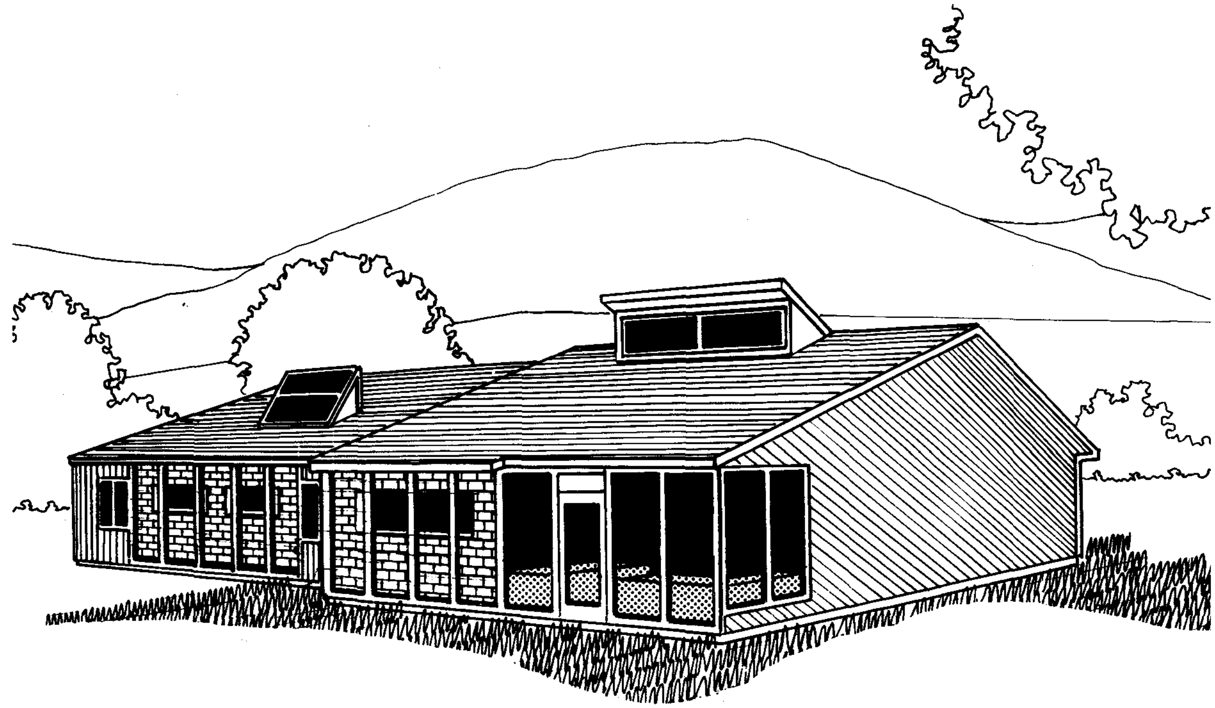
Carbondale, CO



Builder: West Sopris Creek Builders

Designer: Sunshine Design, Carbondale, CO

Solar Designer: Sunshine Design

Price: $97,500

Net Heated Area: 1646 ft²

Heat Load: 48.0 x 10^6 BTU / yr

Degree Days: 7339

Solar Fraction: 56%

Auxiliary Heat: 1.69 BTU / DD / ft²

Passive Heating System(s): Direct gain, indirect gain (Trombe wall), isolated gain

Recognition Factors: Collector(s): South-facing glazing, greenhouse glazing, skylight, 348 ft² **Absorber(s):** Concrete floor slab, Trombe wall surface **Storage:** Concrete floor slab, concrete Trombe wall, mass hearth—**capacity:** 12,870 BTU / °F **Distribution:** Radiation, natural and forced convection **Controls:** Trombe wall shade, insulated shutters and curtains, vents, roll-down shades

Active Solar Heating: See DHW

Back-up: Electric resistance heater (32,000 BTU / H), woodburning stove

Domestic Hot Water: 46 ft² flat-plate collectors, 82-gallon storage

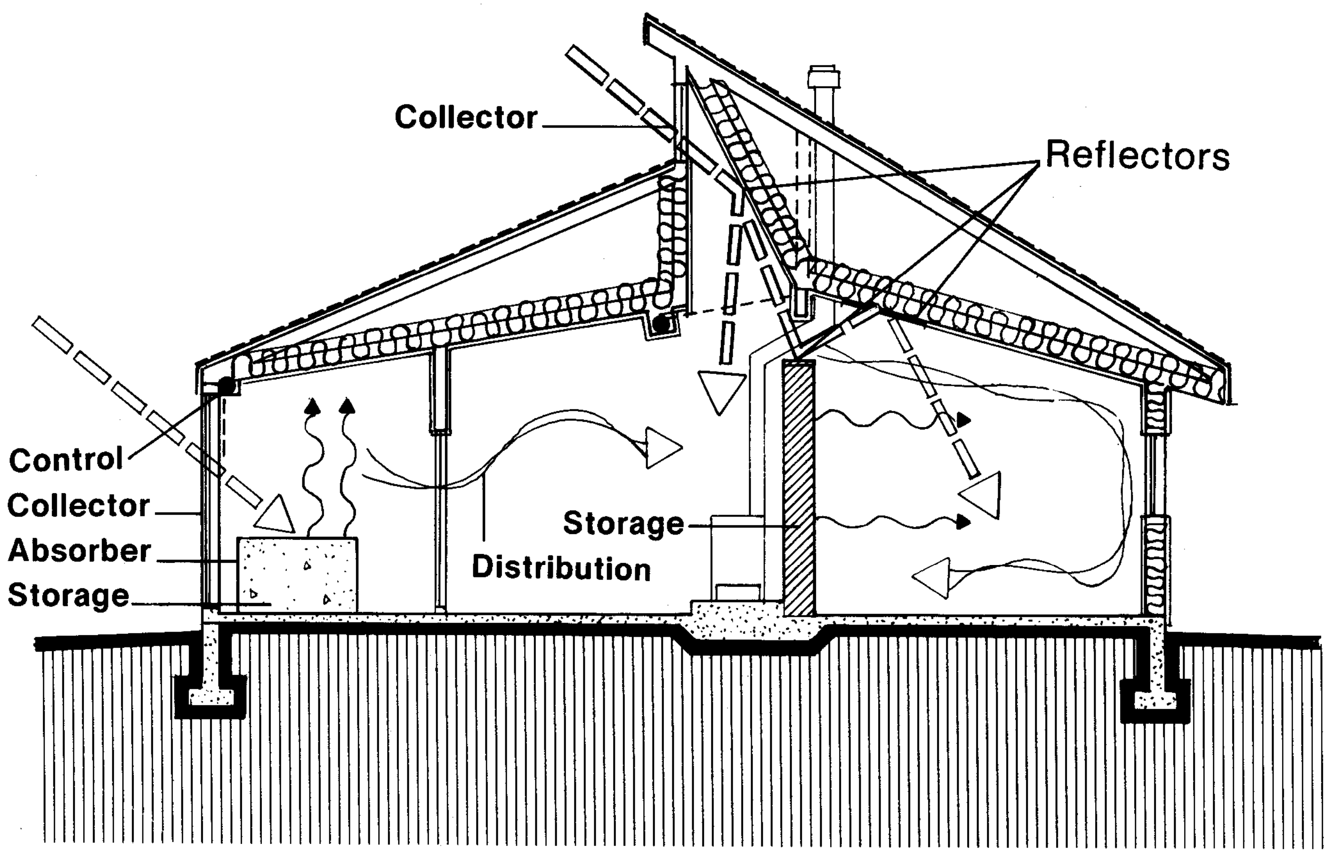
A majestic view of mountain peaks to the south is a by-product of the passive solar design for this contemporary single-level home in Carbondale, Colorado. This area is experiencing a boom in its coal-mining industry, and the home is designed and priced for the typical buyer, a miner with a wife and two children. The gable roof design with attached garage is similar to the other conventional homes in the development. The extensive south-facing glass required for solar **collection** in this house is, because of the mountain view, a feature of many other local homes.

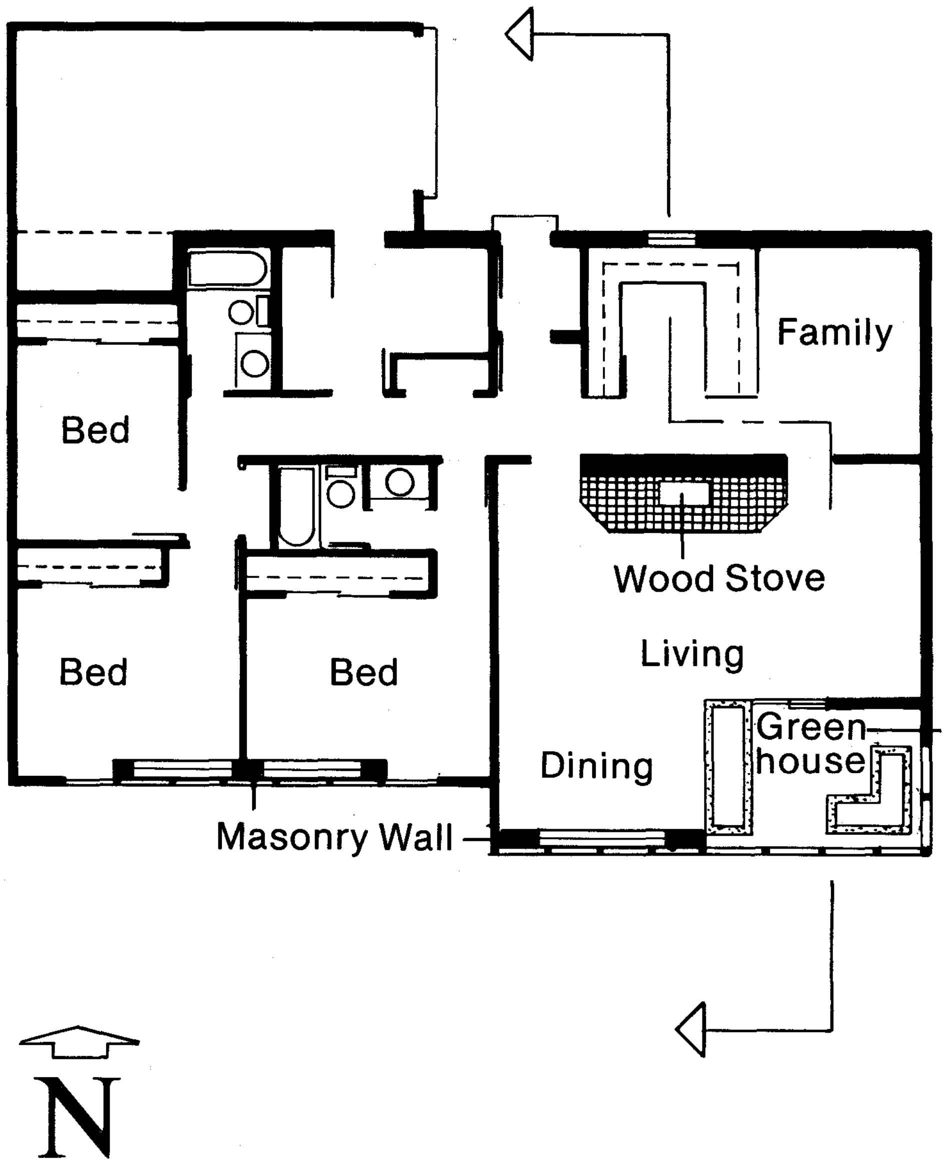
Energy-conservation features are emphasized for this cold winter climate. Insulation in the north and other walls has R-values of 35 and 25, respectively. The R-value of ceiling insulation is 39. All windows are wood frame with insulating glass, and all have moveable insulating shutters, quilted curtains, or reflective shades. The main entry is through an unheated air-lock vestibule, and other entries are through buffer areas. The attached garage is located on the northwest as protection from prevailing winter winds. Inside, the living areas have been placed in the sunny south part of the house and support areas are located along the north wall. This design also includes an enclosed interior greenhouse for heat collection in the 'southeast corner, and a "sunscoopTM" skylight above the central masonry wall and hearth.

Four different passive solar heating systems are simply and efficiently combined in this house. In the winter heating mode, 12inch concrete block Trombe walls in the bedrooms and dining room **absorb** and **store** heat collected through south-facing glazing during the day. These walls are painted dark brown on the glazing side and are finished with stucco on the living side. Floor and ceiling vents in the walls permit convective circulation to **distribute** solar-heated air from the walls to the rooms. Also, heat stored in the Trombe walls is later re-radiated into the interior. In the evening when external temperatures drop, multilayer insulating curtains are automatically closed on the glazed side of the Trombe walls to **control** heat loss; they will open again automatically in the morning. These Insulating Curtain Walls™ are activated by a **control** system that has outdoor temperature and photocell sensors, and includes manual overrides. The **control** mode setting is changed twice a year, once at the beginning of the summer, and again at the beginning of winter. All other windows are equipped with insulating shutters or roll down shades that are manually operated.

In the greenhouse, aluminized Myiar™ shades on the living side of exterior glazing are opened each morning to permit solar **collection.** Heat is absorbed and **stored** in the 4-inch thick mass concrete floor and in mass planters, all of which are painted or stained dark brown. Opening the sliding glass doors and windows communicating with central living spaces allows circulation for **distribution** of solar-heated air from the greenhouse. At night, interior greenhouse doors and windows are closed, isolating this space from the rest of the house; the reflective roller shades, which have tight-fitting side tracks, are manually closed, which adds substantially to the insulating value of the exterior glazing, and the **control** of heat loss.

A third passive system combines a "sunscoop ™" skylight collector and a central concrete mass wall and hearth. The sunscoop is created by cantilevering part of the north roof out over the south roof peak, and glazing from the top of the cantilever





down to the roof. This design produces a tilt angle that is optimum for winter heat **collection.** Inside the house, a reflective surface is constructed behind the glazing by extending plywood from the roof peak down to the ceiling level, and facing the plywood with mirrors. Sunlight passing through the skylight strikes the mirrored surface and is reflected onto the masonry wall and hearth directly below, where it is **absorbed** and **stored** as heat. The top surface of the wall is also faced with mirrors, and further reflects incoming light onto the kitchen ceiling. Heat stored in the wall and hearth during the day is later re-radiated for **distribution** into the kitchen and dining rooms. At night, an insulating window quilt is automatically drawn across the aperture beneath the sunscoop at ceiling level. Controls for this automatic shade are identical to those used for the Trombe wall insulating curtains.

In the fourth passive system, sunlight that is **collected** through exterior glazing and Trombe wall windows strikes bedroom and dining room floors directly. But because the bedroom floors are carpeted, they have less storage capacity. The dining room floor is a dark brown, 4-inch concrete slab that **absorbs** and **stores** solar heat for later release. **Control** of these passive heating elements is achieved by automatic closure of Trombe wall insulating curtains during winter nights and summer days.

Distribution of solar and back-up heat in winter is assisted by through-wall fans that draw warm air from the living space to the sleeping space.

In the summer, the interior greenhouse door and windows are closed during the day and the reflective greenhouse shades are left down. These shades will transmit about 20 percent of the incident light, so this space will not be unpleasantly dark. Venting the greenhouse is partially accomplished by opening the exterior door. An exhaust fan also contributes to ventilation; it is controlled by a cooling thermostat and does not require owner operations.

Opening all moveable insulation and windows throughout the house at night induces natural cross-ventilation and permits stored heat to be exhausted. Ridge and soffit vents cool the attic, and a turbine roof exhaust vent enhances natural summer ventilation. In the winter, an insulated cover is placed over the turbine inlet.

This design includes an active solar water heating system that has two flat-plate collection panels mounted on the roof. The system uses a propylene glycol solution as the heat transfer medium and a double walled heat exchanger. It is expected to provide an average of 43 percent of the domestic hot water needs for a family of four persons.

This plan is from the book
"Passive Solar Homes – 91 new award-winning, energy-conserving single-family homes",
The U.S. Department of Housing and Urban Development, **1982**

The solar homes designs in this book were the winners of HUD's fifth (and final) cycle of demonstration solar homes. The 91 winning home plans in the book were selected from 550 applications from builders.

This was a time of great interest and activity in the passive solar home designs – many of the winning homes show a level of innovation not found in most of today's passive solar designs.