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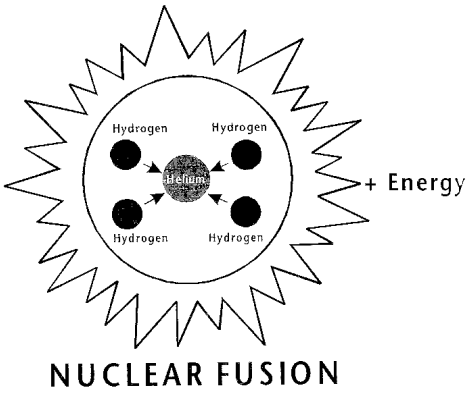
SOLAR ENERGY

INTRODUCTION:

Solar energy is energy that comes from the sun. Every day the sun radiates an enormous amount of energy. The sun radiates more energy in one second than people have used since the beginning of time. All this energy comes from within the sun itself. Like other stars, the sun is a big gas ball made up mostly of hydrogen and helium. The sun generates energy in its core in a process called nuclear fusion.



During nuclear fusion, the sun's extremely high pressure and hot temperature cause hydrogen atoms to come apart and their nuclei to fuse or combine. Some matter is lost during nuclear fusion. The lost matter is emitted into space as radiant energy.

It takes millions of years for the energy in the sun's core to make its way to the solar surface, and then approximately eight minutes to travel the 93 million miles to earth. The solar energy travels to the earth at a speed of 186,000 miles per second, the speed of light.

Only a small portion of the energy radiated by the sun into space strikes the earth, one part in two billion. Yet this amount of energy is enormous. Every day enough energy strikes the United States to supply the nation's energy needs for one and a half years! About 15 percent of the sun's energy that hits the earth is reflected back into space. Another 30 percent is used to evaporate water, which, lifted into the atmosphere, produces rainfall. Plants, the land, and the oceans also absorb solar energy. The rest could be used to supply our needs.

APPLICATIONS

Photovoltaics: Photovoltaic are solar cells that produce electricity directly from sunlight. The solar cells are made of thin layers of material, usually silicon. The layers, after treatment with special compounds, have either too many or too few electrons. When light strikes a

sandwich of the different layers, electrons start flowing and an electric current results.

Photovoltaic are used throughout the nation and elsewhere to operate appliances, provide lighting, and to power navigation and communication aids. Photovoltaic panels provide power for equipment in space ships and satellites. PV cells supply power needed to operate many kinds of consumer products such as calculators and watches. Photovoltaic systems provide electricity to remote villages, residences, medical centers, and other isolated sites where the cost of photovoltaic equipment is less than the expense of extending utility power lines or using diesel-generated electricity.

Solar Thermal: Solar Thermal power is heat energy obtained by exposing a collecting device to the rays of the sun. A solar thermal system makes use of the warmth absorbed by the collector to heat water or another working fluid, or to make steam. Hot water is used in homes or commercial buildings and for industrial processes. Steam is used for process heat or for operating a turbine generator to produce electricity or industrial power.

There are several basic kinds of solar thermal power systems including "flat plate" solar water heaters; concentrating collectors, such as central tower receivers; and parabolic trough and dish collectors.

Flat plate solar water heaters – Water flows through tubes that are attached to a black metal absorber plate. The plate is enclosed in an insulated box with a transparent window to let in sunlight. The heated water is transferred to a tank where it is available for home, commercial or institutional use.

Central tower receivers – In order to produce steam and electricity with solar thermal energy, central receivers have a

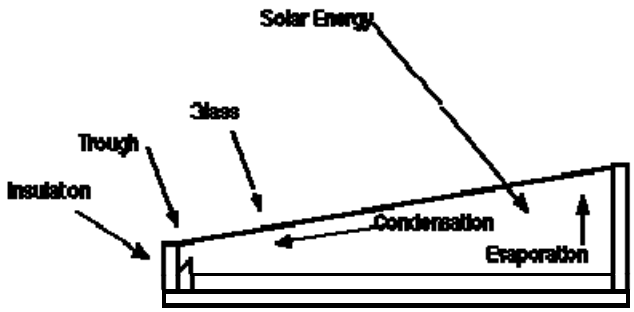
field of tracking mirrors called heliostats to focus sunlight onto a single receiver mounted on a tower. Water or other heat transfer fluid in the tower is heated and used directly or converted into steam for electricity.

Parabolic dishes or troughs – curved panels which follow the direction of the sun's rays and focus the sunlight onto receivers. A liquid inside the pipes at the receivers' focal point absorbs the thermal energy. The thermal energy received can be converted to electricity at each unit or transported to a central point for conversion to electricity.

Solar Stills: Solar stills are systems designed to filter or purify water. The number of systems designed to filter water have increased dramatically in recent years. As water supplies have increased in salinity, have been contaminated, or have experienced periods of contamination, people have lost trust in their drinking water supply. Water filtration systems can be as simple as a filter for taste and odor to complex systems to remove impurities and toxins. Solar water distillation is one of the simplest and most effective methods of purifying water. Solar water distillation replicates the way nature purifies water. The sun's energy heats water to the point of evaporation. As the water evaporates, purified water vapor rises, condensing on the glass surface for collection.

This process removes impurities such as salts and heavy metals, as well as destroying microbiological organisms. The end result is water cleaner than the purest rainwater.

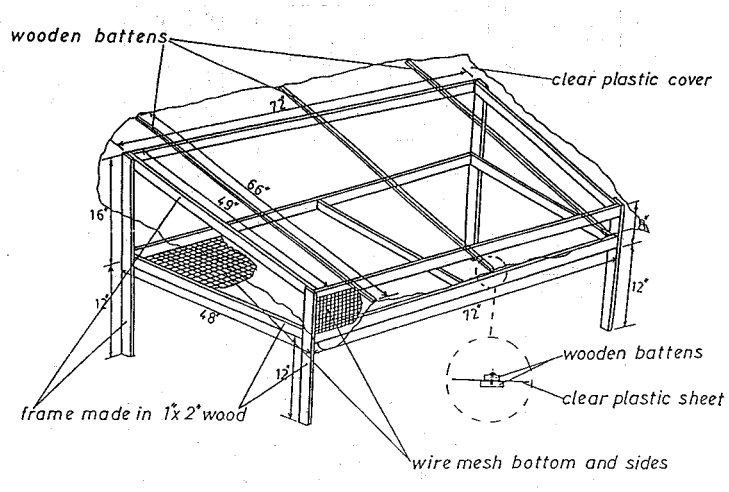
Solar energy is allowed into the collector to heat the water. The water evaporates only to condense on the underside of the glass. When water evaporates, only the water vapor rises, leaving contaminants behind. The gentle slope of the glass directs the condensate to a collection trough, which in turn delivers the water to the collection bottle.



Solar Crop Dryers: Using the sun to dry crops and grain is one of the oldest and most widely used applications of solar energy. The simplest, and least expensive technique is to allow crops to dry naturally in the field, or to spread grain and fruit out in the sun after harvesting. The disadvantage of these methods is that the crops and grain are subject to damage by birds, rodents, wind, and rain, and contamination by windblown dust and dirt. More sophisticated solar dryers protect grain and fruit, reduce losses, dry faster and more uniformly, and produce a better quality product than open air methods.

The basic components of a solar dryer are an enclosure or shed, screened drying trays or racks, and a solar collector. In hot, arid climates the collector may not even be necessary. The southern side of the enclosure itself can be glazed to allow sunlight to dry the material. The collector can be as simple as a glazed box with a dark colored interior to absorb the solar energy that heats air. The air heated in the solar collector moves, either by natural convection or forced by a fan, up through the material being dried. The size of the collector and rate of airflow depends on the amount of material being dried, the moisture content of the material, the humidity in the air, and the average amount of solar radiation available during the drying season.

There are a relatively small number of large solar crop dryers in the United States. This is because the cost of the solar collector can be high, and drying rates are not as controllable as they are with natural gas or propane powered dryers. Using the collector at other times of the year, such as for heating farm buildings, may make a solar dryer more cost-effective. It is possible to make small, very low cost dryers out of simple materials. These systems can be useful for drying vegetables and fruit for home use.



ADVANTAGES AND DISADVANTAGES OF SOLAR ENERGY

Advantages: Solar energy makes use of a renewable natural resource that is readily available.

Solar power used by itself creates no carbon dioxide or other toxic emissions.

Use of solar thermal power to heat water or generate electricity will help reduce the Territory's complete dependence on fossil fuels.

Solar water heaters are an established technology, readily available on the commercial market, and simple enough to build, install and maintain by yourself.
The production of electricity by the photovoltaic process is quiet and produces no toxic fumes.

PV cells generate direct-current electricity that can be stored in batteries and used in a wide range of voltages depending on the configuration of the battery bank.

Although most electric appliances operate on alternating current, an increasing number of appliances using direct current are now available. Where these are not practical, PV-generated direct current can be changed into alternating current by use of devices called inverters.

Disadvantages: Solar thermal systems are not cost-effective in areas that have long periods of cloudy weather or short daylight hours.

The arrays of collecting devices for large systems cover extensive land areas.

Solar thermal systems only work with sunshine and do not operate at night or in inclement weather. Storage of hot water for domestic or commercial use is simple, using insulated tanks, but storage of fluids at the higher temperatures needed for electrical generation, or storage of electricity itself, needs further technical development.

Photovoltaic-produced electricity is presently more expensive than power supplied by utilities.

Batteries need periodic maintenance and replacement.

High voltage direct-current electricity can pose safety hazards to inadequately trained home operators or utility personnel.

ADDITIONAL RESOURCES

Photovoltaic Program: **www.eren.doe.gov/pv/**
www.nrel.gov/ncpv/
Solar Thermal Program: **www.eren.doe.gov/ste/**
www.eren.doe.gov/csp
www.sandia.gov/Renewable_Energy/solarthermal/nsttf.html
American Solar Energy Society: **www.ases.org/solar**