: 5,000 gallons

Auxiliary System Type: Natural gas/fuel oil boiler and mechanical chiller

PROJECT DESCRIPTION

A solar energy heating and cooling system is being installed as a part of new construction of a college building. The building will house classrooms and laboratories (photography, fire science, and criminalistics), education facilities, resource centers for the hearing and visually impaired programs, administrative offices, and three lecture halls. The building was designed to be extremely energy efficient. The HVAC system consists of a four-pipe fan coil and unit ventilator system. The unit ventilators are equipped with an economizer cycle. The 5000-gallon storage tank will be constructed of steel and be buried outside the building.

PROJECT INFORMATION

Owner/Builder: Highlights for Children, Inc.

Contractor: Columbia Gas System Service Corporation

Operational Date: July 1977

Total Estimated DOE Funds: \$265,508

Building

Type: Office

Area: 25,000 sq. ft.

Location: Columbus, Ohio

Latitude: 40° N

Climatic Data

Degree Days	Heating	5700	Cooling	893
Avg. Temp. (°F)	Winter	43	Summer	67
Avg. Insol. (Ly/d)	Winter	220	Summer	460

SOLAR ENERGY SYSTEM

Application Heating 35% Cooling 26% Hot Water 78%

Collector

Type: Parabolic concentrator

Area (sq. ft.): 3,000

Manufacturer: Honeywell, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 5,000 gallons

Auxiliary System Type: Natural gas boiler/natural gas hot water heater

PROJECT DESCRIPTION

This building is a research project for the Columbia Gas System Service Corporation to design, install, operate, and evaluate a solar energy system for a typical three-story office building. The solar energy system being installed in the Highlights Building is designed to provide solar energy for space heating, space cooling, and domestic hot water applications. The collector array is the first installation of the Honeywell single-axis tracking concentrating collector which tracks north to south. The Honeywell collector is a north/south tracking collector with a 40:1 concentration ratio. The system in the Highlights Building includes 44 collector panels arranged in 11 rows with a total field area of approximately 3000 sq. ft. The primary loop heat transfer fluid is a Dowtherm SR1/Water Solution. The storage system consists of a 5000-gallon ASME pressure vessel located in an addition to the existing building. The fluid in the secondary loop and storage system is a Mogul 0-301/Water Solution, and the maximum temperature of the heated storage water is 220°F.

PROJECT INFORMATION

Owner/Builder: Rodeway Inns of America &
R. V. Development Company

Contractor: Charter Builders, Inc.

Operational Date: July, 1978

Total Estimated DOE Funds: \$79,253

Building

Type: High rise motel

Area: Not applicable to hot water systems

Location: Columbus, Ohio

Latitude: 40°N

Climatic Data

Degree Days	Heating 5427	Cooling 1147
Avg. Temp. (°F)	Winter 33	Summer 76
Avg. Insol. (Ly/d)	Winter 225	Summer 429

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 52%

Collector

Type: Evacuated tubes

Area (sq. ft.): 3,000

Manufacturer: General Electric Company

Storage

Type: Steel water tank (above ground)

Capacity: 2,700 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

The collectors for this system will be located on the roof of the motel. The energy collected by the collectors will be transferred to a double bundle heat exchanger via a collector loop circulating pump. Through the heat exchanger, the absorbed energy will be transferred to the storage tank via the storage loop circulating pump. Utilization of the double bundle heat exchanger eliminates the danger of ethylene glycol leakage from the solar loop to the storage tank. Energy from the storage tank is utilized for the motel potable water and laundry.

PROJECT INFORMATION

Owner/Builder: Ohio Department of Natural Resources

Contractor: PDT, Inc.

Operational Date: December 1979

Total Estimated DOE Funds: \$180,000

Building

Type: Low rise lodge

Area: 135,000 sq. ft.

Location: Deer Creek Park, Ohio

Latitude: 40°N

Climatic Data

Degree Days	Heating	5221	Cooling	852
Avg. Temp. (°F)	Winter	36	Summer	67.7
Avg. Insol. (Ly/d)	Winter	264	Summer	392

SOLAR ENERGY SYSTEM

Application Heating 20.8% Cooling 0% Hot Water 58.8%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 10,000

Manufacturer: Revere Copper & Brass, Inc.

Storage

Type: Insulated steel water tanks (underground)

Capacity: 20,000 gallons

Auxiliary System Type: Electric fired boiler

PROJECT DESCRIPTION

A 10000 sq. ft. collector system shall be integrated into the south-facing roof. The system shall be drain-down type, requiring no antifreeze. Water for the swimming pool and domestic hot water shall be preheated via heat exchangers located in the storage tank. When excess heat is available from the solar system, it will be utilized by the water source heat pumps for space heating. Existing electric boilers shall provide the auxiliary energy.

PROJECT INFORMATION

Owner/Builder: Troy-Miami County Public Library

Contractor: Richard Levin Associates, Inc.

Operational Date: October 1977

Total Estimated DOE Funds: \$272,896

Building

Type: Library

Area: 23,000 sq. ft.

Location: Troy, Ohio

Latitude: 40.0° N

Climatic Data

Degree Days	Heating 5641	Cooling 936
Avg. Temp. (° F)	Winter 42.3	Summer 71.3
Avg. Insol. (Ly/d)	Winter 287	Summer 519

SOLAR ENERGY SYSTEM

Application Heating 67% Cooling 0% Hot Water 0%

Collector

Type: Evacuated glass tubular

Area (sq. ft.): 3,264

Manufacturer: Owens-Illinois, Inc.

Storage

Type: Insulated fiberglass water tank (underground)

Capacity: 5,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

This public library is located in the downtown area of the city. An array of advanced, evacuated, tubular collectors on the roof supply sufficient energy to heat the building. The buried insulated storage tank is fabricated from fiberglass to insure long-term corrosion-resistant operation. Windows have been installed in deep recesses to reduce direct heat build-up during summer months. Existing trees were trimmed to give maximum sun exposure to the collectors during the various seasons. The ratio of glass to masonry walls is less than 20%. The City of Troy, Ohio has expressed serious interest in becoming a model solar city. Plans are being developed to establish a program to provide financial support to design solar energy systems for every new building constructed in the city.

PROJECT INFORMATION

Owner/Builder: Oklahoma Department of Tourism and Recreation

Contractor: John Buckley

Operational Date: October 1978

Total Estimated DOE Funds: \$47,400

Building

Type: Low rise hotel

Area: Not applicable to hot water systems

Location: Kingston, Oklahoma

Latitude: 35° N

Climatic Data

Degree Days	Heating 3800	Cooling 1800
Avg. Temp. (°F)	Winter 45	Summer 73
Avg. Insol. (Ly/d)	Winter 415	Summer 488

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 86%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,248

Manufacturer: Daystar Corporation

Storage

Type: Steel water tank (above ground)

Capacity: 4,160 gallons

Auxiliary System Type: Fuel oil

PROJECT DESCRIPTION

This system is intended to replace the existing hot water heating system. The present oil fired boilers are not very energy efficient, as they must be fired all year long. Excess solar heat will be used for space heating. Supply water will be preheated by a liquid-to-liquid heat exchanger during the summer and by an air-to-water heat exchanger in the boiler exhaust flue in the winter. A recirculation loop improves system efficiency.

PROJECT INFORMATION

Owner/Builder: American Motor Inns, Inc.

Contractor: To be determined

Operational Date: October 1978

Total Estimated DOE Funds: \$38,039

Building

Type: Low rise motor inn

Area: Not applicable to hot water systems

Location: Lancaster, Pennsylvania

Latitude: 40° N

Climatic Data

Degree Days	Heating	5347	Cooling	1026
Avg. Temp. (° F)	Winter	32	Summer	73
Avg. Insol. (Ly/d)	Winter	495	Summer	610

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 58%

Collector

Type: Liquid flat-plate

Area (sq. ft.); 1,995

Manufacturer: Sunworks, Inc.

Storage

Type: Insulated steel water tanks (in mechanical room)

Capacity: 3,000 gallons

Auxiliary System Type: Natural gas fired boiler

PROJECT DESCRIPTION

This project consists of three distinct systems. One system, consisting of 24 collectors and a 500-gallon storage tank, will provide hot water to the kitchen, dining area and managerial offices located in the commercial building. The second system, consisting of 55 collectors, a new 1000-gallon tank and an existing 1000-gallon tank, will provide hot water to the 126 guest units and laundry. The third system, consisting of 16 collectors and a 500-gallon storage tank, will provide domestic hot water to the 64 guest unit annex building. All three systems will be backed up by the existing hot water heaters in each building.

* NOTE: DHW system schematic for guest rooms in annex building is similar to commercial building HW system schematic shown.

PROJECT INFORMATION

Owner/Builder: Bell Telephone Company of Pennsylvania

Contractor: Hummel Engineering Corporation

Operational Date: October 1977

Total Estimated DOE Funds: \$201,429

Building

Type: Office/storage

Area: 9,800 sq. ft.

Location: West Goshen, Pennsylvania

Latitude: 40.0° N

Climatic Data

Degree Days	Heating	5144	Cooling	1050
Avg. Temp. (°F)	Winter	41.8	Summer	73.0
Avg. Insol. (Ly/d)	Winter	290	Summer	486

SOLAR ENERGY SYSTEM

Application Heating 62% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,900

Manufacturer: Heliotherm, Inc.

Storage

Type: Insulated steel water tank

Capacity: 6,000 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

This is a T-shaped, one-story building, consisting of an office section and a large open storeroom section. The office section contains 20 separate enclosures, heated and cooled by 20 unitary heat pumps. The storeroom section is heated by a fan-coil unit connected to air ducts and diffusers. The heat source for both the heat pumps and the fan-coil unit is solar energy, backed up by an electric boiler. Solar energy is stored in a 6000-gallon, above-ground, insulated steel tank. The solar array consists of two rows of flat-plate solar collectors, 44 panels each. Provisions have been made for draining the water from the collectors into a 300-gallon holding tank and replacing it with nitrogen, to avoid freezing. The solar panels are mounted above the roof, facing south, at 55° from the horizontal.

PROJECT INFORMATION

Owner/Builder: Commonwealth of Puerto Rico

Contractor: Department of Natural Resources

Operational Date: September 1978

Total Estimated DOE Funds: \$587,000

Building

Type: Industrial factory

Area: 10,800 sq. ft.

Location: Canovanas, Puerto Rico

Latitude: 18.5° N

Climatic Data

Degree Days	Heating	N/A	Cooling	4982
Avg. Temp. (°F)	Winter	76.7	Summer	80.6
Avg. Insol. (Ly/d)	Winter	494	Summer	570

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 95% Hot Water 45%

Collector

Type: Evacuated tube

Area (sq. ft.): 7,600

Manufacturer: Owens-Illinois, Inc.

Storage

Type: Steel water tank (above ground)

Capacity: 20,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

The Puerto Rico Industrial Development Company (FOMENTO), which provides standard factories and leases them at low rates to industry, has contributed this factory and its site, in Guaynabo, about six miles south of San Juan. Puerto Rico has one of the highest year-round insulations in the world. Air conditioning will be needed every day, and data collection will be done throughout the year. Hot water is secured from the roof-top solar collectors and run through an absorption refrigerating machine which generates chilled water necessary for cooling. A 30-ton electric drive reciprocating water chiller provides for auxiliary cooling. If the operation of this solar-equipped building proves commercially practical and energy conservative, it would be used as a prototype for a number of buildings constructed by FOMENTO. It would also create the opportunity for a new solar industry to be started in Puerto Rico.

PROJECT INFORMATION

Owner/Builder: Days Inn of America, Inc.

Contractor: Georgia-Carolina Heating & Air-Conditioning, Inc.

Operational Date: November 1977

Total Estimated DOE Funds: \$10,162

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Anderson, South Carolina

Latitude: 32° N

Climatic Data

Degree Days	Heating	3163	Cooling	1573
Avg. Temp. (° F)	Winter	45	Summer	77
Avg. Insol. (Ly/d)	Winter	295	Summer	528

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 45%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 750

Manufacturer: Gulf Thermal

Storage

Type: Fiberglass water tank (above ground, in mechanical room)

Capacity: 1,000 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

The solar system designed for this building will have 25 flat-plate collectors with single-glazing and flat black absorbers facing due south, mounted on the roof of the building at a tilt angle of 35°. The solar array will consist of five rows of collectors, with each row containing five collectors in parallel flow. This system operates at atmospheric pressure. Water is used as the heat transfer fluid. There are no heat exchangers between the storage tank and collector loop. The collectors are protected from freezing by a simple drain-down technique. The drain system operates as follows: when plate temperature reaches 35°F the controller activates a N.O. valve, this allows air to enter the system and the water drains back through the supply and return lines. The system is fail-safe, since the valve opens if power is lost. Usable heat is transferred to the existing electric hot water boilers via a 200-foot copper coil immersed in the storage tank

Photograph not available

PROJECT INFORMATION

Owner/Builder: Blakedale Professional Center, Inc.

Contractor: W.E. Gilbert and Associates

Operational Date: August 1977

Total Estimated DOE Funds: \$52,616

Building

Type: Office

Area: 4,400 sq. ft.

Location: Greenwood, South Carolina

Latitude: 34.4° N

Climatic Data

Degree Days	Heating	2926	Cooling	1789
Avg. Temp. (°F)	Winter	51.9	Summer	75.7
Avg. Insol. (Ly/d)	Winter	320	Summer	521

SOLAR ENERGY SYSTEM

Application Heating 85% Cooling 0% Hot Water 100%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 954

Manufacturer: PPG Industries, Inc.

Storage

Type: Steel water tank (underground)

Capacity: 5,000 gallons

Auxiliary System Type: Electrical heat pump

PROJECT DESCRIPTION

This project involves the use of solar energy for space and hot water heating in an office building located in Greenwood, S.C. The solar energy system uses roof-mounted solar collectors and an underground storage tank. A conventional electric system for space and water heating supplements the solar energy system. Heat loss in the building is minimized through the use of thermopane glass. The storage tank holds water which is circulated through the collectors whenever the water temperature is lower than the temperature of the collectors. The heated water in the storage tank is then used to preheat the city water that will be consumed in the building. Space heating is accomplished by a pump that circulates hot water from the storage tank through a coil in the air duct system. The air heated by the water in the coil is then circulated through the building.

PROJECT INFORMATION

Owner/Builder: First Baptist Church

Contractor: Michaud, Cooley, Halberg, Erickson and Associates

Operational Date: April 1978

Total Estimated DOE Funds: \$69,942

Building

Type: Church

Area: 12,486 sq. ft. (total); 7,050 sq. ft. (cond.)

Location: Aberdeen, South Dakota

Latitude: 44° 3'N

Climatic Data

Degree Days	Heating 8223	Cooling 800
Avg. Temp. (°F)	Winter 28.8	Summer 72.1
Avg. Insol. (Ly/d)	Winter 264	Summer 351

SOLAR ENERGY SYSTEM

Application Heating 21% Cooling 0% Hot Water 80%

Collector

Type: Air flat-plate

Area (sq. ft.): 1,253

Manufacturer: Solaron Corporation

Storage

Type: Pebble bed (below mechanical room floor)

Capacity: 700 cu. ft.

Auxiliary System Type: Forced air with electric boiler

PROJECT DESCRIPTION

The site for this church is absolutely flat. To diminish the wind effect, a 70' wide shelter-belt will be planted around the perimeter of the site. To further blunt the wind effect, the building design is much like an arrowhead pointed north. The main sanctuary is nearly circular to produce the maximum floor area with the least wall perimeter and minimum wind resistance by the roof form. The solar air collectors, mounted on the roof at a 50° tilt, will provide space heating and domestic water preheating. Space heat can be provided either directly from the solar air collectors or from the storage bed. Supplementary heat is provided with an auxiliary electric boiler.

PROJECT INFORMATION

Owner/Builder: National Park Service, Dept. of Interior

Contractor: The Spitznagel Partners

Operational Date: November 1977

Total Estimated DOE Funds: \$228,280

Building

Type: Visitors center

Area: 7,250 sq. ft.

Location: Keystone, South Dakota (Mt. Rushmore National Memorial)

Latitude: 43.9° N

Climatic Data

Degree Days	Heating 7292	Cooling 1488
Avg. Temp. (° F)	Winter 27.8	Summer 69.5
Avg. Insol. (Ly/d)	Winter 332	Summer 577

SOLAR ENERGY SYSTEM

Application Heating 45% Cooling 45% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,000

Manufacturer: Lennox Industries, Inc.

Storage

Type: Steel water tank

Capacity: 3,000 gallons

Auxiliary System Type: Oil furnace

PROJECT DESCRIPTION

The solar energy system will be integrated with the existing heating and cooling system of the Mount Rushmore National Visitor Center to provide approximately 45% of the total heating and approximately 45% of the cooling of the observation room. Solar collectors will be mounted on the roof facing southwest. To conserve energy, the control system will be upgraded and the make up air will be preheated. The existing refrigeration compressor is a standard, reciprocating, Freon-22 condensing unit.

PROJECT INFORMATION

Owner/Builder: Spearfish School District No. 40-2

Contractor: Hengle, Berg and Associates, Architects-Engineers

Operational Date: September 1979

Total Estimated DOE Funds: \$199,502

Building

Type: High school

Area: 85,000 sq. ft. (total); 43,200 sq. ft. (cond.)

Location: Spearfish, South Dakota

Latitude: 49° 48'N

Climatic Data

Degree Days	Heating	7345	Cooling	N/A
Avg. Temp. (°F)	Winter	26	Summer	68.6
Avg. Insol. (Ly/d)	Winter	208.7	Summer	582.6

SOLAR ENERGY SYSTEM

Application Heating 55% Cooling 0% Hot Water 90%

Collector

Type: Air flat-plate

Area (sq. ft.): 7,308

Manufacturer: Solaron Corporation

Storage

Type: Rock bed (underground)/steel water tanks
(in mechanical room)

Capacity: 4,620 cu. ft./1,000 gallons

Auxiliary System Type: Natural gas boiler

PROJECT DESCRIPTION

This is an air system using flat-plate collectors. The system will provide space heating and domestic hot water to the arts and drama wing and to classroom areas. Collectors are mounted on the roof and heat is stored in a rock storage compartment under the ground floor of the building. Heat is supplied to the building by roof-mounted heat pumps, or from the solar heating system. Domestic hot water is heated to 120°F by an air-to-water heat exchanger located upstream from the storage compartment, and is stored in two 500-gallon, insulated tanks located in front of the storage compartment.

PROJECT INFORMATION

Owner/Builder: Coca-Cola Bottling Works of Jackson, Inc.

Contractor: Coca-Cola Bottling Works of Jackson, Inc.

Operational Date: January 1979

Total Estimated DOE Funds: \$487,107

Building

Type: Soft drink bottling plant

Area: 70,000 sq. ft.

Location: Jackson, Tennessee

Latitude: 35° N

Climatic Data

Degree Days	Heating	3327	Cooling	2029
Avg. Temp. (°F)	Winter	44.1	Summer	76.1
Avg. Insol. (Ly/d)	Winter	212	Summer	510

SOLAR ENERGY SYSTEM

Application Heating 53% Cooling 0% Hot Water 54%

Collector

Type: Water cooled evacuated glass tubular

Area: 10,000

Manufacturer: Owens-Illinois, Inc.

Storage

Type: Steel water tanks (above ground, outside)

Capacity: 42,000 gallons

Auxiliary System Type: Gas heaters

PROJECT DESCRIPTION

The solar energy system will provide space heating for the bottling works in the winter and water heating for bottle-washing in the summer. The system consists of 10000 sq. ft. of evacuated glass tubular collectors. Energy is stored in three 14000-gallon tanks and dispersed via air-handling units. Large storage capacity is needed due to the four-day work week so that energy collected on long weekends can be utilized. Back-up space heating is 20 gas fired unit heaters suspended from the ceiling. The solar system will reduce natural gas consumption by over 50%. During warm months, the system will provide nearly 100% of the hot water heating needs.

PROJECT INFORMATION

Owner/Builder: La Quinta Motor Inns, Inc.

Contractor: Travis-Braun & Associates, Inc.

Operational Date: October 1978

Total Estimated DOE Funds: \$38,767

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Nashville, Tennessee

Latitude: 36° 1'N

Climatic Data

Degree Days	Heating	3573	Cooling	1600
Avg. Temp. (°F)	Winter	48.9	Summer	75
Avg. Insol. (Ly/d)	Winter	175	Summer	400

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 57.6%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,500

Manufacturer: Lennox Industries, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 1,600 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

A freeze protected system is proposed under this grant. The collector circulating fluid is a water buffered ethylene glycol solution. This mixture prevents the occurrence of freezing in the collector. Even though many codes do not require a double separation insulating the potable water system, provisions for such a separation are included. The mixture of antifreeze and water can be further buffered to include corrosion inhibitors, thus prolonging the collector life. The antifreeze solution protects a collector from damage which could occur from low temperatures. Mineral buildup problems are eliminated by the contained, relatively nonchanging solution.

PROJECT INFORMATION

Owner/Builder: Tennessee Building Material Association

Contractor: I. C. Thomasson Engineers

Operational Date: June 1978

Total Estimated DOE Funds: \$68,193

Building

Type: Office

Area: 12,036 sq. ft.

Location: Nashville, Tennessee

Latitude: 36° 7' N

Climatic Data

Degree Days	Heating	3508	Cooling	2100
Avg. Temp. (°F)	Winter	48.3	Summer	80
Avg. Insol. (Ly/d)	Winter	244	Summer	475

SOLAR ENERGY SYSTEM

Application Heating 19.4% Cooling 0% Hot Water 90%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 576

Manufacturer: Solar Unlimited Corporation

Storage

Type: Steel water tank (underground)

Capacity: 1,500 gallons

Auxiliary System Type: Electric boiler/hydronic heat pump

PROJECT DESCRIPTION

This three-story office building will house the Tennessee Building Material Association, a statewide trade association which represents all segments of the building material industry. Wall construction is block and brick with 2" of urethane insulation; roof construction is masonry with 2" urethane insulation. The environment control system is a solar-assisted, water-to-air heat pump system. This is a system of self-contained, reverse-cycle refrigeration machines, all interconnected via a piping loop, which have the capability to provide heating or cooling to rooms within the building. The heat pump units are supplied with water to either remove heat of rejection when the units are in the cooling mode, or provide the heat of absorption when the units are in the heating mode.

PROJECT INFORMATION

Owner/Builder: Lloyd A. Bell/American Ornamental Metal Company

Contractor: American Ornamental Metal Company

Operational Date: September 1977

Total Estimated DOE Funds: \$70,329

Building

Type: Factory/office

Area: 11,500 sq. ft.

Location: Austin, Texas

Latitude: 30.5° N

Climatic Data

Degree Days	Heating 1737	Cooling 1706
Avg. Temp. (°F)	Winter 54	Summer 80
Avg. Insol. (Ly/d)	Winter 660	Summer 783

SOLAR ENERGY SYSTEM

Application Heating 100% Cooling 90% Hot Water 0%

Collector

Type: Thermoponds

Area (sq. ft.): 8,800

Manufacturer: To be determined

Storage

Type: Plastic thermoponds on a metal deck

Capacity: 70,000 gallons

Auxiliary System Type: Heat pump

PROJECT DESCRIPTION

This building will have tilt-up, load-bearing concrete walls with stuccoed polystyrene exterior insulation. The capacitance of the concrete will be varied to obtain different thermal time lags for unlike exposure to transient thermal flow. Sun screens on south-facing windows will decrease summer heat gain while allowing winter insolation. In this installation, 12"-deep thermoponds will provide 70000 gallons of water storage over the roof deck supported by bar joists spaced approximately 4' on centers. Inexpensive plastic films are used as a black liner over the roofdeck for the transparent thermopond covers. During summer months, moveable insulation panels are closed during the day with comfort resulting from radiation of body heat to the 75° ceiling. At night, the panels are opened and the interior heat is re-radiated to the night sky. During the summer humid period, indirect evaporative cooling will be obtained by flooding the thermoponds. Convection losses will contribute as well. An air cell is used over the bags to maximize heat collection in cooler months.

PROJECT INFORMATION

Owner/Builder: Radian Corporation

Contractor: Radian Corporation

Operational Date: August 1977

Total Estimated DOE Funds: \$32,205

Building

Type: Office/laboratory

Area: 850 sq. ft. (cond.)

Location: Austin, Texas

Latitude: 30.3° N

Climatic Data

Degree Days	Heating	1737	Cooling	2908
Avg. Temp. (°F)	Winter	54.8	Summer	77.7
Avg. Insol. (Ly/d)	Winter	286	Summer	501

SOLAR ENERGY SYSTEM

Application Heating 85% Cooling 75% Hot Water 0%

Collector

Type: Linear Fresnel Lens, concentrating & tracking

Area (sq. ft.): 350

Manufacturer: Northrup, Inc.

Storage

Type: Fiberglass water tank (above ground)

Capacity: 1,500 gallons

Auxiliary System Type: Gas fired, electric

PROJECT DESCRIPTION

This solar heating and cooling demonstration consists of heating or cooling 3 offices in a new office building. The 3-ton solar system is set up in parallel with a 3-ton conventional gas unit. The air ducts service only the 3 demonstration offices. This unique situation allows closely controlled performance comparisons to be made between the solar and conventional systems. Major components (an ARKLA 3-ton absorptive heating and cooling unit, the sun tracking solar collectors, and the thermal storage tank) may be easily replaced with other units for future performance evaluation purposes. In monitoring and analyzing system performance, Radian proposes to identify those areas of the system most in need of improvement. The company will then complete whatever research and development work is necessary.

PROJECT INFORMATION

Owner/Builder: La Quinta Motor Inns, Inc.

Contractor: Travis-Braun & Associates, Inc.

Operational Date: To be determined

Total Estimated DOE Funds: \$53,415

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Beaumont, Texas

Latitude: 30°0'N

Climatic Data

Degree Days	Heating	1274	Cooling	N/A
Avg. Temp. (°F)	Winter	62.2	Summer	N/A
Avg. Insol. (Ly/d)	Winter	270	Summer	520

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 59%

Collector

Type: Evacuated tube

Area (sq. ft.): 2,000

Manufacturer: General Electric Company

Storage

Type: Steel water tank (above ground)

Capacity: 1,600 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

A freeze protected system is proposed under this grant. The collector circulating fluid is a water buffered ethylene glycol solution. This mixture prevents the occurrence of freezing in the collector. Even though many codes do not require a double separation insulating the potable water system, provisions for such a separation are included. The mixture of antifreeze and water can be further buffered to include corrosion inhibitors, thus prolonging the collector life. The antifreeze solution protects a collector from damage which could occur from low temperatures. Mineral buildup problems are eliminated by the contained, relatively nonchanging solution.

PROJECT INFORMATION

Owner/Builder: City of Dallas

Contractor: Travis-Braun & Associates, Inc.

Operational Date: May 1978

Total Estimated DOE Funds: \$430,430

Building

Type: Recreation/health care

Area: 16,000 sq. ft. (total); 8,000 sq. ft. (cond.)

Location: Dallas, Texas

Latitude: 32.5° N

Climatic Data

Degree Days	Heating	2382	Cooling	2587
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Avg. Temp. (°F)	Winter	50	Summer	80
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Avg. Temp. (°F)	Winter	55	Summer	85
Avg. Insol. (Ly/d)	Winter	674	Summer	836

SOLAR ENERGY SYSTEM

Application	Heating 80%	Cooling 48%	Hot Water 54%
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Collector

Type: Liquid flat-plate

Area (sq. ft.): 3,650

Manufacturer: Honeywell, Inc.

Storage

Type: Steel water tank (above ground)

Capacity: 6,000 gallons (hot), 2,000 gallons (chilled)

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

The North Hampton Park Recreation and Health Center is an existing building located in West Dallas. The one-story structure (two levels) consists of a gymnasium, locker area, and health care clinic. The building is surrounded by a recreational area and athletic field. The exterior of the building is brick veneer over masonry block. The solar system has been designed to provide 54% of the combined annual energy requirements for heating and cooling.

PROJECT INFORMATION

Owner/Builder: Lon W. Travis/Earl E. Braun, Jr. Partnership

Contractor: Travis-Braun and Associates, Inc.

Operational Date: July 1978

Total Estimated DOE Funds: \$65,107

Building

Type: Office

Area: 10,000 sq. ft.

Location: Dallas, Texas

Latitude: 32°N

Climatic Data

Degree Days	Heating	2382	Cooling	2587
Avg. Temp. (°F)	Winter	47	Summer	83.4
Avg. Insol. (Ly/d)	Winter	250	Summer	600

SOLAR ENERGY SYSTEM

Application Heating 85% Cooling 0% Hot Water 100%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,596

Manufacturer: Solargenics, Inc.

Storage

Type: Concrete water tank (above ground)

Capacity: 3,500 gallons

Auxiliary System Type: Electric heaters/electric resistance space heating

PROJECT DESCRIPTION

The collector system serves as a roof above the lobby with brightly painted storage tanks below, making the solar system an important architectural element. The system is designed for a future addition of solar absorption or Rankine cycle cooling because this is a large part of the yearly energy load and the modification could be accomplished with a minimal amount of revision to the solar space heating system. The system is part of a 6238 sq. ft. addition to the existing 3100 sq. ft. one-story building. The collectors are mounted in a metal frame 40' square on the south side at a 42° tilt.

PROJECT INFORMATION

Owner/Builder: Rodeway Inns of America & R. V. Development Company

Contractor: Charter Builders, Inc.

Operational Date: December 1978

Total Estimated DOE Funds: \$69,967

Building

Type: High rise hotel

Area: Not applicable to hot water systems

Location: Farmers Branch, Texas

Latitude: 32° N

Climatic Data

Degree Days	Heating	2342	Cooling	2609
Avg. Temp. (°F)	Winter	50	Summer	86
Avg. Insol. (Ly/d)	Winter	406	Summer	512

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 52%

Collector

Type: Evacuated tubular

Area (sq. ft.): 3,000

Manufacturer: General Electric Company

Storage

Type: Steel water tank (above ground)

Capacity: 3,800 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

The collectors for this system will be located on the roof of the motel. The energy collected by the collectors will be transferred to a double bundle heat exchanger via a collector loop circulating pump. Through the heat exchanger, the absorbed energy will be transferred to the storage tank via the storage loop circulating pump. Utilization of the double bundle heat exchanger eliminates the danger of ethylene glycol leakage from the solar loop to the storage tank. Energy from the storage tank is utilized for the motel potable water and laundry.

PROJECT INFORMATION

Owner/Builder: La Quinta Motor Inns, Inc.

Contractor: Travis-Braun & Associates, Inc.

Operational Date: To be determined

Total Estimated DOE Funds: \$38,039

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: San Antonio, Texas

Latitude: 29° 3' N

Climatic Data

Degree Days	Heating	1715	Cooling	2846
Avg. Temp. (° F)	Winter	53	Summer	78
Avg. Insol. (Ly/d)	Winter	260	Summer	520

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 70%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,800

Manufacturer: Revere Copper & Brass, Inc.

Storage

Type: Steel water tank (above ground)

Capacity: 1,600 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

A drain-down system is proposed under this grant. This system is one in which, each time the water circulation pump stops, the collector fluid water drains out of and down into the protection of an enclosed space. In this proposal, this enclosed space is the mechanical room of the motel. This system is a hybrid version of a drain-down system employing a heat exchanger. By using this heat exchanger, the buildup of minerals in the solar collector is eliminated. On the solar loop of the system, a contained amount of water is employed. Even as this water level drops and makeup water is introduced into the system, new minerals, acids, etc., are also introduced; however, this introduction is extremely minor in comparison to the minerals which would be constantly introduced by a direct link between the storage vessel and the solar collectors.

PROJECT INFORMATION

Owner/Builder: Trinity University

Contractor: Bridgers and Paxton

Operational Date: September 1977

Total Estimated DOE Funds: \$1,100,000

Building

Type: Power plant

Area: 284,928 sq. ft.

Location: San Antonio, Texas

Latitude: 29.5° N

Climatic Data

Degree Days	Heating	1570	Cooling	2994
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Avg. Temp. (°F)	Winter	55.8	Summer	78.1
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Avg. Insol. (Ly/d)	Winter	299	Summer	515
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SOLAR ENERGY SYSTEM

Application Heating 100% Cooling 5% Hot Water 100%

Collector

Type: Fresnel Lens, concentrating and tracking

Area (sq. ft.): 16,080

Manufacturer: Northrup, Inc.

Storage

Type: Steel water tank (underground)

Capacity: 40,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

Rooftop collectors provide energy for the University's Energy Plant No. 2. The plant serves an athletic complex known as Sams Memorial Center and 6 dormitories located on the west side of the campus. A new electric centrifugal chiller, cooling-tower, and associated auxiliary equipment have been added. No modifications to the existing HVAC system were required within the buildings served. Approximately 3% of the collector area was used as part of an experimental program to optimize efficiency and compare cost benefits for alternative types of solar energy collectors. An instrumentation and data acquisition system are used to monitor system performance. The project provides facilities for collector performance testing in accordance with the NBS Manual NBS IR74-635, "Method of Testing for Rating Solar Collectors Based on Thermal Performance."

PROJECT INFORMATION

Owner/Builder: John W. Thompson
 Contractor: Thompson Construction Company
 Operational Date: To be determined
 Total Estimated DOE Funds: \$21,670

Building

Type: Low rise motel
 Area: Not applicable to hot water systems

Location: Taylor, Texas

Latitude: 30° N

Climatic Data

Degree Days	Heating	2833	Cooling	2039
Avg. Temp. (°F)	Winter	53	Summer	84
Avg. Insol. (Ly/d)	Winter	283	Summer	353

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 73%

Collector

Type: Liquid flat-plate
 Area (sq. ft.): 1,232
 Manufacturer: Lennox Industries, Inc.

Storage

Type: Steel water tank (above ground)
 Capacity: 2,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

A central solar facility, on ground level for public accessibility, will assist the hot water systems of three surrounding buildings: a two-story building with 30 conventional rental units, a one-story building with 32 rental units for railroad employees, and a one-story commercial building with a restaurant and offices. Each building will have a separate circulating hot water system which will be tied to a central solar storage tank. When the tank can contribute heat to a loop, the tank is included in that loop; otherwise it is bypassed by a three-way valve. The solar collectors, mechanical shed, and tall storage tank will be constructed in the center of the motel complex and will be open for walking tours by the public. The mechanical shed will include an active system display for the education of motel guests and restaurant customers.

PROJECT INFORMATION

Owner/Builder: La Quinta Motor Inns, Inc.

Contractor: Travis-Braun & Associates, Inc.

Operational Date: To be determined

Total Estimated DOE Funds: \$40,441

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Texas City, Texas

Latitude: 30° 1'N

Climatic Data

Degree Days	Heating	1274	Cooling	N/A
Avg. Temp. (°F)	Winter	62.4	Summer	N/A
Avg. Insol. (Ly/d)	Winter	270	Summer	520

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 63%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,0000

Manufacturer: Raypak, Inc.

Storage

Type: Steel water tank (above ground)

Capacity: 1,600 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

A drain-down system is proposed under this grant. This system is one in which, each time the water circulation pump stops, the collector fluid water drains out of and down into the protection of an enclosed space. In this proposal, this enclosed space is the mechanical room of the motel. This system is a hybrid version of a drain-down system employing a heat exchanger. By using this heat exchanger, the buildup of minerals in the solar collector is eliminated. On the solar loop of the system, a contained amount of water is employed. Even as this water level drops and makeup water is introduced into the system, new minerals, acids, etc., are also introduced; however, this introduction is extremely minor in comparison to the minerals which would be constantly introduced by a direct link between the storage vessel and the solar collectors.

PROJECT INFORMATION

Owner/Builder: The Woodlands Commercial Development Company

Contractor: Interactive Resources, Inc.

Operational Date: August 1978

Total Estimated DOE Funds: \$46,719

Building

Type: Low rise hotel

Area: Not applicable to hot water systems

Location: The Woodlands, Texas

Latitude: 29° N

Climatic Data

Degree Days	Heating 1334	Cooling 2656
Avg. Temp. (° F)	Winter 54	Summer 82
Avg. Insol. (Ly/d)	Winter 370	Summer 607

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 56.3%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 4,080

Manufacturer: Solar Energy Products, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 1,520 gallons

Auxiliary System Type: Electricity/natural gas

PROJECT DESCRIPTION

This project consists of two distinct systems. One system consists of 1200 sq. ft. of collectors on the roof and a 1520-gallon solar water storage tank. This system will operate in pre-heat mode, supplying 57% of the yearly load. An electric water heater will serve as a back-up. The other system, consisting of 2880 sq. ft. of collectors will supply 56% of the indoor swimming pool's year-round heating load. The existing gas fired heater will serve as the back-up.

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PROJECT INFORMATION

Owner/Builder: The Woodlands Commercial Development Company

Contractor: Interactive Resources, Inc.

Operational Date: August 1978

Total Estimated DOE Funds: \$130,301

Building

Type: Low rise hotel

Area: Not applicable to hot water systems

Location: The Woodlands, Texas

Latitude: 29° N

Climatic Data

Degree Days	Heating	1334	Cooling	2656
Avg. Temp. (°F)	Winter	54	Summer	82
Avg. Insol. (Ly/d)	Winter	370	Summer	607

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 58%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 7,140

Manufacturer: Solar Energy Products, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 7,450 gallons

Auxiliary System Type: Electric/natural gas

PROJECT DESCRIPTION

A differential thermostat activates the system both to collect solar energy and also to circulate water through to prevent freezing. Energy is stored in a pressurized steel tank. Circulation loops assure hot water delivery to each fixture. The back-up heat is in series with the solar system and supplements the energy needed during periods of low insolation.

PROJECT INFORMATION

Owner/Builder: Young Ideas Consultants

Contractor: To be determined

Operational Date: March 1978

Total Estimated DOE Funds: \$101,943

Building

Type: Light manufacturing

Area: 17,000 sq. ft. (total); 9,751 sq. ft. (cond.)

Location: Ogden, Utah

Latitude: 40° N

Climatic Data

Degree Days	Heating	6052	Cooling	N/A
Avg. Temp. (°F)	Winter	41	Summer	71
Avg. Insol. (Ly/d)	Winter	183	Summer	643

SOLAR ENERGY SYSTEM

Application Heating 62% Cooling 0% Hot Water 0%

Collector

Type: Air flat-plate

Area (sq. ft.): 3,800

Manufacturer: Permaloy Corporation/Young Ideas Consultants

Storage

Type: Rock bed (underground)

Capacity: 1,360 cu. ft.

Auxiliary System Type: Natural gas heaters

PROJECT DESCRIPTION

The solar system will be retrofitted to the existing Permaloy building. Solar heated air can be used to directly heat the building or it can be blown through a rock storage bin. The storage bin is utilized to store solar heat for later use or it can be vented to outside air, releasing its heat. Cool night air can then be blown through the rock storage bin to provide daytime cooling. An automatic control system with associated sensors is utilized to select the proper damper positions for the various operating modes.

Photograph not available

PROJECT INFORMATION

Owner/Builder: La Quinta Motor Inns, Inc.

Contractor: William Francis Construction

Operational Date: July 1978

Total Estimated DOE Funds: \$133,050

Building

Type: Low rise motel

Area: 41,400 sq. ft.

Location: Salt Lake City, Utah

Latitude: 40° 50'

Climatic Data

Degree Days Heating 6052 Cooling 927

Avg. Temp. (°F)	Winter	38.4	Summer	73
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Avg. Insol. (Ly/d)	Winter	258	Summer	597
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SOLAR ENERGY SYSTEM

Application	Heating 25%	Cooling 0%	Hot Water 61%
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Collector

Type: Liquid flat-plate

Area (sq. ft.): 3,000

Manufacturer: Chamberlain Manufacturing Corporation

Storage

Type: Insulated steel water tanks (above ground)

Capacity: 10,000 gallons

Auxiliary System Type: Water-to-air heat pumps with electric boiler

PROJECT DESCRIPTION

A solar-assisted water source heat pump system is utilized. The low temperature thermal requirement of the water source heat pump allows use of low temperature solar energy. At lower temperatures, the collectors operate at a higher efficiency, which allows fewer collectors and lower associated cost. The collectors are at a 55° tilt angle for maximum winter performance. Collector working fluid is a 50/50 ethylene glycol/water solution with corrosion inhibitors. A heat exchanger is installed inside of the storage tank. Domestic hot water will be preheated by energy in the heat pump water loop and/or energy in the thermal storage tank.

PROJECT INFORMATION

Owner/Builder: The Rutland Group, Inc.

Contractor: The Rutland House Construction Corporation

Operational Date: September 1978

Total Estimated DOE Funds: \$22,287

Building

Type: Office/warehouse

Area: 5,020 sq. ft. (total); 1,900 sq. ft. (cond.)

Location: Rutland, Vermont

Latitude: 43.6° N

Climatic Data

Degree Days	Heating 8972	Cooling 496
Avg. Temp. (° F)	Winter 25.3	Summer 65.4
Avg. Insol. (Ly/d)	Winter 85	Summer 188

SOLAR ENERGY SYSTEM

Application Heating 75% Cooling 0% Hot Water 0%

Collector

Type: Air flat-plate

Area (sq. ft.): 2,000

Manufacturer: The Rutland Group, Inc.

Storage

Type: Rock bed

Capacity: 1,000 cu. ft.

Auxiliary System Type: Fuel oil furnace

PROJECT DESCRIPTION

The Rutland Group, Inc. is a small, privately-owned real estate and development firm. They are planning to construct a pre-engineered Armco Steel Building for their new offices and warehouse. The solar energy system will utilize air-cooled vertical south wall and roof collectors with the Armco "steelox" sheathing as the absorber plate. Heated air from the roof is passed through a concrete masonry cavity wall on the interior then to an underslab perimeter distribution "moat" which is a concrete plenum supplying the rock bed through perforated tubes. The masonry wall and washed rock is thermal storage. The collectors are thoroughly integrated with the building forming a vital element for the facade.

PROJECT INFORMATION

Owner/Builder: Woodstock Resort Corporation

Contractor: Wormser Scientific Corporation

Operational Date: Fall 1978

Total Estimated DOE Funds: \$138,194

Building

Type: Low rise hotel

Area: Not applicable to hot water systems

Location: Woodstock, Vermont

Latitude: 43° N

Climatic Data

Degree Days	Heating	7601	Cooling	699
Avg. Temp. (°F)	Winter	23	Summer	75
Avg. Insol. (Ly/d)	Winter	265	Summer	462

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 84%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 5,292

Manufacturer: Revere Copper & Brass, Inc.

Storage

Type: Insulated steel water tank (underground)

Capacity: 10,000 gallons

Auxiliary System Type: Oil fired hot water heater

PROJECT DESCRIPTION

The collector mounting structure forms two units of parking shelters. The collectors are piped in a series parallel arrangement. With the internal manifolding available with this collector, external piping is greatly reduced. Fluid flow in the collectors will be contained in a closed loop with the exchange of heat taking place in a shell and tube heat exchanger adjacent to the storage tank. A multiplicity of heat exchangers provides dual separation between the antifreeze solution in the collector loop and the potable domestic water.

PROJECT INFORMATION

Owner/Builder: Rockresorts, Inc.

Contractor: Owen & Mayes

Operational Date: August 1978

Total Estimated DOE Funds: \$72,996

Building

Type: Duplex cottages/low rise hotel

Area: Not applicable to hot water systems

Location: St. John, Virgin Islands

Latitude: 18°N

Climatic Data

Degree Days	Heating	N/A	Cooling	4982
Avg. Temp. (°F)	Winter	77	Summer	81
Avg. Insol. (Ly/d)	Winter	494	Summer	570

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 67%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 4,365

Manufacturer: Revere Copper & Brass, Inc.

Storage

Type: Glass lined steel water tanks (above ground)

Capacity: 6,220 gallons

Auxiliary System Type: Electric immersion heater

PROJECT DESCRIPTION

The domestic hot water solar energy system proposed for Caneel Bay Plantation is a series of individual domestic hot water systems for 104 of the guest rooms in addition to the two kitchens and laundry facilities. The 104 guest rooms are located in 25 separate buildings. The kitchens and the laundry are located in separate buildings with each building having an individual solar hot water system. Since the temperature in the Virgin Islands rarely drops below 70°F and the all time low is 63°F, there is no need for freeze protection on the solar system. This considerably simplifies the design of the domestic hot water system and improves the overall system efficiency since the potable water can be pumped through the copper tubed collector. The collectors will be mounted on the roof of each flat-roofed cottage; they will face south with a 28° tilt angle.

Guest unit hot water schematic – typical

Kitchen and laundry schematic

PROJECT INFORMATION

Owner/Builder: American Motor Inns, Inc.

Contractor: Oversea's Mechanical, Inc.

Operational Date: September 1977

Total Estimated DOE Funds: \$411,447

Building

Type: Hotel

Area: 250,000 sq. ft.

Location: St. Thomas, Virgin Islands

Latitude: 18.4° N

Climatic Data

Degree Days	Heating	N/A	Cooling	4982
Avg. Temp. (°F)	Winter	76.7	Summer	80.6
Avg. Insol. (Ly/d)	Winter	494	Summer	570

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 25% Hot Water 0%

Collector

Type: Concentrating tracking

Area (sq. ft.): 13,000

Manufacturer: Northrup, Inc.

Storage

Type: None

Capacity: Not applicable

Auxiliary System Type: Oil fired steam boiler

PROJECT DESCRIPTION

The Frenchman's Reef is a new multistory resort hotel and convention center with 300 guest rooms and an electrical and mechanical support system. The energy plant currently consumes approximately 1.2 million gallons of oil per year. The solar collector is to be arrayed on three roof surfaces facing south and tilted at a 15° angle. The solar system will provide approximately 54% of the energy requirements for an average of 12 hours per day for one of the two 200-ton absorption chillers. There will be no need for a storage system; the solar contribution will always be less than the minimum air conditioning load. Some of the conservation improvements underway and under consideration involve the capturing and recycling of rainwater to reduce desalination plant load, modification of guest room air conditioning units to operate on low and medium speeds only and recycling the condensate from desalination air ejectors.

PROJECT INFORMATION

Owner/Builder: American Motor Inns, Inc.

Contractor: To be determined

Operational Date: October 1978

Total Estimated DOE Funds: \$32,800

Building

Type: High rise motor inn

Area: Not applicable to hot water systems

Location: Alexandria, Virginia

Latitude: 38° N

Climatic Data

Degree Days	Heating	3413	Cooling	1554
Avg. Temp. (°F)	Winter	44	Summer	70
Avg. Insol. (Ly/d)	Winter	550	Summer	614

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 62%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,533

Manufacturer: Sunworks, Inc.

Storage

Type: Insulated steel water tanks (underground)

Capacity: 2,000 gallons

Auxiliary System Type: Natural gas fired boiler

PROJECT DESCRIPTION

This proposed system consists of two distinct systems. One system, consisting of 22 collectors and a 500-gallon storage tank, provides hot water to the kitchen and dining area located in the commercial building. A new 70-gallon hot water heater will be installed as a back-up for this system. The other system, consisting of 51 collectors and two 750-gallon storage tanks, connected in series, will provide hot water to the ten-story, 204 guest unit building. The existing boiler will provide any necessary auxiliary energy.

PROJECT INFORMATION

Owner/Builder: Arlington Associates, Inc.

Contractor: Owen and Mayes Consulting Engineers

Operational Date: October 1978

Total Estimated DOE Funds: \$64,637

Building

Type: Psychiatric hospital

Area: 32,000 sq. ft. (total); 7,200 sq. ft. (cond.)

Location: Charlottesville, Virginia

Latitude: 37.5° N

Climatic Data

Degree Days	Heating 4166	Cooling 1000
Avg. Temp. (°F)	Winter 40	Summer 68
Avg. Insol. (Ly/d)	Winter 200	Summer 450

SOLAR ENERGY SYSTEM

Application Heating 66% Cooling 0% Hot Water 87%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,000

Manufacturer: Sunworks, Inc.

Storage

Type: Concrete water tank (above ground)

Capacity: 5,000 gallons

Auxiliary System Type: Electric resistance heaters/gas fired boiler/
gas fired hot water heater

PROJECT DESCRIPTION

The Arlington House Hospital has 50 beds and provides patient care 24 hours a day. The solar system consists of single glazed, selectively coated, copper base plate collector modules; hot water circulating coils on the air intakes of each heat pump; a hot water coil on the hot air supply of each heat pump; a 5000 gallon concrete, urethane-insulated storage tank and other miscellaneous components. The collector will be mounted on the roof in a sawtooth arrangement facing due south, inclined at an angle of 53° from the horizontal. The collector is elevated above the storage tank so that any time the collector pump cuts off, a vacuum relief valve opens at the top of the collector allowing air to enter and the water in the collector piping automatically flows back into the storage tank, eliminating any need for freeze protection. Flow control valves will be used in lieu of reverse return piping to balance the flow of the collector arrays.

Photograph not available

PROJECT INFORMATION

Owner/Builder: Allen Management, Inc.

Contractor: Solar Systems of Virginia, Inc.

Operational Date: March 1978

Total Estimated DOE Funds: \$11,928

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Hampton, Virginia

Latitude: 37.5° N

Climatic Data

Degree Days	Heating 3865	Cooling 1353
Avg. Temp. (°F)	Winter 43	Summer 73
Avg. Insol. (Ly/d)	Winter 260	Summer 550

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 68%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,024

Manufacturer: Solar Systems of Virginia, Inc.

Storage

Type: Insulated steel water tanks (above ground)

Capacity: 1,500 gallons

Auxiliary System Type: Electric hot water heater

PROJECT DESCRIPTION

The solar collectors for this system are flat-plate, double glazed, with black painted absorbers. The outer glazing is premium grade .040" Sunlite, the inner glazing is four-mils thick Tedlar, and the collectors incorporate a tube-fin design. Sunlite was chosen over glass because of the light weight and ease and safety of assembly. The collectors are tilted at 30° to obtain maximum insolation during summer months when the motels are running at peak occupancy. The collectors face due south. A solution of 40% propylene glycol/60% water is pumped through the collectors. This working fluid is transported to a tube and shell heat exchanger. Water heated in the heat exchanger is stored in vertical storage tank to obtain as much stratification as possible.

⬤ = PUMP

PROJECT INFORMATION

Owner/Builder: Loudoun County School Board

Contractor: Anthony F. Musolino, AIA/John F. Lawrence &
Associates/Solar Energy Scientific and Technical Services

Operational Date: March 1978

Total Estimated DOE Funds: \$56,336

Building

Type: Vocational school

Area: To be determined

Location: Leesburg, Virginia

Latitude: 39.1°N

Climatic Data

Degree Days	Heating	4503	Cooling	1284
Avg. Temp. (°F)	Winter	41.6	Summer	69.4
Avg. Insol. (Ly/d)	Winter	247	Summer	485

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 26%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,225

Manufacturer: Southwest Ener-Tech, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 2,056 gallons

Auxiliary System Type: Electric hot water boiler

PROJECT DESCRIPTION

This project requires the installation of a solar energy water heating system in the Loudoun County Vocational-Technical Education Center. The design for the hot water system is unique in its use of building waste heat to preheat the water. The waste heat used is that generated by the pumps that circulate air in the building. In the past, this excess heat would have been carried by a condenser system to cooling towers and dissipated in the air. The current design calls for the use of a converter to work with the condenser system to preheat the water which would then be raised to its proper temperature by heat gathered in the solar collectors. The solar collectors are located on the ground near the building, rather than on its roof, and are surrounded by stone walls that blend with the building walls. They enclose a courtyard that can be used for classes or meetings, and they also undergo less wind-induced thermal loss than they would if they were located on the building's roof.

PROJECT INFORMATION

Owner/Builder: Terrell E. Moseley, Inc.

Contractor: Terrell E. Moseley, Inc.

Operational Date: November 1976

Total Estimated DOE Funds: \$15,630

Building

Type: Office

Area: 1,780 sq. ft.

Location: Lynchburg, Virginia

Latitude: 37.3°N

Climatic Data

Degree Days	Heating 4200	Cooling 1400
Avg. Temp. (°F)	Winter 44	Summer 71
Avg. Insol. (Ly/d)	Winter 900	Summer 2500

SOLAR ENERGY SYSTEM

Application Heating 70% Cooling 0% Hot Water 50%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 400

Manufacturer: Terrell E. Moseley, Inc.

Storage

Type: Insulated steel water tank (above ground)

Capacity: 2,000 gallons

Auxiliary System Type: Gas fired hot water boiler

PROJECT DESCRIPTION

This project calls for the space and hot water heating for a one-story cement block office building. A packaged water-to-air heat pump forces heat to the offices through a conventional insulated duct system. Heat is supplied to the evaporator of the pump by a south-facing solar collector array on the building's roof. Heat collected by the array is transmitted to a steel storage tank and then relayed to the pump. The storage tank is also used to preheat water needed in the building. The preheated water will be brought to its required temperature by a gas fired hot water heater.

PROJECT INFORMATION

Owner/Builder: Allen Management, Inc.

Contractor: Solar Systems of Virginia, Inc.

Operational Date: March 1978

Total Estimated DOE Funds: \$11,928

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Portsmouth, Virginia

Latitude: 37.5° N

Climatic Data

Degree Days	Heating	3421	Cooling	1441
Avg. Temp. (° F)	Winter	46	Summer	74
Avg. Insol. (Ly/d)	Winter	260	Summer	550

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 68%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,024

Manufacturer: Solar Systems of Virginia, Inc.

Storage

Type: Insulated steel water tanks (above ground)

Capacity: 1,500 gallons

Auxiliary System Type: Electric hot water heater

PROJECT DESCRIPTION

The solar collectors for this system are flat-plate, double glazed, with black painted absorbers. The outer glazing is premium grade .040" Sunlite, the inner glazing is 4-mils thick Tedlar, and the collectors incorporate a tube-fin design. Sunlite was chosen over glass because of the light weight and ease and safety of assembly. The collectors are tilted at 30° to obtain maximum insolation during summer months when the motels are running at peak occupancy. The collectors face due south. A solution of 40% propylene glycol/60% water is pumped through the collectors. This working fluid is transported to a tube and shell heat exchanger. Water heated in the heat exchanger is stored in vertical storage tank to obtain as much stratification as possible.

PROJECT INFORMATION

Owner/Builder: Allen Management, Inc.

Contractor: Solar Systems of Virginia, Inc.

Operational Date: March 1978

Total Estimated DOE Funds: \$11,928

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Sandston, Virginia

Latitude: 37° 51'N

Climatic Data

Degree Days	Heating	3865	Cooling	1353
Avg. Temp. (° F)	Winter	43	Summer	73
Avg. Insol. (Ly/d)	Winter	260	Summer	550

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 68%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,024

Manufacturer: Solar Systems of Virginia, Inc.

Storage

Type: Insulated steel water tanks (above ground)

Capacity: 1,500 gallons

Auxiliary System Type: Electric hot water

PROJECT DESCRIPTION

The solar collectors for this system are flat-plate, double glazed, with black painted absorbers. The outer glazing is premium grade .040" Sunlite, the inner glazing is 4-mils thick Tedlar, and the collectors incorporate a tube-fin design. Sunlite was chosen over glass because of the light weight and ease and safety of assembly. The collectors are tilted at 30° to obtain maximum insolation during summer months when the motels are running at peak occupancy. The collectors face due south. A solution of 40% propylene glycol/60% water is pumped through the collectors. This working fluid is transported to a tube and shell heat exchanger. Water heated in the heat exchanger is stored in vertical storage tank to obtain as much stratification as possible.

PROJECT INFORMATION

Owner/Builder: Fauquier County

Contractor: InterTechnology Solar Corporation (ITSC)

Operational Date: February 1978

Total Estimated DOE Funds: \$560,884

Building

Type: School (five detached temporary buildings)

Area: 4,100 sq. ft.

Location: Warrenton, Virginia

Latitude: 38.9° N

Climatic Data

Degree Days	Heating	4217	Cooling	1330
Avg. Temp. (°F)	Winter	43.1	Summer	70.0
Avg. Insol. (Ly/d)	Winter	269	Summer	489

SOLAR ENERGY SYSTEM

Application Heating 77% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,600

Manufacturer: InterTechnology Solar Corporation

Storage

Type: Insulated fiberglass water tank (underground)

Capacity: 10,000 gallons

Auxiliary System Type: Electric, oil

PROJECT DESCRIPTION

This project aimed at determining whether solar energy could supply a substantial part of the heating requirements of a school, at estimating the cost of installing and maintaining such a system, and at determining the savings in fuel that would be realized from its installation. The system was developed and became operational early in 1974. Since that time it has supplied some (60% current) heating requirements of the five detached classrooms that it was designed to serve. The total thermal storage system can meet all heating requirements for twelve days without sunlight. The original solar collector constructed for this project consisted of 2540 sq. ft. of collector surface, the collector modules being assembled on a support structure measuring 126' x 26'. For the refurbishment, 1600 sq. ft. of ITSC's Solar Mark III collectors with black chrome coating are being used in place of the original collector. This project was partially funded by the National Science Foundation and is one of the early proof-of-concept experiments started in 1974.

PROJECT INFORMATION

Owner/Builder: Allen Management, Inc.

Contractor: Solar Systems of Virginia, Inc.

Operational Date: March 1978

Total Estimated DOE Funds: \$16,150

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Woodbridge, Virginia

Latitude: 39° N

Climatic Data

Degree Days	Heating	4224	Cooling	779
Avg. Temp. (° F)	Winter	41	Summer	73
Avg. Insol. (Ly/d)	Winter	225	Summer	485

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 71%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,536

Manufacturer: Solar Systems of Virginia, Inc.

Storage

Type: Insulated steel water tanks (above ground)

Capacity: 2,500 gallons

Auxiliary System Type: Electric hot water heater

PROJECT DESCRIPTION

The solar collectors for this system are flat-plate, double glazed, with black painted absorbers. The outer glazing is premium grade .040" Sunlite, the inner glazing is 4-mils thick Tedlar, and the collectors incorporate a tube-fin design. Sunlite was chosen over glass because of the light weight and ease and safety of assembly. The collectors are tilted at 30° to obtain maximum insolation during summer months when the motels are running at peak occupancy. The collectors face due south. A solution of 40% propylene glycol/60% water is pumped through the collectors. This working fluid is transported to a tube and shell heat exchanger. Water heated in the heat exchanger is stored in vertical storage tank to obtain as much stratification as possible.

PROJECT INFORMATION

Owner/Builder: Development Dynamics of Richland

Contractor: George Grant Construction

Operational Date: March 1978

Total Estimated DOE Funds: \$710,295

Building

Type: Office

Area: 14,400 sq. ft.

Location: Richland, Washington

Latitude: 46.3° N

Climatic Data

Degree Days	Heating	5267	Cooling	800
Avg. Temp. (° F)	Winter	29	Summer	77
Avg. Insol. (Ly/d)	Winter	125	Summer	675

SOLAR ENERGY SYSTEM

Application Heating 71% Cooling 97% Hot Water 100%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 6,000

Manufacturer: General Electric Company

Storage

Type: Insulated water tanks (above ground)

Capacity: 9,000 gallons (hot); 2,000 gallons (chilled)

Auxiliary System Type: Heat pumps

PROJECT DESCRIPTION

This demonstration site, in the desert of south central Washington State, is adjacent to and readily visible from a principal north-south traffic artery in Richland. The design involves two identical single-story office buildings in a four-building complex known as Hanford Square. The buildings, each with a capacity of about 100 persons, have the same external climatographic exposure and nearly identical internal environmental conditions. One building, heated and cooled solely by electrical systems, acts as a control, furnishing power data needed to compute solar energy input as a percentage of total power consumed. Energy conserving features incorporated into the solar building include solar ponds, dual purpose absorption/reflection venetian blinds, solar panel insulation and double windows. Energy conserving features unrelated to the solar system are duplicated in both buildings.

PROJECT INFORMATION

Owner/Builder: Bethany College
Contractor: InterTechnology Corporation/Solar Corporation of America
Operational Date: September 1978
Total Estimated DOE Funds: \$156,820

Building

Type: Conference center/multipurpose dining facility
Area: 41,200 sq. ft.

Location: Bethany, West Virginia

Latitude: 40.1° N

Climatic Data

Degree Days	Heating 5402	Cooling N/A
Avg. Temp. (°F)	Winter 41.8	Summer 68.0
Avg. Insol. (Ly/d)	Winter 165	Summer 435

SOLAR ENERGY SYSTEM

Application Heating 33% Cooling 0% Hot Water 86%

Collector

Type: Liquid flat-plate
Area (sq. ft.): 4,518
Manufacturer: InterTechnology Corporation/
Solar Corporation of America

Storage

Type: Insulated steel water tank (above ground)
Capacity: 6,500 gallons

Auxiliary System Type: Gas forced air/gas boiler

PROJECT DESCRIPTION

In addition to its regular academic program for residential undergraduates in the liberal arts, Bethany College operates the Leadership Center as a separate, non profit, educational enterprise dedicated to developing and training the adult human resources of the tri-state region and to fostering the economic and community development of the region. The Center is a three-building complex composed of two existing buildings and one planned building scheduled for occupancy the fall of 1978. The proposed solar heating system is to be applied to the three buildings of the Center. As a combination new building/retrofit application, a unique demonstration is provided for the solar heating demonstration program. The collectors will be installed on the roof of the existing motel building. The solar heat will be used for space heating both the motel lobby and the adjacent new dining facility, and for preheating the domestic water and for all three buildings of the Center, thus reducing the consumption of electricity currently used for these purposes.

PROJECT INFORMATION

Owner/Builder: Allen Management, Inc.

Contractor: Solar Systems of Virginia, Inc.

Operational Date: March 1978

Total Estimated DOE Funds: \$16,150

Building

Type: Low rise motel

Area: Not applicable to hot water systems

Location: Bluefield, West Virginia

Latitude: 37° 5'N

Climatic Data

Degree Days	Heating	5675	Cooling	1030
Avg. Temp. (° F)	Winter	41	Summer	73
Avg. Insol. (Ly/d)	Winter	220	Summer	510

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 81%

Collector

Type: Insulated steel water tanks (above ground)

Area (sq. ft.): 1,536

Manufacturer: Solar Systems of Virginia, Inc.

Storage

Type: Insulated steel water tanks (above ground)

Capacity: 2,500 gallons

Auxiliary System Type: Electric hot water heater

PROJECT DESCRIPTION

The solar collectors for this system are flat-plate, double glazed, with black painted absorbers. The outer glazing is premium grade .040" Sunlite, the inner glazing is 4-mils thick Tedlar, and the collectors incorporate a tube-fin design. Sunlite was chosen over glass because of the light weight and ease and safety of assembly. The collectors are tilted at 30° to obtain maximum insolation during summer months when the motels are running at peak occupancy. The collectors face due south. A solution of 40% propylene glycol/60% water is pumped through the collectors. This working fluid is transported to a tube and shell heat exchanger. Water heated in the heat exchanger is stored in vertical storage tank to obtain as much stratification as possible.

PROJECT INFORMATION

Owner/Builder: Jefferson County Board of Education

Contractor: Pickett, Siess, and Hook Associates

Operational Date: August 1978

Total Estimated DOE Funds: \$996,853

Building

Type: School

Area: 50,600 sq. ft.

Location: Charles Town, West Virginia

Latitude: 38.4° N

Climatic Data

Degree Days	Heating	4590	Cooling	1055
Avg. Temp. (° F)	Winter	46.8	Summer	72.0
Avg. Insol. (Ly/d)	Winter	285	Summer	485

SOLAR ENERGY SYSTEM

Application Heating 85% Cooling 51% Hot Water 0%

Collector

Type: Liquid flat-plate/reflector

Area (sq. ft.): 10,943/10,775

Manufacturer: PPG Industries, Inc.

Storage

Type: Steel water tanks (above ground)

Capacity: 17,000 gallons

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

This project is for the use of a solar energy system to provide heating, cooling, and hot water heating for the Page Jackson School, now being constructed in Jefferson County, West Virginia. The system will utilize flat-plate collectors, roof-top reflectors, two water storage tanks, a 100-ton absorption chiller, and a 100-ton conventional backup chiller. The roof will have several skylights which should appreciably reduce the need for electric lighting. The school has been designed for minimal energy utilization for heating and cooling requirements.

PROJECT INFORMATION

Owner/Builder: School District of Howards Grove

Contractor: School District of Howards Grove

Operational Date: March 1978

Total Estimated DOE Funds: \$35,301

Building

Type: Elementary school

Area: 12,330 sq. ft.

Location: Howards Grove, Wisconsin

Latitude: 43.5° N

Climatic Data

Degree Days	Heating 7360	Cooling N/A
Avg. Temp. (°F)	Winter 21	Summer 70
Avg. Insol. (Ly/d)	Winter 114	Summer 534

SOLAR ENERGY SYSTEM

Application Heating 58% Cooling 0% Hot Water 0%

Collector

Type: Air flat-plate

Area (sq. ft.): 2,277

Manufacturer: Sunstone Solar Energy Equipment

Storage

Type: Pebble bed (partially buried)

Capacity: 3,000 cu. ft.

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

The 12330 sq. ft., eight-classroom addition to an existing 30000 sq. ft. school could not be provided with natural gas fuel. The 2277 sq. ft. solar collector consisting of six roof-mounted arrays of 23 panels each will provide about 58% of the total space heating requirement of 650×10^6 Btu per year. The system will be inactive during the summer months. The air system was selected for low initial cost, low maintenance cost, and ease of interfacing with the warm air building heating supply back-up system. The site will be fully instrumented.

PROJECT INFORMATION

Owner/Builder: Dr. Walter A. Handzlik

Contractor: Zien Mechanical Contractor

Operational Date: June 1978

Total Estimated DOE Funds: \$35,026

Building

Type: Dental clinic

Area: 8,000 sq. ft. (total); 7,750 sq. ft. (cond.)

Location: West Bend, Wisconsin

Latitude: 42°N

Climatic Data

Degree Days	Heating 7444	Cooling 450
Avg. Temp. (°F)	Winter 26.8	Summer 66.2
Avg. Insol. (Ly/d)	Winter 258	Summer 390

SOLAR ENERGY SYSTEM

Application Heating 100% Cooling 0% Hot Water 0%

Collector

Type: Evacuated tubular

Area (sq. ft.): 1,000

Manufacturer: Owens-Illinois, Inc.

Storage

Type: Insulated concrete tank (underground)

Capacity: 4,000 gallons

Auxiliary System Type: Electric water

PROJECT DESCRIPTION

This clinic is designed to minimize energy consumption. The north elevation, prone to cold winds and little sunlight, is one-story above grade with few windows. The south, east, and west elevations are two-stories above grade, and have windows to allow daytime solar heating. The collectors are mounted on the roof and are tilted 55° to the horizontal. The storage tank is designed to provide enough heat in conjunction with the heat pumps to satisfy the demand for 24 hours when the outside temperature is -10°F and the building is unoccupied. The auxiliary electric water heaters are sized to raise the tank temperature 100°F during a ten-hour nighttime period, which is enough heat to satisfy design conditions if no solar energy is available. The heat reclaim effected by the system serves two purposes: (1) by piping the heat pumps to a storage tank it is possible to store heat rejected during daytime cooling for use in nighttime heating; and, (2) by piping the heat pumps to a common loop, it is possible to transport energy from one side of the building to the other.

PROJECT INFORMATION

Owner/Builder: Wyoming Rural Electric Association

Contractor: Marker Associates

Operational Date: April 1978

Total Estimated DOE Funds: \$40,283

Building

Type: Office

Area: 9,030 sq. ft.

Location: Casper, Wyoming

Latitude: 43° N

Climatic Data

Degree Days	Heating	6899	Cooling	1013
Avg. Temp. (°F)	Winter	35.8	Summer	83
Avg. Insol. (Ly/d)	Winter	132.8	Summer	581.5

SOLAR ENERGY SYSTEM

Application Heating 51% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 870

Manufacturer: Solargenics, Inc.

Storage

Type: Glass lined steel water tank (above ground)

Capacity: 1,520 gallons

Auxiliary System Type: Electric duct heater

PROJECT DESCRIPTION

This two-story structure is constructed of steel frame with panel curtain wall. Brick veneer is the exterior finish. The nonstructural panel curtain wall is a foam core plywood laminate. Expanded styrene is used as the core. The heating/cooling system is a roof top unit, dual duct, variable air volume system with a hot deck floor and a cold deck floor. The air conditioning cycle is provided with an economizer cycle mixing outside air with recirculated air. Twenty six collectors will be mounted on the south-facing, slanted wall of the structure at 62° from horizontal. Heat will be transferred from the collectors to a heat exchanger by a circulating pump and a hot transfer fluid. Storage tank water is heated by a tank type heat exchanger immersed in the storage tank. Hot water in the storage tank will be pumped through a coil in the hot deck of the central air handling unit.

SECTION II

COMMERCIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS

SECTION I COMMERCIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS (CONTINUED)

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	SOLAR APPLICATION	SOLAR MANUFACTURER	PROGRAM TYPE			
							PON*	PON	HOT WATER INITIATIVE	OTHER**
1	2									
I-154		Farmers Branch	Rodeway Inns of America & R. V. Development Company	High Rise Hotel	HW	General Electric Company			X	
I-155		San Antonio	La Quinta Motor Inns, Inc.	Low Rise Motel	HW	Revere Copper & Brass, Inc.			X	
I-156		San Antonio	Trinity University	Power Plant	H C HW	Northrup, Inc.		X		
I-157		Taylor	John W. Thompson	Low Rise Motel	HW	Lennox Industries, Inc.			X	
I-158		Texas City	La Quinta Motor Inns, Inc.	Low Rise Motel	HW	Raypak, Inc.			X	
I-159		The Woodlands	The Woodlands Commercial Development Company	Low Rise Hotel	HW	Solar Energy Products, Inc.			X	
I-160		The Woodlands	The Woodlands Commercial Development Company	Low Rise Hotel	HW	Solar Energy Products, Inc.			X	
I-161	UTAH	Ogden	Young Ideas Consultants	Light Manufacturing	H	Permaloy Corporation/Young Ideas Consultants		X		
I-162		Salt Lake City	LaQuinta Motor Inns, Inc.	Low Rise Motel	H HW	Chamberlain Manufacturing Corporation		X		
I-163	VERMONT	Rutland	The Rutland Group, Inc.	Office/Warehouse	H	The Rutland Group, Inc.		X		
I-164		Woodstock	Woodstock Resort Corporation	Low Rise Hotel	HW	Revere Copper & Brass, Inc.			X	
I-165	VIRGIN ISLANDS	St. John	Rockresorts, Inc.	Duplex Cottages/ Low Rise Hotel	HW	Revere Copper & Brass, Inc.			X	
I-166		St. Thomas	American Motor Inns, Inc.	Hotel	C	Northrup, Inc.		X		
I-167	VIRGINIA	Alexandria	American Motor Inns, Inc.	High Rise Motor Inn	HW	Sunworks, Inc.			X	
I-168		Charlottesville	Arlington Associates, Inc.	Psychiatric Hospital	H HW	Sunworks, Inc.		X		
I-169		Hampton	Allen Management, Inc.	Low Rise Motel	HW	Solar Systems of Virginia, Inc.			X	
I-170		Leesburg	Loudoun County School Board	Vocational School	HW	Southwest Ener-Tech, Inc.		X		
I-171		Lynchburg	Terrell E. Moseley, Inc.	Office	H HW	Terrell E. Moseley, Inc.		X		
I-172		Portsmouth	Allen Management, Inc.	Low Rise Motel	HW	Solar Systems of Virginia, Inc.			X	
I-173		Sandston	Allen Management, Inc.	Low Rise Motel	HW	Solar Systems of Virginia, Inc.			X	
I-174		Warrenton	Fauquier County	Classrooms	H	InterTechnology Solar Corporation				X
I-175		Woodbridge	Allen Management, Inc.	Low Rise Motel	HW	Solar Systems of Virginia, Inc.			X	
I-176	WASHINGTON	Richland	Development Dynamics of Richland	Office	H C HW	General Electric Company		X		
I-177	WEST VIRG'NIA	Bethany	Bethany College	Conference Center/Multi- purpose Dining Facility	H HW	InterTechnology Corporation/ Solar Corporation of America		X		
I-178		Bluefield	Allen Management, Inc.	Low Rise Motel	HW	Solar Systems of Virginia, Inc.			X	
I-179		Charles Town	Jefferson County Board of Education	School	H C	PPG Industries, Inc.				X
I-180	WISCONSIN	Howards Grove	School District of Howards Grove	Elementary School	H	Sunstone Solar Energy Equipment		X		
I-181		West Bend	Dr. Walter A. Handzlik	Dental Clinic	H	Owens-Illinois, Inc.		X		
I-182	WYOMING	Casper	Wyoming Rural Electric Association	Office	H	Solargenics, Inc.		X		

KEY:

H - Heating

C - Cooling

HW - Hot Water

*Program Opportunity Notice (PON) Projects administered by DOE.

**Includes projects initiated by the National Science Foundation.

COMMERCIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS

H	—	HEATING
HW	—	HOT WATER
C	—	COOLING
HHW	—	HEATING, HOT WATER
HC	—	HEATING, COOLING
CHW	—	COOLING, HOT WATER
HCHW	—	HEATING, COOLING, HOT WATER

SECTION II COMMERCIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	SOLAR APPLICATION	SOLAR MANUFACTURER
II-1	ALABAMA	Huntsville	NASA Marshall Space Flight Center	Assembly Building	H	Kalwall Corporation
II-2		Huntsville	NASA Marshall Space Flight Center	Laboratory	H	To be Determined
II-3		Huntsville	NASA Marshall Space Flight Center	Laboratory	H	Marshall Space Flight Center
II-4	CALIFORNIA	Huntsville	NASA Marshall Space Flight Center	Office	HW	To be Determined
II-5		Adin	Dept. of Agriculture/Forest Service	Office	H	To be Determined
II-6		Berkeley	Dept. of Energy/Lawrence Berkeley Laboratory	Office	H HW	To be Determined
II-7		Davis	Dept. of Energy/University of California	Laboratory	H HW	KTA Corporation
II-8		Edwards	NASA Dryden Flight Research Center	Cafeteria	HW	Lennox Industries, Inc.
II-9		Fresno	Dept. of Agriculture/Forest Service	Office/Laboratory	H C HW	To be Determined
II-10		Livermore	Department of Energy/Lawrence Livermore Laboratory	Cafeteria	HW	To be Determined
II-11		Moffett Field	NASA Ames Research Center	Photographic Laboratory	HW	To be Determined
II-12		San Diego	Veterans Administration Hospital	Health Care Facility	H C HW	To be Determined
II-13		San Francisco	Dept. of Interior/Fish and Wildlife Service	Visitors Center	H HW	To be Determined
II-14		Boulder	U.S. Postal Service	Post Office	H C HW	Lennox Industries, Inc./Honeywell, Inc.
II-15		Denver	General Services Administration	Office	H	To be Determined
II-16		Grand Junction	Dept. of Energy/Grand Junction Office	Cafeteria	HW	R-M Products
II-17	DIST.OF COLUMBIA	Bolling Air Force Base	Dept. of Defense/Army and Air Force Exchange Service	Exchange Shopping Center	H C HW	KTA Corporation
II-18	FLORIDA	Cape Canaveral	NASA Kennedy Space Center	Cafeteria	HW	To be Determined
II-19	ILLINOIS	Argonne	Dept. of Energy/Argonne National Laboratory	Cafeteria	HW	Chamberlain Manufacturing Corporation
II-20		Batavia	Dept. of Energy/Fermi National Accelerator Laboratory	Industrial	H	Fermi National Accelerator Laboratory
II-21	KENTUCKY	Land Between the Lakes	Tennessee Valley Authority	Visitors Center	H C HW	To be Determined
II-22	LOUISIANA	Ft. Polk	Dept. of Defense/Army and Air Force Exchange Service	Exchange Shopping Center	H C HW	General Electric Company
II-23	MAINE	Hamlin	Dept. of the Treasury/U.S. Customs Service	U.S. Border Inspection Station	H	Daystar Corporation
II-24	MICHIGAN	Saginaw	General Services Administration	Office	H C HW	Owens-Illinois, Inc.
II-25	NEVADA	Mercury	Dept. of Energy/Nevada Test Site	Fire Station	HW	To be Determined
II-26	NEW HAMPSHIRE	Manchester	General Services Administration	Office	H C HW	Multisource
II-27	NEW MEXICO	Bread Springs	Dept. of Interior/Bureau of Indian Affairs	School	H HW	Gould, Inc./Sunworks, Inc.
II-28		Kirtland Air Force Base	Dept. of Defense/Army and Air Force Exchange Service	Exchange Shopping Center	H C HW	Raypak, Inc.
II-29		Gila National Forest, Mimbres Ranger District	Dept. of Agriculture/Forest Service	Ranger Station	H C HW	To be Determined

KEY:

H - Heating

C - Cooling

HW - Hot Water

PROJECT INFORMATION

Owner/Builder: NASA Marshall Space Flight Center

Contractor: To be determined

Operational Date: June 1978

Total Estimated DOE Funds: \$124,140

Building

Type: Assembly building

Area: 85,000 sq. ft.

Location: Huntsville, Alabama

Latitude: 34.8° N

Climatic Data

Degree Days	Heating	3070	Cooling	1808
Avg. Temp. (°F)	Winter	51.3	Summer	88.3
Avg. Insol. (Ly/d)	Winter	190	Summer	531

Photograph not available

SOLAR ENERGY SYSTEM

Application Heating 35% Cooling 0% Hot Water 0%

Collector

Type: Vertical wall panels (passive)

Area (sq. ft.): 6,400

Manufacturer: Kalwall Corporation

Storage

Type: None

Capacity: Not applicable

Auxiliary System Type: Oil fired boiler

Schematic not applicable

PROJECT DESCRIPTION

This project will provide solar-aided heating of the Marshall Space Flight Center Assembly building, high bay area. The solar system will be a passive system with transparent collectors mounted in the walls and will supply part of the heating load. The existing air handling system will be modified to concentrate heating and cooling loads. The passive system will provide a significant energy saving due to a decreased lighting load.

PROJECT INFORMATION

Owner/Builder: NASA Marshall Space Flight Center

Contractor: To be determined

Operational Date: November 1978

Total Estimated DOE Funds: \$244,000

Building

Type: Laboratory

Area: 285,882 sq. ft.

Location: Huntsville, Alabama

Latitude: 34.8°N

Climatic Data

Degree Days	Heating	3070	Cooling	1808
Avg. Temp. (°F)	Winter	51.3	Summer	88.3
Avg. Insol. (Ly/d)	Winter	190	Summer	531

SOLAR ENERGY SYSTEM

Application Heating 20% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,400

Manufacturer: To be determined

Storage

Type: Water tank

Capacity: To be determined

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

This project supplies heat to several electronic laboratories, instrumentation rooms, and computer rooms. The collectors will be roof mounted. The solar system will provide re-heat to computer areas in the summer and space heating to the high bay in the winter. Existing heating units will be modified to accommodate the solar system. Steam supplied by an oil fired boiler will provide system back-up.

Photograph not available

Schematic not available

PROJECT INFORMATION

Owner/Builder: NASA Marshall Space Flight Center

Contractor: Marshall Space Flight Center

Operational Date: February 1978

Total Estimated DOE Funds: \$35,000

Building

Type: Laboratory

Area: 1,200 sq. ft.

Location: Huntsville, Alabama

Latitude: 34.8°N

Climatic Data

Degree Days	Heating	3070	Cooling	1808
Avg. Temp. (°F)	Winter	51.3	Summer	88.3
Avg. Insol. (Ly/d)	Winter	190	Summer	531

Photograph not available

SOLAR ENERGY SYSTEM

Application Heating 100% Cooling 0% Hot Water 0%

Collector

Type: Air flat-plate

Area (sq. ft.): 520

Manufacturer: Marshall Space Flight Center

Storage

Type: Pebble bed

Capacity: 318 cu. ft.

Auxiliary System Type: Electric

PROJECT DESCRIPTION

This project supplies heat to a facility used for the repair of solar collector panels at the Marshall Space Flight Center. The collectors have been designed by the Marshall Space Flight Center. The collector array is designed to allow experimentation with several types of air collectors. Air is used as the heat transfer medium. A 318 cu. ft. rock tank, with plenums above and below the rock storage, provides storage. An electric heater provides back-up.

PROJECT INFORMATION

Owner/Builder: NASA Marshall Space Flight Center

Contractor: To be determined

Operational Date: September 1978

Total Estimated DOE Funds: \$228,000

Building

Type: Office

Area: 235,000

Location: Huntsville, Alabama

Latitude: 34.8° N

Climatic Data

Degree Days	Heating 3070	Cooling 1808
Avg. Temp. (° F)	Winter 51.3	Summer 88.3
Avg. Insol. (Ly/d)	Winter 190	Summer 531

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 80%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 878

Manufacturer: To be determined

Storage

Type: Water tank

Capacity: 2,000 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

This project will supply domestic hot water to two wings of the main office building of the Space Flight Center. The collector array will be located on the roof of the mezzanine adjoining the nine-story wings. Solar heated hot water is circulated to a 2000-gallon storage tank located in an equipment room located below the mezzanine. An electric boiler is used for back-up. Piping will be installed for future expansion to two sister buildings.

Photograph not available

PROJECT INFORMATION

Owner/Builder: Dept. of Agriculture/Forest Service

Contractor: To be determined

Operational Date: May 1979

Total Estimated DOE Funds: \$16,800

Building

Type: Office

Area: 2,362 sq. ft.

Location: Adin, California

Latitude: 41° 12'N

Climatic Data

Degree Days	Heating 6620	Cooling 329
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Avg. Temp. (°F)	Winter 31	Summer 70
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Avg. Insol. (Ly/d)	Winter 172	Summer 637
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SOLAR ENERGY SYSTEM

Application Heating 57% Cooling 0% Hot Water 0%

Collector

Type: Air flat-plate

Area (sq. ft.): To be determined

Manufacturer: To be determined

Storage

Type: Rock bed

Capacity: To be determined

Auxiliary System Type:

PROJECT DESCRIPTION

This project is being designed to provide solar heating for an addition to an existing Forest Service district office. Air type collectors will be used with a rock-filled tank for heat storage.

Photograph not available

Schematic not available

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/Lawrence Berkeley Laboratory

Contractor: To be determined

Operational Date: June 1978

Total Estimated DOE Funds: \$30,000 (design); \$131,000 (construction)

Building

Type: Office

Area: 88,000 sq. ft.

Location: Berkeley, California

Latitude: 38°N

Climatic Data

Degree Days	Heating	3163	Cooling	492
Avg. Temp. (°F)	Winter	56	Summer	64
Avg. Insol. (Ly/d)	Winter	192	Summer	614

SOLAR ENERGY SYSTEM

Application Heating 30% Cooling 0% Hot Water 80%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,250

Manufacturer: To be determined

Storage

Type: Water tank

Capacity: 2,000 gallons

Auxiliary System Type: Gas fired hot water boiler

PROJECT DESCRIPTION

This project involves the design and construction of a retrofitted solar heating system for a four-story office building (Bldg. 90) at Lawrence Berkeley Laboratory, California. The building, originally planned as a laboratory with 100% outside air, will be modified by a separate project to utilize recirculated air during heating. The solar system utilizes 1250 sq. ft. of flat-plate roof-mounted collectors and a 2000-gallon buried storage tank. A heat exchanger is used between the existing storage tank and the hot water heating system, because of low pressure limitations on the existing hot water boilers. Heating water temperatures have been reduced by the inclusion of a three-way mixing valve to maximize solar energy utilization. Heating water is used for both building space and domestic hot water heating.

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/University of California

Contractor: Construction Development Corporation

Operational Date: April 1978

Total Estimated DOE Funds: \$10,000 (design); \$30,000 (construction)

Building

Type: Laboratory

Area: 4,200 sq. ft.

Location: Davis, California

Latitude: 38° N

Climatic Data

Degree Days	Heating	2502	Cooling	1798
Avg. Temp. (°F)	Winter	54	Summer	71
Avg. Insol. (Ly/d)	Winter	175	Summer	711

SOLAR ENERGY SYSTEM

Application Heating 72% Cooling 0% Hot Water 72%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 764

Manufacturer: KTA Corporation

Storage

Type: Water tank

Capacity: 1,200 gallons

Auxiliary System Type: Gas fired hot water boiler

PROJECT DESCRIPTION

The Tissue Culture Laboratory building will incorporate several energy conservation features. A four-foot roof overhang will protect the south wall from the summer sun and from the cold north wind. The roof will be sloped to accommodate the central mechanical system in the "attic space." The sloped roof will make it possible to install the solar panels without additional panel framings. All building exhaust air, except that taken from laboratory exhaust hoods, will be ducted through the air-to-air heat exchanger in conjunction with outside air to the multizone unit. This will provide winter and summer tempering for the outside air with approximately 75% energy recovery. Economizer dampers will be installed to bypass the heat exchanger to allow energy free cooling when atmospheric conditions are right. Controls will be arranged so that the building heating system has priority over solar heated water during the heating season.

PROJECT INFORMATION

Owner/Builder: NASA Dryden Flight Research Center

Contractor: Quality Air Conditioning

Operational Date: January 1978

Total Estimated DOE Funds: \$68,400

Building

Type: Cafeteria

Area: To be determined

Location: Edwards, California

Latitude: 34.9° N

Climatic Data

Degree Days	Heating	—	Cooling	—
Avg. Temp. (°F)	Winter	46	Summer	80
Avg. Insol. (Ly/d)	Winter	633	Summer	900

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 55%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 700

Manufacturer: Lennox Industries, Inc.

Storage

Type: Steel water tank

Capacity: 1,500 gallons

Auxiliary System Type: Natural gas boiler

PROJECT DESCRIPTION

The cafeteria requires 3000 gallons of water for each of the five days of the week. It is open from 6:00 a.m. to 3:30 p.m. The flat-plate collectors will be roof-mounted at a tilt angle of 30°. A back-up consisting of two 90-gallon natural gas heaters will be used in conjunction with the solar collectors and a 1500-gallon storage tank.

PROJECT INFORMATION

Owner/Builder: Dept. of Agriculture/Forest Service

Contractor: To be determined

Operational Date: December 1978

Total Estimated DOE Funds: \$82,400

Building

Type: Office/laboratory

Area: 8,200 sq. ft. (total); 5,600 sq. ft. (cond.)

Location: Fresno, California

Latitude: 36° 46'N

Climatic Data

Degree Days	Heating	2650	Cooling	1671
Avg. Temp. (° F)	Winter	53	Summer	75
Avg. Insol. (Ly/d)	Winter	211	Summer	668

SOLAR ENERGY SYSTEM

Application Heating 65% Cooling 17.2% Hot Water 61.5%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,000

Manufacturer: To be determined

Storage

Type: Water tank

Capacity: 2,000 gallons

Auxiliary System Type: Gas heating/electric cooling

PROJECT DESCRIPTION

This project is a laboratory and office building for U.S. Forest Service research. The solar system will be a solar atrium roof system. The system is designed to achieve a blending of pleasing architecture with the mechanical and other systems.

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/Lawrence Livermore Laboratory

Contractor: To be determined

Operational Date: June 1978

Total Estimated DOE Funds: \$60,000

Building

Type: Cafeteria

Area: 8,968 sq. ft.

Location: Livermore, California

Latitude: 37° N

Climatic Data

Degree Days	Heating 2881	Cooling 400
Avg. Temp. (° F)	Winter 49	Summer 68
Avg. Insol. (Ly/d)	Winter 180	Summer 609

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 45%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 500

Manufacturer: To be determined

Storage

Type: Water tanks

Capacity: 500 gallons

Auxiliary System Type: Gas fired water heater

PROJECT DESCRIPTION

This project involves the design and construction of a solar energy hot water heating system. The present hot water requirement is 1600 gallons per day. The total yearly energy consumption is 2500 therms. The solar system will interface with the existing process and domestic hot water system to provide 45% of the heat requirement. These collectors will aid the existing gas fired water heater by preheating make up water before it is introduced into the system. System performance will be monitored by instrumentation.

PROJECT INFORMATION

Owner/Builder: Veterans Administration/Veterans Administration Hospital

Contractor: To be determined

Operational Date: May 1979

Total Estimated DOE Funds: \$290,000

Building

Type: Health care facility

Area: 825,000 sq. ft.

Location: San Diego, California

Latitude: 32° 52'N

Climatic Data

Degree Days	Heating	1300	Cooling	702
Avg. Temp. (°F)	Winter	58.2	Summer	65.8
Avg. Insol. (Ly/d)	Winter	309	Summer	519

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling ✓ Hot Water ✓

Collector

Type: To be determined

Area (sq. ft.): 10,000 (approximately)

Manufacturer: To be determined

Storage

Type: Potable water

Capacity: 50,000 gallons (minimum)

Auxiliary System Type: Gas fired with oil standby

PROJECT DESCRIPTION

The Veterans Administration Hospital will be retrofitted with a solar heating and cooling system to augment the existing variable volume terminal reheating HVAC system. The new solar energy system will be connected to an existing computerized total energy monitoring system to optimize the use of fossil fuels and assist in other energy conservation endeavors. Various types of collectors will be incorporated into a flexible design using potable water storage tanks and a solar still to explore innovative methods of solar use at health care facilities.

PROJECT INFORMATION

Owner/Builder: Dept. of Interior/Fish and Wildlife Service

Contractor: Frazier Construction Company

Operational Date: June 1979

Total Estimated DOE Funds: \$33,000

Building

Type: Visitors center

Area: 4,000 sq. ft.

Location: San Francisco, California

Latitude: 37.5° N

Climatic Data

Degree Days	Heating 3320	Cooling 80
Avg. Temp. (° F)	Winter 53	Summer 60
Avg. Insol. (Ly/d)	Winter 150	Summer 650

SOLAR ENERGY SYSTEM

Application Heating 50% Cooling 0% Hot Water 75%

Collector

Type: Evacuated tubular

Area (sq. ft.): 480

Manufacturer: To be determined

Storage

Type: Insulated steel water tank (above ground)

Capacity: 1,400 gallons

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

This project is a retrofit to an existing visitors center in the San Francisco National Refuge. The center has a wood frame structure and is mounted on pilings. The collector array will be roof-mounted and freeze protection will be provided by water circulation on cold nights. System back-up will be supplied by the existing oil fired boiler.

Photograph not available

Schematic not available

PROJECT INFORMATION

Owner/Builder: U.S. Postal Service

Contractor: Honeywell, Inc.

Operational Date: August 1977

Total Estimated DOE Funds: \$399,000

Building

Type: Post Office

Area: 30,000 sq. ft. (total); 29,380 (cond.)

Location: Boulder, Colorado

Latitude: 40.0° N

Climatic Data

Degree Days	Heating 6276	Cooling 566
Avg. Temp. (° F)	Winter 42.5	Summer 69.3
Avg. Insol. (Ly/d)	Winter 383	Summer 624

SOLAR ENERGY SYSTEM

Application Heating 32% Cooling 32% Hot Water 77%

Collector

Type: Liquid flat-plate

Area (sq. ft.); 4,140

Manufacturer Lennox Industries, Inc.

Storage

Type: Water tank

Capacity: 6,000 gallons

Auxiliary System Type: Gas fired boiler, electric

PROJECT DESCRIPTION

A two-story U.S. Postal Service office building, constructed during the 1920's, was retrofitted with a solar energy system. This project is regarded as a prototype to demonstrate the technical and economic feasibility of retrofitting other similar facilities in the U.S. After initial testing, all systems will be operated by the Postal Service personnel normally assigned to building operation and maintenance. Emphasis was placed on making all component parts reliable and easily maintained. The contractor was required to document his methods of defining criteria for system design, his rationale for system, subsystem and component selection, and his design procedures.

PROJECT INFORMATION

Owner/Builder: General Services Administration

Contractor: To be determined

Operational Date: December 1978

Total Estimated DOE Funds: \$378,000

Building

Type: Office

Area: 80,000 sq. ft.

Location: Denver, Colorado

Latitude: 39.5° N

Climatic Data

Degree Days	Heating	5505	Cooling	742
Avg. Temp. (° F)	Winter	37.6	Summer	66
Avg. Insol. (Ly/d)	Winter	264	Summer	468

SOLAR ENERGY SYSTEM

Application Heating 65% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 10,000

Manufacturer: To be determined

Storage

Type: Water tank

Capacity: 80,000 gallons

Auxiliary System Type: Heat pump

PROJECT DESCRIPTION

Building 85 is a one-story concrete block building which has recently undergone major renovation to make it highly energy efficient. The solar collector and associated HVAC systems comprise a major element in the renovation of this building with the aim of conserving fossil fuels. The collectors which will interface with the building's mechanical system will provide source energy for heating and domestic hot water. The existing building system includes a solar domestic water heater. This solar heater may remain separate for the purpose of evaluating both a combined space heat/domestic water heating system and separate systems.

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/Grand Junction Office

Contractor: E.C. Huff

Operational Date: November 1977

Total Estimated DOE Funds: \$4,000 (design); \$44,000 (construction)

Building

Type: Cafeteria

Area: 3,000 sq. ft.

Location: Grand Junction, Colorado

Latitude: 39° N

Climatic Data

Degree Days	Heating	5641	Cooling	1545
Avg. Temp. (°F)	Winter	39	Summer	73
Avg. Insol. (Ly/d)	Winter	227	Summer	708

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 40%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 500

Manufacturer: R-M Products

Storage

Type: Water tank

Capacity: 750 gallons

Auxiliary System Type: Gas fired steam boilers

PROJECT DESCRIPTION

The Grand Junction, Colorado Solar Demonstration project was incorporated into the construction of the new cafeteria built during the summer of 1977 with the solar system being activated during November. This system contains 496 net sq. ft. of collectors and uses a buried 750-gallon storage tank for the heat sink. Antifreeze protection is provided using a nontoxic water propylene glycol solution. The solar panels are of one piece construction and are 2' x 12'. The collector plate is copper with a single glazing and is covered by internal headers used to connect four panels into a single assembly, which is then connected to the supply and return headers. It is estimated that this system will supply 40% (88 M Btu/yr) of the annual hot water heating system requirements for this 3000 sq. ft. building. The cafeteria seating capacity is 120.

PROJECT INFORMATION

Owner/Builder: Dept. of Defense/Army and Air Force Exchange Service

Contractor: To be determined

Operational Date: November 1978

Total Estimated DOE Funds: \$500,000

Building

Type: Exchange shopping center

Area: 73,457 sq. ft.

Location: Bolling Air Force Base, Washington, D.C.

Latitude: 38.5° N

Climatic Data

Degree Days	Heating	4224	Cooling	1659
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Avg. Temp. (°F)	Winter 46	Summer 67
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Avg. Insol. (Ly/d)	Winter	243	Summer	406
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SOLAR ENERGY SYSTEM

Application Heating **88.7%** Cooling 64.2% Hot Water 93%

Collector

Type: Liquid glass tubular

Area (sq. ft.): 18,000

Manufacturer: KTA Corporation

Storage

Type: Water tank

Capacity: 150,000 gallons

Auxiliary System Type: Electric/high temperature hot water

PROJECT DESCRIPTION

This project involves the design and installation of a solar energy heating and cooling system for an Army exchange. The solar system will interface with the mechanical heating and cooling system planned for the facility. The mechanical system will be capable of meeting all of the facility's heating requirements. Data compiled in the project will be useful to those designing heating and cooling systems for private retail business. These projects utilize a concentrating collector and an off-peak mode operation.

PROJECT INFORMATION

Owner/Builder: NASA Kennedy Space Center

Contractor: To be determined

Operational Date: May 1978

Total Estimated DOE Funds: \$88,360

Building

Type: Cafeteria

Area: 8,000 sq. ft.

Location: Cape Canaveral, Florida

Latitude: 28.3°N

Climatic Data

Degree Days	Heating	733	Cooling	3226
Avg. Temp. (°F)	Winter	61.1	Summer	81.1
Avg. Insol. (Ly/d)	Winter	349	Summer	532

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 80%

Collector

Type: To be determined

Area (sq. ft.): 1,000

Manufacturer: To be determined

Storage

Type: Water tank

Capacity 1,500 gallons

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

The solar system will be used to heat hot water for an office building cafeteria. The contractor will be selected in early 1978. Collectors will be roof-mounted.

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/Argonne National Laboratory

Contractor: Power Systems, Inc.

Operational Date: May 1978

Total Estimated DOE Funds: \$27,000 (design); \$101,000 (construction)

Building

Type: Cafeteria

Area: 34,000 sq. ft.

Location: Argonne, Illinois

Latitude: 42° N

Climatic Data

Degree Days	Heating	6600	Cooling	1020
Avg. Temp. (°F)	Winter	36	Summer	71
Avg. Insol. (Ly/d)	Winter	164	Summer	570

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 64%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,500

Manufacturer: Chamberlain Manufacturing Corporation

Storage

Type: Insulated steel water tank (above ground)

Capacity: 2,000 gallons

Auxiliary System Type: Gas/oil fired steam boilers

PROJECT DESCRIPTION

The system is designed to provide preheating of the central cafeteria domestic hot water. The current daily usage of hot water in the cafeteria is 4000 gallons of 140°F water. When a demand for hot water occurs, water will be drawn from the storage tanks and pass through the conventional hot water heaters, which will maintain a 140°F discharge temperature to the cafeteria system. Heat will be transferred from the collectors whenever the collector temperature is 20°F higher than storage or during a demand period for hot water if the collector temperature is 20°F higher than the cold water entering the system. A double heat exchanger system with an intermediate water loop has been incorporated to provide double-wall protection between the collector glycol-water loop and the cafeteria domestic hot water system. The collectors are mounted on a steel and concrete support structure at grade level.

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/Fermi National Accelerator Laboratory

Contractor: Fermi National Accelerator Laboratory

Operational Date: October 1978

Total Estimated DOE Funds: \$12,000 (design); \$48,000 (construction)

Building

Type: Industrial

Area: 32,000 sq. ft.

Location: Batavia, Illinois

Latitude: 42° N

Climatic Data

Degree Days	Heating 6600	Cooling 1020
Avg. Temp. (°F)	Winter 36	Summer 71
Avg. Insol. (Ly/d)	Winter 164	Summer 570

SOLAR ENERGY SYSTEM

Application Heating 15% Cooling 0% Hot Water 0%

Collector

Type: Liquid nontracking concentrator

Area (sq. ft.): 583

Manufacturer: Fermi National Accelerator Laboratory

Storage

Type: Insulated aluminum water tank (above ground)

Capacity: 2,700 gallons

Auxiliary System Type: Radiant electric

PROJECT DESCRIPTION

The object of the project is to provide a solar energy system supplemental to the conventional space and process heatings at Fermilab's Magnet Facility complex. This will be achieved through the use of a unique, inverted panel mirror-augmented design. The complex considered for this project is a unit of two industrial prefabricated buildings called Industrials 1 and 2. The two buildings are interconnected by a third area, the midway building, which is office and work space. This is also where the solar storage tank, controls, and pumps will be located. The collectors will be located on the roof of Industrial 1 which the space and process heating systems will be in Industrial 2. The collectors are adjusted seasonally to match the sun's trajectory, but no daily adjustment is required.

PROJECT INFORMATION

Owner/Builder: Tennessee Valley Authority

Contractor: Tennessee Valley Authority

Operational Date: May 1979

Total Estimated DOE Funds: \$170,000

Building

Type: Visitors center

Area: 6,600 sq. ft.

Location: Land Between The Lakes, Kentucky

Latitude: 37° N

Climatic Data

Degree Days	Heating	3578	Cooling	549
Avg. Temp. (°F)	Winter	48.9	Summer	75.4
Avg. Insol. (Ly/d)	Winter	257	Summer	492

SOLAR ENERGY SYSTEM

Application Heating 87% Cooling 31% Hot Water 80%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 2,000

Manufacturer: To be determined

Storage

Type: Insulated steel water tank (below ground)

Capacity: 6,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

The heating and air conditioning system for use in this facility will be a solar assisted heat pump system with provision for direct solar heating and cooling. This system will incorporate a solar assisted heat system for space heating and domestic hot water heating with a solar cooling system utilizing an absorption refrigeration unit. The major items of equipment will include the electric driven reciprocating chiller arranged for operation as a heat pump, the absorption chiller, the solar collectors, and storage tank. Auxiliary equipment will include pumps, heat exchangers, and an electric supplemental heating boiler. Plans for the system should be completed by February 1978; construction will begin in the spring of 1978, and the center will open in 1979. Because it will be installed in a visitor's center, the system will acquaint an estimated one million people each year with the benefits of solar systems.

PROJECT INFORMATION

Owner/Builder: Dept. of Defense/Army and Air Force Exchange Service

Contractor: To be determined

Operational Date: October 1978

Total Estimated DOE Funds: \$500,000

Building

Type: Exchange shopping center

Area: 71,800 sq. ft.

Location: Fort Polk, Louisiana

Latitude: 31°N

Climatic Data

Degree Days	Heating	1575	Cooling	3100
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Avg. Temp. (°F)	Winter	54	Summer	75
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Avg. Insol. (Ly/d)	Winter	311	Summer	480
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SOLAR ENERGY SYSTEM

Application Heating 87.0% Cooling 58.6% Hot Water 99%

Collector

Type: Liquid evacuated glass tubular

Area (sq. ft.): 10,000

Manufacturer: General Electric Company

Storage

Type: Water tank

Capacity: 150,000 gallons

Auxiliary System Type: Natural gas

PROJECT DESCRIPTION

This project involves the design and installation of a solar energy heating and cooling system for an Army and Air Force exchange. The solar system will interface with the mechanical heating and cooling system planned for the facility. The mechanical system will be capable of meeting all of the facility's heating requirements. Data compiled in the project will be useful to those designing heat and cooling systems for private retail business. These projects utilize a concentrating collector and an off-peak mode operation.

PROJECT INFORMATION

Owner/Builder: Dept. of the Treasury/U.S. Customs Service

Contractor: Solar Assistance Inc.

Operational Date: February 1979

Total Estimated DOE Funds: \$40,572

Building

Type: U.S. Border Inspection Station

Area: 1,400 sq. ft.

Location: Hamlin, Maine

Latitude: 47.0° N

Climatic Data

Degree Days	Heating	11,521	Cooling	0
Avg. Temp. (°F)	Winter	13	Summer	62
Avg. Insol. (Ly/d)	Winter	157	Summer	476

SOLAR ENERGY SYSTEM

Application Heating 70% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,127

Manufacturer: Daystar Corporation

Storage

Type: Water/ethylene glycol

Capacity: 1,500 gallons

Auxiliary System Type: Forced air oil furnace

PROJECT DESCRIPTION

This project is a retrofit to an existing Border Inspection Station. The station is a one-story, brick veneered wood frame structure. The collector array will be located across the highway from the station. Solar heated water will be conducted underground in insulated piping to storage tanks located inside the building. Heat exchangers will transfer heat from the insulated storage tanks to the existing forced warm air duct system. Controls will automatically select the conventional heating system when the solar heating is insufficient.

PROJECT INFORMATION

Owner/Builder: General Services Administration

Contractor: Gilbane Building Company

Operational Date: July 1977

Total Estimated DOE Funds: \$471,000

Building

Type: Office

Area: 59,500 sq. ft.

Location: Saginaw, Michigan

Latitude: 43.4°N

Climatic Data

Degree Days	Heating	7420	Cooling	383
Avg. Temp. (°F)	Winter	38.5	Summer	66.9
Avg. Insol. (Ly/d)	Winter	292	Summer	528

SOLAR ENERGY SYSTEM

Application Heating 60% Cooling 60% Hot Water 100%

Collector

Type: Evacuated glass tubular

Area (sq. ft): 8,000

Manufacturer: Owens-Illinois, Inc.

Storage

Type: Water tank

Capacity: 30,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

This project involves the fabrication, installation and evaluation of an advanced experimental solar collector array on a federal office building. The building design includes numerous innovative and experimental environmental and energy conserving features and systems. It was awarded a Design Citation in the 1974 Annual Progressive Architecture Awards Program and was a winner of the Governmental Category in the 1974 Owens-Corning Fiberglas Energy Conservation Awards Program. The completed building is expected to operate with 40% to 50% less energy than typical modern buildings of comparable size and subjected to similar climatic conditions. The building and the solar energy system will serve as a study model for facilities of its type, size, and location. Monitoring and evaluation of solar energy system performance is being carried out by the University of Michigan over a twelve-month period following initial building occupancy.

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/Nevada Test Site

Contractor: To be determined

Operational Date: March 1978

Total Estimated DOE Funds: \$7,000 (design); \$26,000 (construction)

Building

Type: Fire station

Area: 10,000 sq. ft.

Location: Mercury, Nevada

Latitude: 36° N

Climatic Data

Degree Days	Heating 4600	Cooling 2298
Avg. Temp. (°F)	Winter 46	Summer 72
Avg. Insol (Ly/d)	Winter 277	Summer 748

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 65%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 200

Manufacturer: To be determined

Storage

Type: Water tank

Capacity: 328 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

The basic building service hot water system consists of a central electric water heater circulation loop, and circulation pump. The hot water system includes 200 sq. ft. of flat-plate solar collector panels; four, 82-gallon storage tanks with heat exchangers and circulating pumps; and associated piping and controls. The solar system liquid will be an antifreeze solution. The solar system will preheat the makeup water supplied to the basic building hot water system. The control system consists of one collector control sensor, one solar storage tank control sensor, and one differential thermostat controller for each storage tank/collector system. The two sensors provide signal inputs to the collector. When the collector temperature is sufficiently above the tank temperature the controller will activate the circulating pump. The pump will continue to run until the temperature difference is reduced. The temperature controller shall have a three position selector switch, auto, off and on, for manual overrides of the system operation as described.

PROJECT INFORMATION

Owner/Builder: General Services Administration

Contractor: Davidson Construction Co., Inc.

Operational Date: January 1977

Total Estimated DOE Funds: \$567,000

Building

Type: Office

Area: 131,000 sq. ft. (total); 30,000 sq. ft. (cond.)

Location: Manchester, New Hampshire

Latitude: 43.0° N

Climatic Data

Degree Days	Heating	7360	Cooling	349
Avg. Temp. (° F)	Winter	38.5	Summer	68.5
Avg. Insol. (Ly/d)	Winter	266	Summer	488

SOLAR ENERGY SYSTEM

Application Heating 30% Cooling 30% Hot Water ✓

Collector

Type: Liquid flat-plate

Area (sq. ft.): 3,800

Manufacturer: Multisource

Storage

Type: Water tank

Capacity: 30,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

This project is for the solar system addition to the Norris Cotton Federal Office Building being constructed in Manchester, New Hampshire. The seven-story building has been designated by the General Services Administration (GSA) as its Energy Conservation Demonstration Building, and a variety of energy conservation techniques are being used and tested in its construction and operation. Under optimum conditions the supplementary solar system which utilizes a 25-ton absorption chiller, a conventional 65-ton electrically driven chiller, and three 10000-gallon insulated tanks should be capable of supplying nearly all of the building's energy requirements. Different mechanical and electrical systems are used for heating, cooling, and lighting; and the most effective systems will be determined through evaluations made by GSA and the National Bureau of Standards. The building uses up to 40% less energy than would be used by a conventional office building in the same area.

PROJECT INFORMATION

Owner/Builder: Dept. of Interior/Bureau of Indian Affairs

Contractor: Bureau of Indian Affairs, Branch of Facility Management

Operational Date: February 1978

Total Estimated DOE Funds: \$68,000

Building

Type: School

Area: 8,852 sq. ft.

Location: Bread Springs, New Mexico

Latitude: 35° N

Climatic Data

Degree Days	Heating 6900	Cooling N/A
Avg. Temp. (°F)	Winter 39	Summer 70
Avg. Insol. (Ly/d)	Winter 397	Summer 681

SOLAR ENERGY SYSTEM

Application Heating 80% Cooling 0% Hot Water 20%

Collector

Type: Concentrating/liquid flat-plate

Area (sq. ft.): 1,000/1,000

Manufacturer: Gould, Inc./Sunworks, Inc.

Storage

Type: Water tank

Capacity: 38,000 gallons

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

This project is a rural three-room Navajo school designed and constructed by Branch of Facility Management personnel. Two types of roof-mounted, drain-down collectors are used. The concentrating collectors are connected to an 1800-gallon pressurized storage tank. A three-way valve allows solar heated water to be circulated through existing baseboard heating elements. Solar heated hot water is also used to preheat domestic hot water before it is heated in the oil fired boiler. The flat-plate collectors provide an independent system to pump water into a shallow plastic, 20000-gallon tank. This tank is located under the floor of the north-facing classroom and provides radiative heat.

PROJECT INFORMATION

Owner/Builder: Dept. of Defense/Army and Air Force Exchange Service

Contractor: Raypak, Inc.

Operational Date: July 1977

Total Estimated DOE Funds: \$390,000

Building

Type: Exchange shopping center

Area: 41,000 sq. ft.

Location: Kirtland Air Force Base, New Mexico

Latitude: 35° N

Climatic Data

Degree Days	Heating	4348	Cooling	1250
Avg. Temp. (°F)	Winter	45	Summer	79
Avg. Insol. (Ly/d)	Winter	405	Summer	618

SOLAR ENERGY SYSTEM

Application Heating 98.6% Cooling 78.3% Hot Water 98.6%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 9,410

Manufacturer: Raypak, Inc.

Storage

Type: Water tank

Capacity: 40,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

This project involves the design and installation of a solar energy heating and cooling system for an Air Force base exchange. The solar system interfaces with the mechanical heating and cooling system planned for the facility. Data compiled in the project will be useful to those designing heating and cooling systems for private retail businesses.

PROJECT INFORMATION

Owner/Builder: Dept. of Agriculture/Forest Service

Contractor: To be determined

Operational Date: November 1978

Total Estimated DOE Funds: \$28,400

Building

Type: Ranger station

Area: 2,560 sq. ft.

Location: Gila National Forest, Mimbres Ranger District, New Mexico

Latitude: 33° N

Climatic Data

Degree Days	Heating 4500	Cooling	Very minor
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Avg. Temp. (° F)	Winter 48	Summer	76
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Avg. Insol. (Ly/d)	Winter 565.5	Summer	680
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Photograph not available

SOLAR ENERGY SYSTEM

Application	Heating 70%	Cooling 25%	Hot Water 20%
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Collector

Type: Liquid flat-plate

Area (sq. ft.): 1,038

Manufacturer: To be determined

Storage

Type: Water tank

Capacity: 5,000 gallons

Auxiliary System Type: Heat pump; electric boiler

Schematic not available

PROJECT DESCRIPTION

This project is a new ranger station in the Gila National Forest in New Mexico. Single glazed, flat-plate trickle collectors will be used for the roof mounted solar array. Solar heated hot water will be circulated to three tanks where it will be mixed with auxiliary heated water for seasonal use. An air-to-air heat pump will provide auxiliary heating and cooling. Domestic hot water backup will be furnished by an electric boiler.

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/Brookhaven National Laboratory
 Contractor: To be determined
 Operational Date: April 1978
 Total Estimated DOE Funds: \$30,000 (design); \$170,000 (construction)

Building

Type: Animal quarantine
 Area: 5,300 sq. ft.

Location: Upton, New York

Latitude: 40° N

Climatic Data

Degree Days	Heating	6204	Cooling	1079
Avg. Temp. (°F)	Winter	40	Summer	68
Avg. Insol. (Ly/d)	Winter	149	Summer	575

SOLAR ENERGY SYSTEM

Application Heating 40% Cooling 0% Hot Water 40%

Collector

Type: Liquid flat-plate
 Area (sq. ft.): 3,000
 Manufacturer: To be determined

Storage

Type: Water tank
 Capacity: 6,000 gallons

Auxiliary System Type: Electric and propane

PROJECT DESCRIPTION

This project is a one-story, cement masonry structure. Newly acquired small mammals are housed in this building for observation prior to their transportation to medical research facilities. Large quantities of hot water, as well as steam, are used for washing and disinfecting cages, pens, stalls, and outdoor animal runs. This facility is totally air conditioned with two electrically energized, once-thru air conditioning systems. The solar system is designed to utilize the collected solar energy to meet heating, air preheating and building service hot water loads. A glycol/water mixture is used to transfer solar heat from the collectors to heat exchangers. Existing electric coils provide back-up for building heating and preheating; a propane hot water heater provides back-up for the building service hot water system.

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/Monsanto Research Corporation
 Contractor: To be determined
 Operational Date: July 1978
 Total Estimated DOE Funds: \$15,000 (design); \$105,000 (construction)

Building

Type: Laboratory
 Area: 6,300 sq. ft.

Location: Miamisburg, Ohio

Latitude: 39° N

Climatic Data

Degree Days	Heating	5622	Cooling	1483
Avg. Temp. (°F)	Winter	42	Summer	71
Avg. Insol. (Ly/d)	Winter	128	Summer	562

SOLAR ENERGY SYSTEM

Application Heating 53% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate
 Area (sq. ft.): 2,000
 Manufacturer: To be determined

Storage

Type: Water tank
 Capacity: 2,000 gallons

Auxiliary System Type: Gas/oil fired steam boiler

PROJECT DESCRIPTION

This system provides year-round tempering for a laboratory building. During the heating season, the system provides heat for a ten-hour occupancy period using 60% outside and 40% recirculated reheat air. In the summer season, the system provides reheating from a constant cold deck temperature for humidity control. The solar system will interface with an existing system, a constant cold deck and a multizone, with a large amount of outside air for process usage. The solar collectors will be located on an adjoining hillside. An instrument system is contemplated to monitor system performance and to provide data for the evaluation of energy supplied.

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/Bartlesville Energy Research Center

Contractor: Donohue Service Company

Operational Date: January 1978

Total Estimated DOE Funds: \$7,000 (design); \$48,000 (construction)

Building

Type: Laboratory

Area: 50,000 sq. ft.

Location: Bartlesville, Oklahoma

Latitude: 36° N

Climatic Data

Degree Days	Heating	3860	Cooling	2422
Avg. Temp. (°F)	Winter	47	Summer	78
Avg. Insol. (Ly/d)	Winter	205	Summer	600

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 60%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 600

Manufacturer: Raypak, Inc.

Storage

Type: Water tank

Capacity: 1,200 gallons

Auxiliary System Type: Gas fired boilers

PROJECT DESCRIPTION

An existing U.S. Department of Energy Physical Sciences Building is being retrofitted with a solar energy system to heat the building service hot water. The nominal demand is 1700 gallons of water per day at 120°F. There are approximately 50000 sq. ft. of floor space in the building distributed over three levels including the basement area. The solar heating system is designed to supply approximately 60% of the heating load with 600 sq. ft. of collectors. The collectors are flat-plate, single glaze, with nonselective surface. The fluid utilized with the collectors is an ethylene glycol and water mixture. The secondary system will utilize treated water to transfer heat to the storage tank. Supply water will pass through the storage tank and then be distributed throughout the building. The Btu meters will measure the heat input of the collectors and net output of the system. The collectors will be roof-mounted at a tilt angle of 45° and a 1200-gallon storage tank will be placed in the present basement mechanical area with the pumps and control equipment.

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/Pittsburgh Energy Research Center

Contractor: To be determined

Operational Date: June 1978

Total Estimated DOE Funds: \$80,000

Building

Type: Office/laboratory

Area: 56,000 sq. ft.

Location: Bruceton, Pennsylvania

Latitude: 40° N

Climatic Data

Degree Days	Heating	5672	Cooling	953
Avg. Temp. (°F)	Winter	33	Summer	71
Avg. Insol. (Ly/d)	Winter	94	Summer	491

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 38%

Collector

Type: Concentrator/liquid flat-plate

Area (sq. ft.): 515/546

Manufacturer: Northrup, Inc /Chamberlain
Manufacturing Corporation

Storage

Type: Water tank

Capacity: 2,000 gallons

Auxiliary System Type: Oil fired steam boiler

PROJECT DESCRIPTION

This project provides for the design and installation of a solar energy system to provide hot water to one of the office-laboratory buildings at the Pittsburgh Energy Research Center facility of The Department of Energy. The solar system will include both flat-plate and concentrating collectors to serve as a basis for comparison of these two different systems in the Pittsburgh area. Data collected in this project will be useful to those designing systems for private as well as public use. The solar system will interface with the existing steam heating system which is capable of meeting all heating requirements to the buildings.

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/Oak Ridge National Laboratory

Contractor: Union Carbide Corporation

Operational Date: July 1978

Total Estimated DOE Funds: \$20,000 (design); \$100,000 (construction)

Building

Type: Animal holding facility

Area: 16,000 sq. ft.

Location: Oak Ridge, Tennessee

Latitude: 35°N

Climatic Data

Degree Days	Heating	3817	Cooling	1546
Avg. Temp. (°F)	Winter	49	Summer	75
Avg. Insol. (Ly/d)	Winter	164	Summer	560

SOLAR ENERGY SYSTEM

Application Heating 50% Cooling 0% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 500

Manufacturer: To be determined

Storage

Type: Water tank

Capacity: 7,000 gallons

Auxiliary System Type: Coal fired steam boiler

PROJECT DESCRIPTION

This project provides partial solar heating to the Controlled Environment and Animal Building. The collector array will be mounted at ground level and will provide the heat source for a ten-ton, water-source heat pump. A 4000-gallon tank will be used as a low temperature (90°F) reservoir for solar heat storage. The heat pump will extract heat from this tank as required to maintain a minimum temperature of 130°F in a 3000-gallon high temperature reservoir. Hot water from the high temperature reservoir will be pumped directly to 12 individual laboratory reheat coils. When conditions are such that the low temperature reservoir heat requirements are satisfied and heat is required in any of the 12 reheat coils, the solar array will provide the necessary heat without operating the heat pump. An auxiliary steam coil will be provided to heat the water at times when insufficient solar energy is available to operate the heat pump efficiently.

PROJECT INFORMATION

Owner/Builder: Dept. of Justice/General Services Administration/
Bureau of Prisons

Contractor: Wattinger Co., Inc.

Operational Date: August 1978

Total Estimated DOE Funds: \$800,000

Building

Type: Youth correctional facility

Area: 175,546 sq. ft.

Location: Bastrop, Texas

Latitude: 30.1°N

Climatic Data

Degree Days	Heating	1711	Cooling	2788
Avg. Temp. (°F)	Winter	59.1	Summer	84.4
Avg. Insol. (Ly/d)	Winter	333	Summer	553

SOLAR ENERGY SYSTEM

Application Heating 57% Cooling 8% Hot Water 70%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 25,000

Manufacturer: Cole Solar Systems

Storage

Type: Water tank

Capacity: 40,000 gallons

Auxiliary System Type: Gas fired boilers

PROJECT DESCRIPTION

The Federal Youth Center will provide correctional treatment programs for 500 youthful offenders. The facility consists of youth housing units, administration offices, prison industries, academic and vocational training, a clinic, recreation, and support services similar to a small community. The Youth Center is small enough to make the application of solar energy feasible, but large enough to provide valid documentation of the costs, problems, advantages, limitations, and requirements of solar collection and delivery systems. This "campus type" facility is unique for a solar demonstration project. The operation of this controlled community is a microcosmic reflection of the energy needs of an entire city.

PROJECT INFORMATION

Owner/Builder: Dept. of Defense/U.S. Army

Contractor: General Electric Company

Operational Date: September 1977

Total Estimated DOE Funds: \$588,000

Building

Type: Office/classrooms

Area: 12,200 sq. ft.

Location: Fort Hood, Texas

Latitude: 31.1°N

Climatic Data

Degree Days	Heating 1950	Cooling 2802
Avg. Temp. (°F)	Winter 49	Summer 83
Avg. Insol. (Ly/d)	Winter 285	Summer 501

SOLAR ENERGY SYSTEM

Application Heating 98% Cooling 83% Hot Water 0%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 6,000

Manufacturer: General Electric Company

Storage

Type: Water tank

Capacity: 12,000 gallons

Auxiliary System Type: Central energy plant

PROJECT DESCRIPTION

This proof-of-concept experiment incorporates a solar energy system in a battalion headquarters and classroom building. Solar collectors are mounted at a tilt of 20° above the roof on a structural grid and aligned with the building axis. The buried thermal energy storage tank and the system cooling tower are located on the west side of the building. Ethylene glycol/water is circulated through the collector loop. For cooling, hot water is circulated through a 100-ton absorption chiller which supplies chilled water to coils in the building air duct system. An instrumentation system monitors system performance and provides data for evaluation of energy supplied. A display panel provides a graphic display of system operation along with direct readout of operating conditions and system temperatures.

PROJECT INFORMATION

Owner/Builder: NASA Johnson Space Center

Contractor: Charles G. Heyne and Company

Operational Date: December 1977

Total Estimated DOE Funds: \$18,500 (design); \$318,500 (construction)

Building

Type: Computer center

Area: 89,334 sq. ft.

Location: Houston, Texas

Latitude: 30° N

Climatic Data

Degree Days	Heating 1396	Cooling 2656
Avg. Temp. (° F)	Winter 33	Summer 96
Avg. Insol. (Ly/d)	Winter 250	Summer 618

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 20%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 5,657

Manufacturer: Southwestern Sheetmetal Works, Inc.

Storage

Type: None

Capacity: Not applicable

Auxiliary System Type: Steam

PROJECT DESCRIPTION

This system is designed to provide hot water to the Mission Control Computer Center air conditioning system. The collectors are mounted above the roof and have black painted absorbers and single glazing of tempered white crystal. The existing hot water system is a closed loop using a steam-to-water heat exchanger with solar heated water used to preheat water. The energy generated by the solar system is less than the minimum amount required so that a storage tank is not required. A manual drain-down is provided for freeze protection.

PROJECT INFORMATION

Owner/Builder: Dept. of Defense/Army and Air Force Exchange Service

Contractor: Raypak, Inc.

Operational Date: October 1977

Total Estimated DOE Funds: \$510,000

Building

Type: Exchange shopping center

Area: 62,000 sq. ft.

Location: Randolph Air Force Base, Texas

Latitude: 29.5° N

Climatic Data

Degree Days	Heating	1546	Cooling	2990
Avg. Temp. (°F)	Winter	60	Summer	78
Avg. Insol. (Ly/d)	Winter	340	Summer	545

SOLAR ENERGY SYSTEM

Application Heating 99.7% Cooling 64% Hot Water 99.7%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 14,700

Manufacturer: Raypak, Inc.

Storage

Type: Water tank

Capacity: 50,000 gallons

Auxiliary System Type: Oil

PROJECT DESCRIPTION

The project involved the design and construction of a solar energy system that would meet a large part of the heating and cooling requirements of an Air Force base exchange shopping center. The center consists of a large retail sales area, concession shops, mall, administrative offices, and storage facilities. The solar energy system interfaces with a back-up heating and air conditioning system capable of meeting design requirements of the facility.

PROJECT INFORMATION

Owner/Builder: NASA Langley Research Center

Contractor: To be determined

Operational Date: October 1978

Total Estimated DOE Funds: \$260,000

Building

Type: Photographic laboratory

Area: 12,000 sq. ft.

Location: Hampton, Virginia

Latitude: 36°N

Climatic Data

Degree Days	Heating	3285	Cooling	1744
Avg. Temp. (°F)	Winter	41	Summer	73
Avg. Insol. (Ly/d)	Winter	200	Summer	552

Photograph not available

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 70%

Collector

Type: Evacuated tubular

Area (sq. ft.): 3,000

Manufacturer: To be determined

Storage

Type: Insulated steel water tank (above ground)

Capacity: 6,000 gallons

Auxiliary System Type: Electric

Schematic not available

PROJECT DESCRIPTION

This solar project will provide solar heating of process water for an existing NASA photographic laboratory. Evacuated tubular collectors mounted on wood supports will be used for the solar array. Ethylene glycol will be used for freeze protection. Backup will be provided by existing electric heating elements.

PROJECT INFORMATION

Owner/Builder: Dept. of Energy/Hanford Works

Contractor: To be determined

Operational Date: November 1978

Total Estimated DOE Funds: \$12,000 (design); \$78,000 (construction)

Building

Type: Laboratory

Area: 35,000 sq. ft.

Location: Richland, Washington

Latitude: 46° N

Climatic Data

Degree Days	Heating	5267	Cooling	46
Avg. Temp. (° F)	Winter	43	Summer	74
Avg. Insol. (Ly/d)	Winter	118	Summer	633

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 70%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 800

Manufacturer: To be determined

Storage

Type: Water tank

Capacity: 1,500 gallons

Auxiliary System Type: Steam

PROJECT DESCRIPTION

The system will supply domestic hot water for the cafeteria and office areas of the High Temperature Sodium Facility. The solar energy will be collected by 800 sq. ft. of flat-plate solar collectors mounted on the roof of the south office wing. Water will be circulated through the collectors to transfer the energy to a 1500-gallon storage tank located in the equipment room beneath the lobby. The storage tank will store energy for peak demand periods and for use during cloudy days. About 70% of the building's domestic hot water requirements will be supplied by the solar collector system. The remainder will be supplied by the existing steam heated hot water system.

SECTION II COMMERCIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS (CONTINUED)

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	SOLAR APPLICATION	SOLAR MANUFACTURER
II-30	NEW YORK	Upton	Dept. of Energy/Brookhaven National Laboratory	Animal Quarantine	H HW	To be Determined
II-31	OHIO	Miamisburg	Dept. of Energy/Monsanto Research Corporation	Laboratory	H	To be Determined
II-32	OKLAHOMA	Bartlesville	Dept. of Energy/Bartlesville Energy Research Center	Laboratory	HW	Raypak, Inc.
II-33	PENNSYLVANIA	Bruceton	Dept. of Energy/Pittsburgh Energy Research Center	Office/Laboratory	HW	Northrup, Inc./Chamberlain Manufacturing Corporation
II-34	TENNESSEE	Oak Ridge	Dept. of Energy/Oak Ridge National Laboratory	Animal Holding Facility	H	To be Determined
II-35	TEXAS	Bastrop	Dept. of Justice/General Services Administration/Bureau of Prisons	Youth Correctional Facility	H C HW	Cole Solar Systems
II-36		Ft. Hood	Dept. of Defense/U.S. Army	Office/Classrooms	H C	General Electric Company
II-37		Houston	NASA Johnson Space Center	Computer Center	HW	Southwestern Sheet Metal Works, Inc.
II-38		Randolph Air Force Base	Dept. of Defense/Army and Air Force Exchange Service	Exchange Shopping Center	H C HW	Raypak, Inc.
II-39	VIRGINIA	Hampton	NASA Langley Research Center	Photographic Laboratory	HW	To be Determined
II-40	WASHINGTON	Richland	Dept. of Energy/Hanford Works	Laboratory	HW	To be Determined

KEY:

H - Heating

C - Cooling

HW - Hot Water

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SECTION III

RESIDENTIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS

RESIDENTIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS

H	—	HEATING
HW	—	HOT WATER
C	—	COOLING
HHW	—	HEATING, HOT WATER
HC	—	HEATING, COOLING
CHW	—	COOLING, HOT WATER
HCHW	—	HEATING, COOLING, HOT WATER

SECTION III RESIDENTIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	NUMBER OF UNITS	SOLAR APPLICATION	SOLAR MANUFACTURER
III-1	DIST. OF COLUMBIA	Bolling Air Force Base	Dept. of Defense/U.S. Air Force	MF	20	H C	Owens-Illinois, Inc.
III-2	LOUISIANA	Ft. Polk	Dept. of Defense/U.S. Army	SFA	40	H C	To be Determined
III-3	RHODE ISLAND	Newport Naval Station	Dept. of Defense/U.S. Navy	SFA	20	H HW	Honeywell, Inc.
III-4	TEXAS	Sheppard Air Force Base	Dept. of Defense/U.S. Air Force	SFA	1	H HW	Honeywell, Inc.
III-5		Sheppard Air Force Base	Dept. of Defense/U.S. Air Force	SFA	1	H HW	Sunworks, Inc.
III-6		Sheppard Air Force Base	Dept. of Defense/U.S. Air Force	SFA	1	H HW	General Electric Company
III-7		Sheppard Air Force Base	Dept. of Defense/U.S. Air Force	SFA	1	H HW	General Electric Company
Additional projects being implemented:							
	ARIZONA	Davis-Montham Air Force Base	Dept. of Defense/U.S. Air Force	SFD	1	H HW	Daystar Corporation
	IDAHO	Mt. Home Air Force Base	Dept. of Defense/U.S. Air Force	SFD	1	H HW	Ametek, Inc.
	KANSAS	Fort Riley	Dept. of Defense/U.S. Army	MF	8	HW	To be Determined
	KENTUCKY	Fort Campbell	Dept. of Defense/U.S. Army	SFD	1	H HW	To be Determined
	LOUISIANA	New Orleans Naval Base	Dept. of Defense/U.S. Navy	MF	12	HW	To be Determined
	MARYLAND	U.S. Naval Academy	Dept. of Defense/U.S. Navy	MF	16	HW	To be Determined
	NORTH CAROLINA	Fort Bragg	Dept. of Defense/U.S. Army	SFD	1	H	To be Determined
	VIRGINIA	Fort Meyer	Dept. of Defense/U.S. Army	MF	120	HW	Sunworks, Inc.

KEY:

SFD-Single Family Detached SFA-Single Family Attached MF-Multifamily H-Heating C-Cooling HW-Hot Water

PROJECT INFORMATION

Owner/Builder: Dept. of Defense/U.S. Air Force

Contractor: To be determined

Operational Date: January 1979

Total Estimated DOE Funds: \$330,000

Building

Type: Four two-story multiple dwellings (20 units)

Area: 1,150 sq. ft. (each unit); 23,000 sq. ft. (total)

Location: Bolling Air Force Base, Washington, D.C.

Latitude: 39° N

Climatic Data

Degree Days	Heating	4211	Cooling	1499
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Avg. Temp. (° F)	Winter	44	Summer	69
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Avg. Insol. (Ly/d)	Winter	262	Summer	450
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SOLAR ENERGY SYSTEM

Application Heating 60% Cooling 60% Hot Water 0%

Collector

Type: Evacuated tubular

Area (sq. ft.): 4,500 sq. ft.

Manufacturer: Owens-Illinois, Inc.

Storage

Type: Water tank

Capacity: To be determined

Auxiliary System Type: Heat pump

PROJECT DESCRIPTION

This project will provide solar-assisted heating and cooling to twenty residential projects in four two-story buildings. Solar energy will be used to boost heat pumps installed in each unit. All residential units will be supported from a centrally located collector field.

Photograph not available

Schematic not available

PROJECT INFORMATION

Owner/Builder: Dept. of Defense/U.S. Army

Contractor: To be determined

Operational Date: May 1979

Total Estimated DOE Funds: \$660,000

Building

Type: Townhouses (40 units)

Area: 1,350 sq. ft. (each unit); 54,280 sq. ft. (total)

Location: Fort Polk, Louisiana

Latitude: 31°N

Climatic Data

Degree Days	Heating	1927	Cooling	3175
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Avg. Temp. (°F)	Winter	54	Summer	79
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Avg. Insol. (Ly/d)	Winter	311	Summer	480
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SOLAR ENERGY SYSTEM

Application Heating 100% Cooling 100% Hot Water 0%

Collector

Type: To be determined

Area (sq. ft.): To be determined

Manufacturer: To be determined

Storage

Type: Water tank

Capacity: 70,000 gallons

Auxiliary System Type: Heat pump

PROJECT DESCRIPTION

This project consists of forty townhouses at Fort Polk for base housing. All forty units will be supported from a centrally located collector field. Solar energy collected will be used to boost heat pumps installed in each townhouse.

Photograph not available

Schematic not available

PROJECT INFORMATION

Owner/Builder: Dept. of Defense/U.S. Navy

Contractor: To be determined

Operational Date: September 1978

Total Estimated ERDA Funds: \$330,000

Building

Type: Two-story duplexes (20 units)

Area: 1,191 sq. ft. (each unit); 23,820 sq. ft. (total)

Location: Newport Naval Station, Rhode Island

Latitude: 41°N

Climatic Data

Degree Days	Heating	5972	Cooling	532
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Avg. Temp. (°F)	Winter	38	Summer	68
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Avg. Insol. (Ly/d)	Winter	332	Summer	408
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SOLAR ENERGY SYSTEM

Application Heating 60% Cooling 0% Hot Water 90%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 6,990

Manufacturer: Honeywell, Inc.

Storage

Type: Water tank

Capacity: 13,000 gallons

Auxiliary System Type: Heat pump

PROJECT DESCRIPTION

This project will provide solar-assisted heating and domestic hot water to twenty units at the Newport Naval Station. All units will be supported from a centrally located collected field.

Photograph not available

Schematic not available

PROJECT INFORMATION

Owner/Builder: Dept. of Defense/U.S. Air Force

Contractor: To be determined

Operational Date: April 1977

Total Estimated DOE Funds: To be determined

Building

Type: Single family attached

Area: 1,534 sq. ft.

Location: Sheppard Air Force Base, Texas

Latitude: 34° N

Climatic Data

Degree Days	Heating	3009	Cooling	2000
Avg. Temp. (°F)	Winter	48	Summer	76
Avg. Insol. (Ly/d)	Winter	324	Summer	528

SOLAR ENERGY SYSTEM

Application Heating 69% Cooling 0% Hot Water 85%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 288

Manufacturer: Honeywell, Inc.

Storage

Type: Water tank

Capacity: 113 sq. ft.

Auxiliary System Type: Gas furnace with humidifier

PROJECT DESCRIPTION

Objective(s): To compare fixed and tiltable collectors and to demonstrate a carport installation.

PROJECT INFORMATION

Owner/Builder: Dept. of Defense/U.S. Air Force

Contractor: To be determined

Operational Date: April 1977

Total Estimated DOE Funds: To be determined

Building

Type: Single family attached.

Area: 1,534 sq. ft.

Location: Sheppard Air Force Base, Texas

Latitude: 34° N

Climatic Data

Degree Days	Heating	3009	Cooling	2000
Avg. Temp. (°F)	Winter	48	Summer	76
Avg. Insol. (Ly/d)	Winter	324	Summer	528

SOLAR ENERGY SYSTEM

Application Heating 63% Cooling 0% Hot Water 80%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 336

Manufacturer: Sunworks, Inc.

Storage

Type: Water tank

Capacity: 113 sq. ft.

Auxiliary System Type: Gas furnace with humidifier

PROJECT DESCRIPTION

Objective(s): To compare fixed and tiltable collectors and to demonstrate a carport installation.

PROJECT INFORMATION

Owner/Builder: Dept. of Defense/U.S. Air Force

Contractor: To be determined

Operational Date: April 1977

Total Estimated DOE Funds: To be determined

Building

Type: Single family attached

Area: 1,534 sq. ft.

Location: Sheppard Air Force Base, Texas

Latitude: 34° N

Climatic Data

Degree Days	Heating	3009	Cooling	2000
Avg. Temp. (°F)	Winter	48	Summer	76
Avg. Insol. (Ly/d)	Winter	324	Summer	528

SOLAR ENERGY SYSTEM

Application Heating 48% Cooling 0% Hot Water 75%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 227

Manufacturer: General Electric Company

Storage

Type: Water tank

Capacity: 113 sq. ft.

Auxiliary System Type: Gas furnace with humidifier

PROJECT DESCRIPTION

Objective(s): To compare fixed and tiltable collectors and to demonstrate a carport installation.

PROJECT INFORMATION

Owner/Builder: Dept. of Defense/U.S. Air Force

Contractor: To be determined

Operational Date: April 1977

Total Estimated DOE Funds: To be determined

Building

Type: Single family attached

Area: 1,534 sq. ft.

Location: Sheppard Air Force Base, Texas

Latitude: 34° N

Climatic Data

Degree Days	Heating	3009	Cooling	2000
Avg. Temp. (°F)	Winter	48	Summer	76
Avg. Insol. (Ly/d)	Winter	324	Summer	528

SOLAR ENERGY SYSTEM

Application Heating 59% Cooling 0% Hot Water 75%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 151

Manufacturer: General Electric Company

Storage

Type: Water tank

Capacity: 113 sq. ft.

Auxiliary System Type: Gas furnace with humidifier

PROJECT DESCRIPTION

Objective(s): To compare fixed and tiltable collectors and to demonstrate a carport installation.

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SECTION IV

RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS

RESIDENTIAL DEMONSTRATION PROGRAM

NON-FEDERAL BUILDINGS

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS

STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	NUMBER OF UNITS	SOLAR APPLICATION	SOLAR MANUFACTURER
ALABAMA	Huntsville	Chester West, Inc.	SFD	1	H HW	Daystar Corp.
	Madison	Housing Development Co.	SFA	5	HW	Energy Converters
	Mobile	Edsel, Inc.	SFD	1	H HW	Revere
ARIZONA	Pima Co.	Bobrick Construction Co.	SFD	1	H C	Sky Therm Processes & Engineering
	Prescott	Hulco Construction Co.	SFD	1	H	Site Built
	Yavapai	Ray L. Hasse	SFD	1	H HW	Site Built
CALIFORNIA	Bodega Bay	Sun House Des. & Environ. Des.	SFD	1	H HW	Site Built
	Cammarillo	Leisure Technology of Calif., Inc.	SFD	4	HW	Raypak, Inc.
	Davis	Michael N. Corbett	MF	10	HW	Sunburst
	Davis	John DeLapp Design & Const.	SFD	1	H HW	Sunburst
	Davis	Living Systems & Jonathan Hamond	SFD	1	H C HW	Sunburst
	Donner	Calif. Energy Res. Conserv. & Dev. Comm.	SFA	1	HW	Chamberlain Manufacturing Corp.
	Escondido	Ortiz & Reill Developers	SFD	12	H HW	Southwest Ener-Tech, Inc.
	Hemet	Blue Skies Radiant Homes	SFD	16	H HW	Revere
	Manchester	Mendocino Coast Properties	SFD	1	H HW	Sunlight & Power Co.
	Mission Viejo	Mission Viejo Co.	SFD	2	HW	Raypak, Inc.
	Mission Viejo	Mission Viejo Co.	SFD	3	HW	Solaray, Inc.
	Mission Viejo	Mission Viejo Co.	SFD	2	HW	Fred Rice Prod.
	Monterey	MAR-MAC Development, Inc.	SFD	2	H HW	Heliothermics
	Palo Alto	Colorado Park Housing Corp.	MF	60	HW	Western Energy
	Prairie Creek	Calif. Energy Res. Conserv. & Dev. Comm.	SFD	1	H HW	Chamberlain Manufacturing Corp.
	Ramona	San Diego Estates & Gas & Elec. Co.	SFD	1	H HW	Solaron Corp.
	San Bernadino	San Bernadino W. Side Comm. Dev. Co.	SFD	10	H HW	Solarcoa, Inc.
	San Diego	Calif. Energy Res. Conserv. & Dev. Comm.	SFD	1	HW	PPG Industries
	San Diego	Facilities Development Company	MF	31	HW	Revere
	Santa Clara	City of Santa Clara	SFD	5	H HW	Solar King
	Santa Monica	Calif. Energy Res. Conserv. & Dev. Comm.	SFD	1	HW	PPG Industries
	Santa Monica	L & S Operating Co.	MF	317	H HW	Daystar Corp.
	Santa Rosa	Montecito Pines - A Ltd. Partnership	MF	76	H HW	Sunburst
	Selma	Self-Help Enterprises	SFD	5	H C	Harold Hay
	Sonoma	Calif. Energy Res. Conserv. & Dev. Comm.	SFD	1	H HW	Chamberlain Manufacturing Corp.
	Trabuco Canyon	Creative Real Estate Develop., Inc.	SFD	2	H HW	Solargenics

KEY:

SFD - Single Family Detached

SFA - Single Family Attached

MF - Multifamily

H - Heating

C - Cooling

HW - Hot Water

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS (CONTINUED)

STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	NUMBER OF UNITS	SOLAR APPLICATION	SOLAR MANUFACTURER
COLORADO	Aurora	Gutrich Development Co., Inc.	SFD	1	H HW	Grumman/Sunstream
	Aurora	Mission Viejo Co.	SFD	2	H HW	Piper Hydro, Inc.
	Aurora	Mission Viejo Co.	SFD	4	H HW	Honeywell/Lennox
	Aurora	Mission Viejo Co.	SFD	1	H HW	Daystar Corp.
	Aurora	Perl-Mack Enterprises Co.	SFD	1	H C HW	Owens-Illinois/Lennox
	Boulder	Ervin J. Bell	SFD	1	H HW	Solaron Corp.
	Boulder	University of Colorado	MF	95	H HW	Lennox Industries
	Boulder	Douglas E. Myers	SFD	1	H HW	KTA Corp.
	Boulder	Robert C. Naumann	SFA	2	H HW	KTA Corp.
	Boulder	Stonebraker Investments	MF	8	H HW	KTA Corp.
	Boulder	Wonderland Hill Development Co.	SFA	35	H HW	Solaron Corp.
	Canon City	United Construction of Colorado	SFD	2	H HW	Solaron Corp.
	Colorado Springs	Colorado Springs Urban Renewal Eff.	MF	12	H C HW	Solaris
	Denver	Brothers Redevelopment, Inc.	SFD	2	HW	Homemade
	Denver	Denver Housing Authority	MF	8	HW	Miromit American Heliothermal
	Denver	Witkin Homes, Inc.	SFD	1	H HW	Grumman/Sunstream
	Evergreen	David L. Vickerman, Inc.	SFD	1	H HW	Solaron Corp.
	Fort Collins	ECO-ERA, Inc.	SFD	1	H HW	Solaron Corp.
	Fort Collins	Solar Engineering Constr. Co.	SFD	1	H HW	Reynolds Metals Co.
	Fort Collins	Sunland Realty, Inc.	SFD	1	H HW	Reynolds Metals Co.
	Ft. Lupton	Colo. Rural Hsg. Dev. Corp.	SFD	10	H HW	Miromit American Heliothermal
	Granada	Colo. Rural Hsg. Dev. Corp.	SFD	18	HW	Miromit American Heliothermal
	Granby	Grand County Fuel & Supply, Inc.	SFD	1	H HW	Rocky Mountain Products
	Longmont	Colorado Sunworks Partnership	SFD	1	H HW	Site Built
	Pueblo	City of Pueblo, Co.	SFD	5	H	Raypak, Inc.
	Silverthorne	JMC Co. & Charles Schiffer Assoc.	SFD	20	H HW	Solaron Corp.
	Silverthorne	JMC Co. & Charles Schiffer Assoc.	SFA	8	H HW	Solaron Corp.
	Westminster	Waverly Homes, Inc.	SFD	1	H	ISC/SUN Glow
	Westminster	Waverly Homes, Inc.	SFD	1	H HW	Solar Energy Products Co.
	Westminster	Waverly Homes, Inc.	SFD	1	H HW	Solaron Corp.
		Perl-Mack Enterprises Co., Inc. PMT	SFD	25	H HW	Miromit American Heliothermal

KEY:
SFD – Single Family Detached SFA – Single Family Attached MF – Multifamily H – Heating C – Cooling HW – Hot Water

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS (CONTINUED)

STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	NUMBER OF UNITS	SOLAR APPLICATION	SOLAR MANUFACTURER
CONNECTICUT	Cheshire	J. Capone Construction Co.	SFA	10	H HW	Sunworks, Inc.
	Hamden	Utility Electrical Contractors	MF	52	H HW	Sunworks, Inc.
	New Haven	Frank Chapman	MF	5	H HW	Solar Energy Struct. Inc.
	Tolland	The Madrid Corporation	SFD	1	H HW	Daystar Corp.
	Unionville	William Francini	SFD	1	H HW	Daystar Corp.
DELAWARE	Wilmington	Bestfield Builders	SFA	14	HW	Revere
DIST. OF COLUMBIA	Washington, D.C.	Forest City Dillon, Inc.	MF	188	HW	Lennox Industries
FLORIDA	Dade Co.	The Babcock Co.	SFD	1	HW	Capitol Solar Heat, Inc.
	Dade Co.	The Babcock Co.	SFA	1	HW	Capitol Solar Heat, Inc.
	Daytona Beach	Embry-Riddle Aeronautical Univ.	MF	186	HW	Gulf Thermal Corp.
	Gainesville	Matt D. Cannon	MF	4	H HW	Gulf Thermal Corp.
	Gainesville	Univ. of Florida, Hsg. Div.	MF	8	HW	Union Co.
	Gretna	Town Council, City of Gretna	SFD	16	H HW	General Electric
	Hialeah	Hialeah Housing Authority	SFD	25	HW	Solar Products, Inc./Sun Tank, Inc.
	Kissimmee	Kissimmee Court Apartments	MF	87	HW	Aztec Solar Co.
	St. Petersburg	City of Petersburg, Florida	MF	4	HW	Gulf Thermal Corp.
	Winter Springs	Florida Gas Co.	SFD	1	H C HW	Chamberlain Manufacturing Corp.
	Clarkston	F. E. Fortenberry & Sons, Inc.	SFD	6	H HW	Scientific-Atlanta, Inc.
	Dacula	Winford Lindsay	SFD	1	H HW	Revere
	Dalton	Dalton Housing Authority	SFD	12	HW	Solar Development, Inc.
	Decatur	Harbor Oaks Apartments	MF	40	H HW	Scientific-Atlanta, Inc.
	De Kalb Co.	Hooker/Barnes	SFD	1	H HW	Revere
GEORGIA	Lawrenceville	Fairview Bldrs/Winford Lindsay	SFD	3	H HW	Revere
	Macon	Kenilworth Manor, Inc.	MF	80	HW	Revere
	Marietta	Christopher David Assoc., Inc.	SFD	1	HW	Solaron Corp.
	Marietta	Christopher David Assoc., Inc.	SFD	1	HW	Daystar Corp.
	Marietta	Christopher David Assoc., Inc.	SFD	2	HW	Sunworks, Inc.
	Shenandoah	Glanton/Russel (Peachtrees Homes)	SFD	1	H HW	Revere
	Swainsboro	Unified Development, Inc.	SFD	3	H HW	Revere
	Ewa Beach	Finance Realty Company Ltd.	SFA	5	HW	Miromit American Heliothermal
	Honolulu	Diamond Head Alii Corp.	MF	54	HW	Raypak, Inc.
	Honolulu	Hei Wai Wong	MF	55	HW	Raypak, Inc.
	Kaneohe	A-Frame Industries	SFD	1	HW	Sunsource Pacific

KEY:

SFD – Single Family Detached

SFA – Single Family Attached

MF – Multifamily

H – Heating

C – Cooling

HW – Hot Water

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS (CONTINUED)

STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	NUMBER OF UNITS	SOLAR APPLICATION	SOLAR MANUFACTURER
HAWAII	Waipahu	Hawaii Housing Authority	MF	19	HW	Raypak, Inc.
IDAHO	Pocatello	Idaho State University	MF	160	HW	Sunworks, Inc.
	Pocatello	TAS Development & Construction	SFD	1	H HW	Piper Hydro, Inc.
	Rexburg	Cascade Construction Ltd.	SFD	1	H HW	Northrup, Inc.
ILLINOIS	Kingston	Sungate Construction Co.	SFD	2	H HW	Site Built
	Lake Forest	Robert M. Roloson Architect	SFD	1	H HW	Solaron Corp.
	Roselle	Foundation for the Handicapped	MF	22	H HW	Chamberlain Manufacturing Corp.
INDIANA	Vernon Hills	United Development Co.	SFA	4	H HW	Owens-Illinois, Inc.
	Batesville	Steinkamp and Company	SFD	1	H HW	Solar Energy Products Co.
	Fort Wayne	Graber Homes, Inc.	SFD	1	H HW	Solar Energy Products Co.
	Fountaintown	R&R Builders, Inc.	SFD	1	H HW	Solar Energy Products Co.
	Greenwood	Ron Smith Custom Builder, Inc.	SFD	1	H HW	Solar Energy Products Co.
	Indianapolis	Historic Landmarks Fdn. of Ind.	SFD	1	HW	Solar Energy Products Co.
	Liberty	Miles-Richmond, Inc.	SFD	1	H HW	Solar Energy Products Co.
	Muncie	Vernon O. Freeman	SFD	1	H HW	Solaron Corp.
	Newburgh	Trica Corporation	SFA	8	H HW	Sunworks, Inc.
	Peru	W. J. Leffel Construction	SFD	1	H HW	Solar Energy Products Co.
	Terre Haute	Stan Peebles & Company	SFD	1	H HW	Solar Energy Products Co.
	Western Greenwood	Moulder Corp.	SFD	1	H HW	Solar Energy Products Co.
IOWA	Glenwood	Glenwood Hsg., Inc.	MF	8	H HW	Miromit American Heliothermal
	West Des Moines	Spence-Urban & Associates	SFD	2	H HW	Solaron Corp.
KANSAS	DeSoto	Ed Thomas & Associates	SFD	2	H HW	Solaron Corp.
	Paola	Ed Thomas & Associates	SFD	2	H HW	Solaron Corp.
	Shawnee	John C. Byram	SFD	1	H HW	Solaron Corp.
	Stillwell	Du-Mac Investment Company	SFD	1	H HW	Solaron Corp.
KENTUCKY	Lexington	Philip Sims	SFA	2	H HW	Solaron Corp./Solar Devel., Inc.
	Lexington	Whitman & Associates, Inc.	SFD	1	H HW	Solaron Corp.
LOUISIANA	Baton Rouge	E. Baton Rouge Parish Hsg. Auth.	SFA	2	H C HW	Northrup, Inc.
MAINE	Harpwell	AIDCO Maine Corp.	SFD	1	H HW	Sunworks, Inc.
	Lewiston	Parkan Constr. Co.	MF	91	H HW	Sunworks, Inc.
	Perry	Pleasant Point Hsg. Authority	SFD	2	H HW	Sunworks, Inc.
	Perry	Pleasant Point Passamaquoddy Reserv.	SFD	1	H	Sunworks, Inc.

KEY:
SFD – Single Family Detached SFA – Single Family Attached MF – Multifamily H – Heating C – Cooling HW – Hot Water

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS (CONTINUED)

STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	NUMBER OF UNITS	SOLAR APPLICATION	SOLAR MANUFACTURER
MARYLAND	Baltimore	Centennial Dev. & Bldg. Corp.	SFA	15	H HW	Revere
	Columbia	J. D. Evans	SFD	4	H HW	Revere
	Damascus	Damascus Land Corporation	SFD	1	H HW	KTA Corp.
MASSACHUSETTS	Jarrettsville	Duerbeck Building Corporation	SFD	1	H HW	Revere
	Amherst	Plantation Valley Homes, Inc.	SFD	1	H HW	Solaron Corp.
	Brewster	Corcoran Mullins Jennison, Inc.	SFA	2	H HW	Daystar Corp.
	Cotuit	R. L. Seaberg Assoc.	SFA	1	H HW	Solaron Corp.
	Falmouth	Laura L. Baker	SFA	5	H HW	Daystar Corp.
	Gloucester	Gloucester Hsg. Authority	MF	97	HW	Daystar Corp.
	Greenfield	Greenfield Housing Authority	MF	16	HW	Sunworks, Inc.
	Marion	Indian Cove Associates	SFD	5	H HW	Daystar Corp.
	Marion	Town of Marion	SFD	12	H HW	Daystar Corp.
	Medway	Saddle Hill Trust	SFD	1	HW	Daystar Corp.
	Medway	Saddle Hill Trust	SFD	1	H HW	Daystar Corp.
	Medway	Saddle Hill Trust	SFD	1	HW	Solaron Corp.
	Monument Beach	Sandman Realty Co.	SFD	1	H HW	Fern Engineering Co., Inc.
	North Easton	Friends' Community Development	MF	69	H HW	Solaron Corp.
	Northampton	Exec. Office of Commun. & Devel.	SFD	1	H HW	Sunsav, Inc.
	Quincy	Hancock House Realty Trust	MF	92	HW	Daystar Corp.
	Raynham	Raynham Housing Authority	MF	62	HW	Daystar Corp.
	Saugus	John M. Corcoran & Co.	MF	24	HW	Daystar Corp.
	Springfield	Landgraf Associates, Inc.	SFD	2	H HW	Daystar Corp.
	West Springfield	Joseph Real Estate & Devel. Co.	SFD	1	H HW	Contemporary Systems, Inc.
	Worcester	Worcester Polytech Institute	MF	36	HW	Daystar Corp.
MICHIGAN	Battle Creek	Battle Creek Hsg. Commission	MF	150	HW	Sunworks, Inc.
	Benton Harbor	Sanford & Son Builders	SFD	1	H HW	Sun Stone
	East Lansing	Sam Eyde Const. Co.	SFD	1	H HW	Revere
	Flint	City of Flint/Dept. of Comm. Dev.	SFA	6	H C HW	General Electric Co.
	Kalamazoo	Willow Creek II Partnership	MF	71	HW	Lennox Industries
MINNESOTA	Bloomington	Marvin H. Anderson Constr. Co.	SFD	1	H HW	Honeywell/Lennox
	Eden Prairie	Houston Construction, Inc.	SFD	1	H HW	Solaron Corp.
	Hutchinson	Professional Builders, Inc.	SFD	1	H C	Solaron Corp.

KEY:

SFD — Single Family Detached

SFA — Single Family Attached

MF — Multifamily

H — Heating

C — Cooling

HW — Hot Water

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS (CONTINUED)

STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	NUMBER OF UNITS	SOLAR APPLICATION	SOLAR MANUFACTURER
MINNESOTA	Maple Grove	Gridley Construction, Inc.	SFD	1	H HW	Isle Engineering, Inc.
	Minneapolis	Creek Associates	MF	77	H HW	Lennox Industries
	Minnetonka	Hobmar Homes, Inc.	SFD	1	H HW	Honeywell/Lennox
	New Brighton	Gridley Construction Co.	SFD	1	H HW	Solaron Corp.
MISSOURI	Barnhart	Parkton Development Co.	SFD	1	H HW	Revere
	Gladstone	Bond Construction Co.	SFD	1	H HW	Miromit American Heliothermal
	Gladstone	Bond Construction Co.	SFD	1	H HW	Miromit American Heliothermal
	Gladstone	Bond Construction Co.	SFD	1	HW	Miromit American Heliothermal
	Richmond	Ed Thomas & Associates	SFD	1	H HW	Solaron Corp.
	St. Louis	Pantheon Corp.	MF	112	HW	Grumman/Sunstream
	Tomaro Oaks	Oscar P. Wren, Jr.	SFD	1	H HW	Sunworks, Inc.
						Revere
MONTANA	Bigfork	Design Construction Associates	SFD	1	H HW	Solar-Aire, Inc.
	Browning	The Blackfeet Tribe	SFD	5	H HW	Miromit American Heliothermal
	Cut Bank	Blackfeet Indian Tribe	MF	10	H HW	Solaron Corp.
	Harlem	Fort Belknap Indian Community	SFD	5	H HW	Solaron Corp.
	Kalispell	Sun Spec	SFD	1	H HW	Solaron Corp.
	Lame Deer	Northern Cheyenne Ind. Hsg. Auth.	SFD	5	H HW	Solaron Corp.
						Miromit American Heliothermal
NEBRASKA	Callaway	Callaway Housing Corporation	MF	8	H HW	Miromit American Heliothermal
	Lincoln	Peterson Construction Co.	SFD	1	H HW	Miromit American Heliothermal
	Plattsmouth	Quadro, Inc.	SFA	6	H HW	Miromit American Heliothermal
	Reno	Frontier Development Co.	SFD	5	H HW	Frontier Development Co.
NEVADA	East Derry	Fletcher Myers, Inc.	SFD	1	H HW	Fletcher Myers, Inc.
NEW HAMPSHIRE	Harrisville	Total Environmental Action, Inc.	SFD	1	H HW	Homemade
	Keene	Style Craft Homes, Inc.	SFD	1	H HW	Site Built/Sunworks, Inc.
	Nashua	First Fidelity Service Corp.	SFD	3	H HW	Acron Structures, Inc.
	New Ipswich	Barrett Mountain	SFD	2	H HW	Daystar Corp.
	North Conway	Forest Park Village, Inc.	MF	12	H C HW	Site Built
	North Conway	Kearsarge Building Co., Inc.	SFA	5	H HW	Daystar Corp.
	Blackwood	Korman Corp.	SFD	2	H HW	General Electric Co.
NEW JERSEY	Dover	Dover Housing Authority	MF	61	HW	Daystar Corp.
	Hoboken	Jefferson Adams Rehab. Co.	MF	172	HW	Sunworks, Inc.
	Newark	Ferry Street Group NJ Sch. of Arch.	MF	1	HW	Sunearth, Inc.

KEY:

SFD – Single Family Detached SFA – Single Family Attached MF – Multifamily H – Heating C – Cooling HW – Hot Water

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS (CONTINUED)

STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	NUMBER OF UNITS	SOLAR APPLICATION	SOLAR MANUFACTURER
NEW JERSEY	Newark	Housing Authority of the City of Newark	SFA	6	H HW	Sunworks, Inc.
	Old Bridge	Jespa Enterprises	SFD	1	H HW	Sunworks, Inc.
	S. Brunswick Twp.	Raritan Valley Comm. Dev. Fndn.	SFA	8	HW	State Industries
NEW MEXICO	Albuquerque	Albuquerque Western Solar Indus.	MF	101	H HW	Albuquerque Western Solar Ind.
	Albuquerque	Homes by Marilyn	SFA	2	H HW	Revere
	Albuquerque	Sandia Homes, Inc.	SFD	1	H HW	Solaron Corp.
	Santa Fe	Communico	SFD	1	H HW	Homemade
	Santa Fe	Public Svc. Co. of New Mexico	SFD	25	H HW	Solar Seven Industry, Inc.
	Santa Fe	Schepps Construction Co.	SFD	1	H HW	Northrup, Inc.
	Santa Fe	Stanley Associates	SFD	1	H HW	Solar Seven Industry, Inc.
	Santa Fe	Stanley Associates	SFD	1	H HW	Solaron Corp.
	Santa Fe	Wayne Nichols - Communico	SFD	1	H HW	Local Greenhouse
	Santa Teresa	Lambert & Winston, Inc.	SFD	20	H HW	Solaron Corp.
NEW YORK	Bedford	D.W.S. Holdings, Inc.	SFA	6	H HW	KTA Corp.
	Bronx	Peoples Development Corp.	MF	28	HW	Sun Harvester Corp.
	Brooklyn	Sunset Park Redev. Committee, Inc.	MF	4	HW	Sunworks, Inc.
	Chester	Suntech Homes, Inc.	SFD	1	H HW	Solar Shelter
	Forest Hills	Lefrak Organization, Inc.	MF	207	HW	Sunworks, Inc.
	Hamburg	Innovative Building Systems, Inc.	SFD	1	H HW	PPG Industries
	La Grangeville	Solar Structures, Inc.	SFD	1	H HW	Revere
	Long Island	Pinewood Manor, Inc.	SFD	1	H	Sunenergy Power Ltd.
	Malta	Stewart-Teele-Mitchell Const.	SFD	1	H HW	Lennox Industries
	New York	Bedford Stuyvesant Restor. Corp.	MF	10	HW	Grumman/Energy Systems, Inc.
	New York	Lefrak Organization, Inc.	MF	96	HW	Sunworks, Inc.
	New York	Mountbatten Equities	MF	188	HW	Grumman/Energy Systems, Inc.
	New York	South Bronx Community Hsg. Corp.	MF	4	HW	Sunworks, Inc.
	New York	South Bronx Community Hsg. Corp.	MF	4	H HW	Sunworks, Inc.
	New York	924 West End Ave., Inc.	MF	68	HW	Daystar Corp.
	Pomona	Pomona Heights, Inc.	SFD	1	H HW	KTA Corp.
NORTH CAROLINA	Columbus	Morgan Chapel Enterprises	SFD	2	H HW	Helio Thermics, Inc.
	Durham	Durham Housing Authority	MF	18	H C HW	Owens-Illinois, Inc.
	Fayetteville	L&O Investments, Inc.	SFD	1	H HW	Solaron Corp.

KEY:

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MF - Multifamily

H - Heating

C - Cooling

HW - Hot Water

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS (CONTINUED)

STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	NUMBER OF UNITS	SOLAR APPLICATION	SOLAR MANUFACTURER
NORTH CAROLINA	Pinehurst	Page Associates, Inc.	SFD	1	H HW	Helio Thermics, Inc.
	Pineville	Habitat 2000, Inc.	SFD	1	H HW	Revere
	Pittsboro	Beatrice Mongeau	SFA	3	H HW	Revere
	Winston-Salem	GLS Construction Co.	SFD	5	HW	Energy Converters
NORTH DAKOTA	Grand Forks	Liberty Estates Developers	SFA	12	H HW	Solaron Corp.
OHIO	Bryant & Others	Homes by Stan-Jim, Inc.	SFD	4	H HW	Solar Energy Products Co.
	Canton	Alpha Construction Co.	SFD	4	H HW	Solar Energy Products Co.
	Columbus	D. C. Winslow Construction Co.	SFD	1	HW	Sunworks, Inc.
	Columbus	Davidson-Phillips, Inc.	SFD	1	HW	Raypak, Inc.
	Columbus	Davidson-Phillips, Inc.	SFD	2	H C HW	General Electric Co.
	Columbus	Davidson-Phillips, Inc.	SFD	1	H HW	Sun Stone
	Fairfield	Universal Home Builders	SFD	2	H HW	Sunworks, Inc.
	Findlay	Boyle & Schey Builders	SFD	5	H HW	Solaron Corp.
	Loveland	Lucke & Strassel Builders	SFD	1	H HW	Revere
	Marietta	Sims Brothers Builders, Inc.	SFD	3	H HW	Solaron Corp.
	Piqua	First Piqua Corporation	SFD	1	H HW	Revere
	Poland Twnshp.	Volpini & Sorice Builders	SFD	1	H HW	Solar Energy Products Co.
	Troy	Caprice Builders, Inc.	SFA	1	H HW	Revere
OKLAHOMA	Norman	Moore-Norman Vo-Tech. Fndn., Inc.	SFD	1	H HW	Sunworks, Inc.
	Okmulgee	Creek National Hsg. Authority	SFD	5	H HW	Raypak, Inc.
	Tulsa	Connors Construction Co., Inc.	SFD	3	H HW	Solaron Corp.
OREGON	Ashland	Larry Barr & Lance Pugh - Partners	SFD	1	H HW	Reynolds Metals Co.
	Ashland	Vincent L. Oredson	SFD	1	H HW	Sunwater Co.
	Coos Bay	Twin City Builders, Inc.	SFD	1	H HW	Revere
	Stayton	Landura Corporation	SFD	2	H HW	Sunworks, Inc.
PENNSYLVANIA	Bryn Mawr	William Felton, Inc.	SFD	1	H HW	Solaron Corp.
	Havertown	Hollow Run Associates	MF	30	HW	Heliotherm
	Mechanicsburg	United Methodist Homes for Aging	MF	150	HW	Lennox Industries
	Milford Township	Regent Valley Builders, Inc.	SFD	1	H HW	Daystar Corp.
	N. Franklin Twp.	Walnut Ridge, Inc.	SFD	1	H HW	Kalwall Corp.
	Northampton Twp.	Gigliotti Corp.	SFD	1	H HW	Daystar Corp.
	Penn Valley	William Felton, Inc.	SFD	1	H HW	Solaron Corp.

KEY:

SFD - Single Family Detached

SFA - Single Family Attached

MF - Multifamily

H - Heating

C - Cooling

HW - Hot Water

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS (CONTINUED)

STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	NUMBER OF UNITS	SOLAR APPLICATION	SOLAR MANUFACTURER
PENNSYLVANIA	Philadelphia	Drexel University	MF	5	HW	PPG Industries
	Philadelphia	The Fumo, Manfredi Partnership	MF	9	HW	Sunearth, Inc.
	Philadelphia	University of Pennsylvania	SFA	1	H HW	PPH & Intl. Environ. Corp.
	Pittsburgh	Contemporary Import & Export Co.	SFA	4	H HW	Daystar Corp.
	Towamencin Twp.	Regent Valley Builders, Inc.	SFD	1	H HW	Daystar Corp.
	West Grove	Christopher Shipp Productions	SFD	1	H HW	Revere
PUERTO RICO	Rio Piedros	Puerto Rico Urban Renewal & Hsg. Corp.	MF	12	HW	Solar Devices, Inc.
RHODE ISLAND	Jamestown	M. F. Smith Associates	SFD	1	H HW	Solar Homes, Inc.
	Newport	Church-Community Corp.	SFD	1	H HW	Homemade
SOUTH CAROLINA	Columbia	Cambridge Development Group, Inc.	SFD	4	H HW	Olin Brass
	Greenville	Batesville Property Assoc. II	SFD	3	H HW	Gulf Thermal Corp.
	Greenville	Helio Thermics, Inc.	SFD	6	H HW	Helio Thermics, Inc.
	Greenville	Helio Thermics, Inc.	SFD	1	H C HW	Helio Thermics, Inc.
	Hilton Head Isl.	Solar Development Associates	SFD	2	H HW	Sunworks, Inc.
	St. Matthews	Phillips Kauric Adams & Branham	SFA	12	H HW	Revere
	Summerville	Everett A. Knight Agency	SFD	1	H HW	Solaron Corp.
	Summerville	Everett A. Knight Agency	SFD	1	HW	Solaron Corp.
SOUTH DAKOTA	Rapid City	Harney Lumber Company	SFA	9	H HW	Miromit American Heliothermal
	Sioux Falls	Environmental Contact, Inc.	SFA	4	H HW	National Energy Corp.
TENNESSEE	Memphis	Acropolis Joint Venture	SFD	1	H HW	Solaron Corp.
	Memphis	Rainey Bros. Construction Co., Inc.	SFD	1	H HW	Solaron Corp.
TEXAS	Austin	Carl Morris Custom Builder	SFD	1	H HW	Cole Solar Systems, Inc.
	Austin	College Houses	MF	80	H C HW	Northrup, Inc.
	Austin	University of Texas/Austin	MF	12	H C HW	Northrup, Inc.
	Carrollton	Brad Popkin, Inc.	SFD	1	H HW	Northrup, Inc.
	Corsicana	Navarro College	MF	25	HW	Northrup, Inc.
	Dallas	W. Brown Custom Builders	SFD	2	H HW	Sun Source
	Lago Vista	Starr Homes	SFA	3	HW	Solargenics
	Lubbock	Gordon Deering	SFD	1	H C HW	Owens-Illinois, Inc.
	Lubbock	Gordon Deering, Jr.	SFD	1	H HW	Solaron Corp.
	San Antonio	Housing Authority San Antonio	MF	100	HW	Sunworks, Inc.
	San Antonio	San Antonio Ranch, Ltd.	SFD	3	H C HW	Honeywell/Lennox

KEY:

SFD - Single Family Detached

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MF - Multifamily

H - Heating

C - Cooling

HW - Hot Water

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS (CONTINUED)

STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	NUMBER OF UNITS	SOLAR APPLICATION	SOLAR MANUFACTURER
UTAH	Granger	IPK Corporation	SFD	3	H	Griep Heating
	Logan	Villatek	SFD	1	H HW	Solaron Corp.
	Salt Lake City	Tios Corporation	SFD	1	H HW	Lennox Industries
	Stansbury Park	Terracor, Utah	SFD	1	H	Solaron Corp.
VERMONT	Brookline	Grassy Brook Village, Inc.	SFA	10	H HW	Sunworks, Inc.
	Burlington	Cathedral Square Corporation	MF	100	HW	Daystar Corp.
	Waitsfield	Greenmoss Builders, Inc.	SFD	1	H HW	Sunearth, Inc.
VIRGINIA	Berryville	Ritter Buildings, Inc.	SFD	1	H C HW	Sunworks, Inc.
	Dumfries	J&J Construction, Inc.	SFA	1	H	Sunworks, Inc.
	Fairfax Co.	Strawbridge Square Assoc.	SFA	12	H HW	Solaron Corp.
	Falls Church	Barcroft Hills Council-Co-Owners	MF	140	HW	Central Boilers, Ltd.
	Lynchburg	Solar Structures	SFD	1	H HW	Sunworks, Inc.
	Vienna	The Yeonas Company	SFD	1	HW	Sunworks, Inc.
	Virginia Beach	Sir Galahad Co.	SFD	1	H HW	Revere
	Williamsburg	S. M. Nichols Builder, Inc.	SFD	1	H HW	Solaron Corp.
	Seattle	Washington Natural Gas Co.	SFD	1	H HW	Solaron Corp.
	Clarksburg	City of Clarksburg	MF	21	HW	InterTechnology Corp./Solar Corp.
WASHINGTON	Inwood	Middle Creek Investment Corp.	SFD	6	H HW	Lennox Industries
WEST VIRGINIA	Baraboo	J. A. Verthein Construction Co.	SFD	1	H HW	Sun Stone
	Eldorado	Robert J. Zimmerman	SFD	1	H HW	Sun Stone
WISCONSIN	Sheboygan	Theodore A. Kuck	SFD	1	H HW	Sunstone Solar Energy Equipment
	Milwaukee	University of Wisconsin-Milwaukee	SFD	1	H HW	Solaron Corp.
	Milwaukee	Zien Mechanical Contractors	SFD	1	H HW	Solaray, State Ind.
	Osceola	Nelson-Lewis Construction Co.	SFD	1	H HW	Solaron Corp.
	Racine	Lincoln Lutheran Racine Wisc., Inc.	MF	50	HW	Revere
	Rice Lake	William C. Burdick	SFD	1	H HW	Sunworks, Inc.
	Summit Meadows	Friedman, Rosen, Zien	SFD	1	H HW	Zien Mechanical Contractor
	Winneconne	Family Homes United, Inc.	SFD	5	H HW	Sun Stone

KEY:

SFD — Single Family Detached SFA — Single Family Attached MF — Multifamily H — Heating C — Cooling HW — Hot Water