COLORADO FLOWER GROWERS ASSOCIATION

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SOLAR HEATED GREENHOUSE/RESIDENCE STRUCTURE

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Greenhouses are faced with a long-range problem of developing alternate energy sources which will meet their needs for energy. Solar energy is widely available, abundant and non-polluting. Its disadvantages are variability, diffuse qualities and requirements for storage. Solar energy conversion technologies are available and are presently in an expanding phase of research and development.

A combined solar heated greenhouse/residence structure was constructed last fall by the Solar Energy Applications Laboratory at Colorado State University. (Fig. 1) Combining these spaces allowed us to observe their compatability as well as system performance. The residence will eventually serve as a visitor reception center and research area. As noted in Fig. 1, the greenhouse abuts the south side of the residence, the two sharing a common wall with solar collectors on the residence's roof above the greenhouse. Both residence and greenhouse contain 640 sq. ft. of floor area, and are designed to be heat conserving. The residence meets standards insulation requirements. R11 insulation is in the walls, and R19 in the ceiling. All windows are wood frame, double glazed. Heat conserving construction in the greenhouse include double pane, sealed glass roof units, double wall, Tedlar© coated fiberglass and sidewalls and foundation insulation extending three feet into the ground.

Flat plate, air collectors were fitted to utilize the greenhouse as a preheater. When collectors are sufficiently warm, thermostats start the collector blower. Air passes through the greenhouse to gain surplus heat during sunny days before entering the 507 sq. ft. solar collector on the roof of the house. The heated air is passed through 384 cu. ft. of rock storage before returning to the greenhouse. During hot weather, heat collection is discontinued when evaporative cooling begins in the greenhouse. Collectors are then vented to the outside, and residence and greenhouse

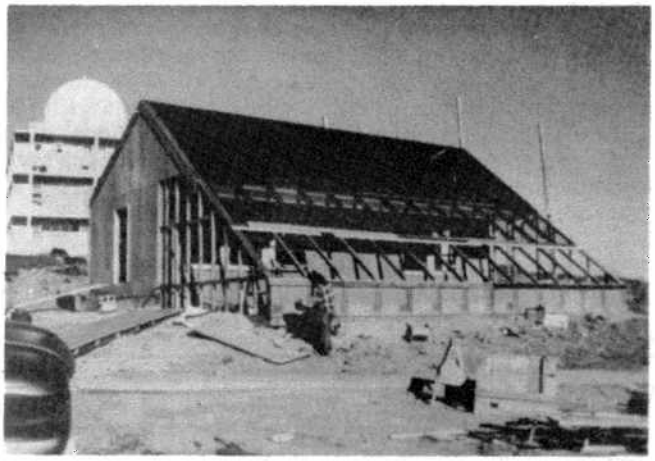

Fig. 1: Combined greenhouse/residence heated by solar energy at the Solar Energy Applications Laboratory, Colorado State University.

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operate independently. When stored heat is insufficient, natural gas is used as a back-up system. Fig. 2 shows a schematic. Operation was started December, 1976. Records show that solar energy has supplied more than 80% of the space heating requirements.

Crops are grown in 425 sq. ft. of drip irrigated, gravel beds. Cool crop vegetables such as cauliflower, broccoli, lettuce and radishes were raised at 52°F nights during the winter. Warmer crops, such as tomatoes, melons, cucumbers and peppers are being tested during the summer.

The principal factor limiting application of solar energy is competitiveness with existing fuel and conventional systems. Before solar energy can be applied to commercial greenhouses, present energy consumption must be reduced by more than half through rigorous conservation measures. Engineering design, and lowered costs for collectors and storage systems must be investigated for the particular climatic area. Colorado has the advantage of high sunlight and many clear days. Although subject to large temperature extremes, it may be possible that our high light could off-set the low temperatures.

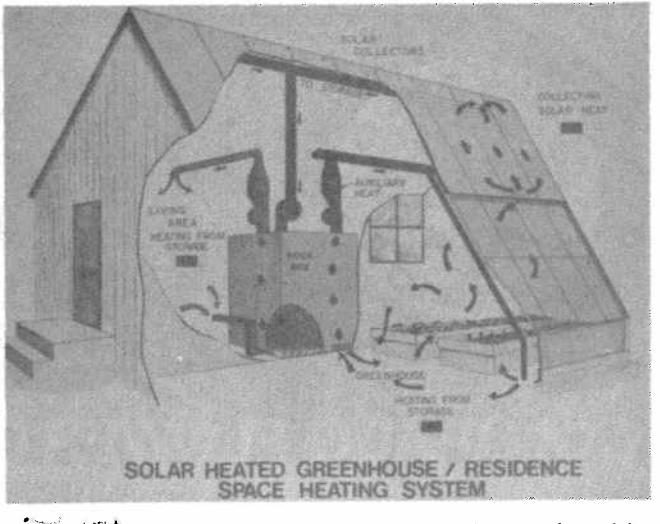

Fig. 2: Schematic diagram of heating system for greenhouse/residence. Solar collectors cover 507 sq. ft., rock storage contains 384 cu. ft., consisting of ½ to 1-inch diameter rock. Controls operate residence and greenhouse separately, each with its own gas, back-up heater.