# SCI – PRINCIPLES OF SOLAR ENERGY

Solar energy originates with thermonuclear fusion in the sun. (Importantly, all the chemical and radioactive polluting by-products of the reactions remain behind on the sun.) The solar energy reaching Earth is radiant energy, entering at the top of the atmosphere at 1370 watts per square metre, the solar constant. This energy ranges from ultraviolet light to visible light and infrared (heat energy). About half of this energy actually makes it to Earth's surface; 30% is reflected and 20% is absorbed by the atmosphere. Thus, full sunlight can deliver about 700 watts per square metre to the Earth's surface when the sun is directly overhead. At that rate, the sun can deliver 700 megawatts of power (the output of a large power plant) to an area of 1000 square kilometres (390 square miles).

The total amount of solar energy reaching Earth is vast almost beyond belief. Just 40 minutes of sunlight striking the land surface of the US yields the equivalent energy of a year's expenditure of fossil fuel. The sun delivers 10,000 times the energy used by humans.

Moreover, using some of this energy will not change the basic energy balance of the biosphere. Solar energy absorbed by water or land surface is converted to heat energy and eventually lost to outer space. Even the fraction that is absorbed by vegetation and used in photosynthesis is ultimately given off again in the form of heat energy as various consumers break down food. Similarly, if humans were to capture and obtain useful work from solar energy, it would still ultimately be converted to heat and lost in accordance with the second law of thermodynamics. The overall energy balance would not change.

Although solar energy is an abundant source, it is also diffused (widely scattered), varying with the season, latitude and atmospheric conditions. The main problem associated with using solar energy is one of taking a diffuse and intermittent source and concentrating it into an amount and form, such as fuel or electricity that can be used as heat and to run vehicles, appliances, and other machinery. In addition, what do you do when the sun is not shinning? The problems involve the collection, conversion and storage of solar energy. Also, in the final analysis, overcoming such hurdles must be cost effective.