A completely site-built solar-heated home design which can supply up to 75% of its own heat almost anywhere in the United States has been designed, built, tested and released by USDA's Rural Housing Research Unit. The house design incorporates a built-in solar collector system in the attic, thus eliminating the need for expensive and complicated factory-built solar collector units. The attic solar collector system can be readily adapted to nearly any house size or floor plan.

The prototype home, for which detailed construction plans are available at a cost of seven dollars ($7.00), is a 1,100-square foot, three-bedroom, one-bath ranch-style wood frame structure. It is conventional in all respects except for the heat-collecting attic, a crushed rock heat sink in the crawl space and use of 2 x 6 stud wall construction. The solar heat collector can be built on front or back roof of house but must face south for maximum sun exposure.

Solar heat is transferred through two layers of reinforced (greenhouse quality) fiberglass plastic paneling into the specially designed and shaped attic, which is painted black on the interior for maximum heat absorption. A system of air ducts and blowers transfers the trapped solar-heated air from the attic to the living area for heating, or to the crushed rock heat sink for storage and later use at night or on cloudy days. The 600 to 800 cubic feet of heated railroad ballast rock can store a three-day supply of reserve heat. Auxiliary or back-up heat is supplied by a conventional electric resistance hot air furnace or heat pump unit in the air distribution system. The back-up unit, which is sized to satisfy local conditions, operates only when no heat is available from the solar-heated attic or rock bed heat sink.

Solar energy can also be utilized for summer attic ventilation and water heating. By opening the ridge and eave vents, air circulates through the attic. As it exhausts through the ridge vent, cooler outside air is drawn into the lower plenum through the open eave vents. This cooler air will keep attic temperatures 20 to 40°F cooler than conventional attics. The rock bed beneath the house is also used to cool the house during hot summer days—rocks are cooled at night and air is circulated through the cooled rock bed during the heat of day to lower living area temperature.

Performance data indicate the system is economically feasible in areas having heating energy costs of about 3-1/2 cents per KWH for electric resistance heating (5 to 8 cents per KWH for heat pump), 50 to 70 cents per therm for gas, 70 to 90 cents per gallon for fuel oil, or 45 to 60 cents per gallon (or 10 to 15 cents per pound) for LP gas. With present-day interest in solar energy for space heating and domestic water heating, many families will want to explore the possible applications of this concept to their present or planned home.
End view of house showing collector slope and depth for solar zone 1. Most efficient collector slope angle approximates latitude plus 15, i.e., 40° latitude uses 40°+15 or 55° slope from horizontal. Collector length, depth and slope are varied according to zone.

Air flow distribution system is designed to provide six operating modes as shown at right. The two-speed blower in attic and furnace blower above ceiling—each powered by a permanent-split capacitor motor—and motorized dampers or shutters are sequenced and operated with a special solid-state electronic controller unit. The lower attic serves as a plenum to distribute return air along length of attic and a slot meters air into upper attic space along collector plate.

heating: attic to house
cooling: outside air to house (optional)

heating: furnace to house
cooling: storage to house

heating: attic to storage
cooling: outside air to storage (optional)
Length of eave overhang (dimension "Y") for best solar control depends on roof pitch and roof position relative to ceiling line. To determine proper overhang for southern exposure windows, sketch to scale as follows:

1. Floor line, wall with window and ceiling line
2. Measure and mark sill height from floor
3. Pick latitude and sill height column on chart for specific situation
4. Select measurement "x" from chart (use boldface when designing primarily for solar heat gain during cold months; use lightface when designing primarily for solar shade to reduce air conditioning load)
5. Draw line "x" from outside wall/ceiling intersection
6. Draw solar line from outer end of "x" to sill (as a check, use solar angle from chart—it should intersect sill)
7. Sketch eave (rafter or upper truss chord extension) position and slope to intersect solar line
8. Measure eave overhang "Y."

Properly-designed roof overhangs or eaves are needed to effectively shade south windows during warm summer months, but allow solar heat to enter house during winter months. The amount of overhang varies with latitude, height of window sill and position of eave tip relative to ceiling line, as dictated by roof pitch and eave length. The design shown uses the elevated or square-end truss which provides ample room to place insulation out over stud wall plate. The removable outrigger may have a solid surface or louvers slanted to provide shade on windows. The outrigger can also be made with aluminum or thin board framing and louvers and hinged at outer eave—extended out during summer and folded back against soffit or under eave during winter.

<table>
<thead>
<tr>
<th>Latitude</th>
<th>48°</th>
<th>44°</th>
<th>40°</th>
<th>36°</th>
<th>32°</th>
<th>28°</th>
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</thead>
<tbody>
<tr>
<td>Neon Solar Angle Apr 11 &amp; Aug 31</td>
<td>58°</td>
<td>54°</td>
<td>50°</td>
<td>56°</td>
<td>62°</td>
<td>68°</td>
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<tr>
<td>Sill Height Distance &quot;x&quot; (Inches)</td>
<td>48 inches</td>
<td>34 48 29 40 24 34 20 29 13 24 12 20</td>
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<td></td>
<td></td>
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<tr>
<td>42 inches</td>
<td>39 54 34 48 28 39 23 34 18 28 14 22</td>
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<tr>
<td>36 inches</td>
<td>44 61 36 52 32 44 28 38 21 32 16 20</td>
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<tr>
<td>32 inches</td>
<td>47 66 41 56 35 47 29 41 23 35 17 25</td>
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<tr>
<td>30 inches</td>
<td>49 67 43 58 36 49 30 43 24 36 19 28</td>
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<tr>
<td>24 inches</td>
<td>54 74 47 64 40 54 33 47 26 40 21 29</td>
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<tr>
<td>18 inches</td>
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<tr>
<td>12 inches</td>
<td>64 87 56 76 40 64 39 56 32 48 25 28</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Note: Above chart applicable to finished ceiling heights ranging from 7'-9" to 8'-1".

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sets #7220 at $7. Enclosed find $... Name

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State Zip

Plan set #7220 (seven sheets) contains working drawings, construction details and insulation/vapor barrier installation instructions for solar home shown in this leaflet. Plans should be checked and approved by local housing and/or building code enforcement agencies before beginning construction.

This brochure prepared by Hugh J. Hanlon, Extension Agricultural Engineer and Manager of WRAES. Material based on USDA Solar House Plan #720 and American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbook data.