

SMALL, MULTI-PURPOSE CONCENTRATING SOLAR ENERGY SYSTEMS

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Abstract. Small (4 to 50 kW) concentrating solar energy systems suitable for use and production in developing countries are discussed. The design of a system to provide heat at temperatures around 400 °C is treated in some detail. It has a reflector covered with mirror tiles or curved mirror strips on a paraboloidal backing, which concentrates the radiation by a factor of the order of 100. The radiation is absorbed in a fibre mat receiver, and the resulting heat transferred to a rock bed storage by a once through air current. A cool surface and a restricted solid angle reduce the radiative heat loss from the receiver. The system construction is compact; the air exit tube may carry the whole collector. The modest fan power, the net value is of the order of 0.1 W/kW, could be provided by sun facing solar cells on the top of the receiver with a control circuit to give constant temperature. The fan is placed at the air exit, the slight under-pressure restrict heat loss by leakage. The rock heat storage may have overnight capacity or capacity for several days. Heat loss problems are discussed in some detail.

The system is in first place intended for use in locations out of reach of the public electricity grid to provide heat for food preparation, for cooling by absorption processes and sterilisation for health institutions. Heating and/or pasteurisation of water as “by-products” will give the system high energy efficiency. The ability to replace electricity makes the system potentially interesting for the whole sun-belt region. The system may serve homes, farms, schools and other institutions, villages as well as local industry. Motoring and control parts can be made from standard components; the remaining system can be constructed from readily available materials with simple technology. Solar tracking may be based on a Grandfather clock system powered by a weight lifted every day or so. Manual adjustment to changes of declination and control of system position should be done at the same time. The cost of the materials needed is low. But the production technology needs to be developed. Production in developing countries, where wages are low, or large volume automated production, should bring prices down to an acceptable level. The potential market is enormous.