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SOLAR ENERGY FOR RESIDENTIAL USE

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The local capture and conversion of sunshine for use on residences (and other low-rise buildings) is one of the large potential areas of application of solar energy. The major driving force for massive solar energy utilization will be economic, with expected prices of other available energy sources setting the basis which must be surpassed by a solar configuration. This defines cost, performance and reliability objectives for a solar energy system if it is to be competitive.

It is probable that a residence of the late 1980's will utilize both thermal and photovoltaic direct conversion of sunlight. Thermal conversion, because of its higher efficiency, may be used for all space heating, hot water, and air conditioning (via an absorption chiller) requirements. Photovoltaic conversion will be used where electricity is essential - lights, motors, and appliances.

Thermal and photovoltaic panels should cost about the same per square foot, with other system components (e.g., storage and control) and installation approximately doubling the panel cost. Standby power, in case of a string of cloudy weather exceeding the system storage capacity, will vary appreciably, from none, through fireplaces and motor-generator sets, to utility grid connecttion where solar energy supplies a relatively modest part (perhaps 50%) of the residential requirement.

A solar energy installation at the point of use, e.g., on a building, eliminates the requirement for a distribution system, and thus can be perhaps the most economical method of utilization. Photovoltaic and thermal systems can be easily expanded, permitting initial installation of a minimal capacity system and spreading the capital cost over a period of time.

For solar collectors to be widely competitive with other energy sources within ten years or so, they must be made to display mean-time-to-failure values of 20 years. Thermal panels must have high efficiency which is retained to appreciable temperatures above ambient (e.g., 90% at a small excess temperature, 50% at an excess temperature of $150^{o}F$ - at an isolation level of $250BTU/ft^2$) and sell for less than $50 per square meter. Photovoltaic panels must display efficiencies of about 15% at peak terrestrial ambient temperatures, and sell for less than $75 per square meter. To meet these objectives will require the development of advanced technologies, and their utilization in the production of solar panels.

A promising approach to meeting these objectives for the photovoltaic panel involves the use of self-supporting, thin single crystal silicon ribbons as the substrate for solar cells; it requires a fast, effective technique for pulling the ribbon, as well as low-cost raw silicon, automated processes for fabricating high efficiency solar cells, and an economical interconnect and encapsulation system. The thermal panel will probably be a flat plate collector utilizing a highly selective absorber and geometric means for effectively reducing conductive and convection losses through the top surface.