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Solar energy becomes an alternative to burning fossil fuels when the installed cost of the solar energy harvesting system is low and the value of the captured energy is high. Payback period is a simple way of judging the economics of alternative energy systems. The payback period is the installed cost of the system divided by its yearly energy savings; its units are usually in years.

The installed cost is composed of two components. One is the system cost, the sum of all the components of the system itself. The system cost is kept low by fabricating a system from low-cost materials and by reducing the weight of these materials to the minimum while still resisting structural loads that are experienced during its lifetime. The other component is the cost of the system's installation. Since on-site installation can be as costly as the system cost, reducing on-site installation costs leads to a lower installed cost and faster payback period.

Solar energy systems that have been developed over the last five decades have lowered the system cost substantially. However, many of these systems are installed on the roof of a building where building codes are in force. The lowest installed cost is usually one where the installation tasks are few and simple enough for low-skill workmen.

At any particular latitude, solar heat comes to the earth as a flux (energy per unit area) that is nearly constant above the cloud cover. With no clouds, solar collectors or reflectors capture this flux in proportion to their area. The bigger the area, the more solar energy is available. Often solar energy costs are measured by their cost per unit area, (e.g., dollars per square meter) in order to compare big systems with small systems. The cheapest solar energy systems are ones that have the lowest installed cost per unit area. The system's efficiency is the ratio of the solar energy utilized and the solar energy available. For example, a photovoltaic system that converts 20% of the solar energy falling on it into electricity has an efficiency of 20%. Usually the efficiency is given for "peak" conditions: the efficiency of a system pointed normal to the sun's flux at solar noon on a clear day. In summary, the solar energy systems with the shortest payback have the highest efficiency (high utilization of the solar energy) at the lowest installed cost.

Other variables such as time of day, solar fraction (% of sunshine that makes it through the clouds), direction of collector surface normal and latitude affect the absolute value of the solar energy that can be extracted. But for two solar energy systems of the same size at the same location pointed in the same direction, the design of the system is the most important factor determining payback period.

As noted above, the design of the system should have minimal costs of all its components and should be easy to install with low-skill workers. In addition, the system should have high efficiency in converting the available solar flux into useful energy. Useful energy comes in two forms: electricity and heat. The electricity is useful because it can offset the electricity required from the electric grid and can even augment grid electricity. The heat is useful in an industrial setting for process heat and for factory space heating. In a residential setting, domestic hot water heating and space heating can be augmented by solar energy.

In many solar energy systems that generate electricity, the heat portion is not used. It is called "waste heat" because the heat is often dumped to the atmosphere and wasted. The ability to use waste heat is an important one because contemporary thermodynamic and photovoltaic conversion is typically 20% or less. That means 80% of the available solar flux is wasted unless it can be used locally.

In addition to having low cost components and being easily installed, the most efficient solar energy systems must also use waste heat (energy not converted to electricity).

Heliostats are reflectors that move in response to the sun's position in the sky. Heliostats have been used for over a century to concentrate solar energy. For example, U.S. Pat. No. 4,109,640, 1978 issued Aug. 29, 1978 to Smith uses heliostats. Similar heliostat-based concentrating system, using photovoltaic has recently been disclosed in U.S. Pat. No. 7,381,886, issued Jun. 3, 2008 to Aiken et al. Heliostats track the sun by moving their reflecting surfaces in either one or two axes.

One of the dominant structural loads of any solar energy system is wind loading. The cost of the structure that must hold and align a system's reflectors is usually lower in a one-axis tracking system than in a two axis tracking system. Single axis concentrating systems called "trough" systems have been developed by several companies. One in commercial production is by Spanish company, Abengoa Solar New Technologies, S.A. (Seville, Spain) disclosed in U.S. Patent Application Serial No. 20080302314 published Dec. 11, 2008 to Gonzalez et al. Another is Ausra (Palo Alto, Calif.) with U.S. Pat. No. 6,131,565 issued Oct. 17, 2000 to Mills.

The Abengoa system has a solar absorber associated with each reflector structure that moves with the reflector. Ausra uses a fixed absorber with reflectors that are supported for rotation by small wheels.

One important structural component in a concentrating system is the reflector, a mirror-like component that reflects solar energy onto an absorber. Reflectors used by Abengoa and Ausra use coated glass as the reflecting surface; a metal framework holds the glass and allows the glass to rotate and focus solar energy on the absorber.

Double wall construction is used to advantage in a passive solar heater in U.S. Pat. No. 4,258,701 (1981) by the present inventor.

There is no found in the prior art an apparatus that tracks the sun in one axis to avoid the cost and complexity of a two axis tracking system. In addition, in single axis tracking, reflector surfaces can be kept close to the ground or to the structure to which they are attached. The present invention uses double wall construction in a unique way to reduce the component cost and installation cost while simultaneously capturing most of the waste heat. In this invention, solar energy is concentrated by heliostats. It uses a fixed absorber and reflectors that rotate on axles. The present invention instead uses double wall construction for the reflectors, forming a unitary structure capable of bearing loads, especially wind-induced bending loads. An inner core prevents the two walls from buckling in compression while keeping the load-carrying walls far from the bending axis.

It is an aspect of the invention to provide a low-weight solar module using one or more reflectors held rigidly by a frame that reflect solar energy onto an absorber that efficiently extracts solar energy as the flow of a heated fluid or as photovoltaic generated electricity.

Another aspect of the invention is a low-eight solar module that has reflectors that pivot on axles in a frame such that the reflector surfaces extend beyond the planform of the frame, reducing the shadowing of one reflector on another that can otherwise occur.

Another object of the invention is to provide tilting means for the module to be tilted with respect to its installed surface maximize the solar energy utilized.

Another object of the invention is to provide a method of manufacture for the module components using double wall construction to produce a reflector that can withstand high wind loading over its faces while maintaining accurate focusing of solar energy on the absorber of the module.

Another object of the invention is to provide a module that can be efficiently packed for shipment by the use of interlocking features on the modules, by simple deployment of packed modules at the installation site and by embedding fragile components within the structure to avoid shipping damage.

Another object of the invention is to provide motors that rotate the reflector components about their long axis under microprocessor control and which motor casing also act as the axle for the reflector components.

Another object of the invention is to construct the module frame using double wall construction that structurally withstands failure to lifetime loads while simultaneously minimizing the materials used in the frame structure.

Another object of the invention is to construct the module's solar energy absorber component to reduce heat loss from absorbing surfaces, to protect fragile internal components, to structurally withstand failure under lifetime loads while simultaneously minimizing the materials used in the absorber structure and to allow for simple connection of one absorber to another during field installation.