

SOLAR POWER FOR ON-SHORE ACTIVITIES: INDO-PACIFIC REGION

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Introduction

Energy is an essential component of any community's activities. Regardless of the state of development of the community, energy is utilized for a variety of purposes.

Traditionally, man has harnessed the forms of energy that were available to him. This principally consisted of the burning of wood and organic wastes for heat, cooking and illumination. With the domestication of animals, man added to his potential through the harnessing of animal power for traction, water pumping, grinding, transportation, etc.

Other renewable forms of energy were also exploited since the dawn of civilization such as the use of wind-power for transportation, water pumping and the generation of mechanical shaft power, as well as water power harnessed for grinding and a variety of other village activities. The use of direct solar energy was also obvious in that man quickly recognized that the sun could be used for drying a wide variety of agricultural produce, nuts, grains, fish, meat and skins.

With the rapid escalation of the price of fossil fuels within the last decade, there has been increasing attention given to the potential utilization of renewable forms of energy based on the sun, such as direct solar energy, wind energy and all forms of biomass energy.

Should it be established that renewable energy resources have a role to play in a fishing community, then a careful examination of the types of technologies selected must be made in

order to ensure that these technologies are appropriate for use in the community and are compatible with the needs and resources of the local population.

Solar Distillation

A solar distillation plant typically comprises an enclosed shallow basin of water over which a sloping transparent cover is fixed. The bottom of the basin is dark colored, the water depth is usually 5 to 10 cm and the glazing may be single sloped toward the equator or if the basin is oriented east-west, or double sloped when other orientations are preferred. Sea or other saline water is fed into the basin and when the sun shines, radiation is absorbed by the dark basin liner and converted to heat. This heats up the water, thus causing evaporation from the water surface. The evaporating water is salt free. It condenses on the underside of the glazing, draining down to a gutter along the lower edge of the glazing. The gutter leads the fresh water into a storage tank, from which the water is distributed for consumption.

The most important criterion for community sized solar distillation plants is the need for a managerial structure that will ensure the smooth operation, maintenance and coordination of the system.

Solar Water Heaters

Generally, two types of solar water heaters are used. In the simplest system, a metal storage drum is painted black, filled with water and exposed to the sun's radiation. The black metal surface becomes warm due to the absorption of incident solar radiation and the heat is transferred through the metal wall of the drum into the water.

A more complicated solar water heater makes use of separate water

heater and storage components. The water is heated in tubes or channels that are thermally integrated into the absorber plate of a solar collector. This warm water passes into the top of an insulated storage tank, forcing colder water out a lower exit and into the bottom of the solar collector.

Solar Refrigeration

Solar powered refrigeration can be accomplished in a number of ways. Perhaps the simplest and most appropriate technique uses an absorption refrigeration system with an ammonia-water solution as the working fluid. The ammonia-water solution is heated in the pipes of a solar collector which has been specially built to withstand high pressures. As the solution heats up, the pressure in the system rises and ammonia is driven out of the solution. The ammonia is ducted off to condense in a separate water cooled chamber. This ammonia liquid-vapor mixture absorbs heat as it cools the water-anti-freeze mixture circulating around the insulated walls of an ice-chamber. The cooling process continues until all the liquid ammonia is vaporized. The ammonia-water solution is then pumped back to the solar collector, is again heated by the solar radiation and driven out of solution to repeat the cycle.

The refrigeration system described is a continuous cycle process. Simpler intermittent cycle absorption refrigerators have been successfully operated using solar energy. However, they suffer the disadvantage of having to be periodically interrupted during operation for a recharging cycle.

Solar Cookers and Food Warmers

Solar cookers and warmers come in a variety of forms, including ovens, steamers, conduction cookers and those with spherical, parabolic and cylin-

GENERALIZED SOLAR HARDWARE REQUIREMENTS FOR VILLAGE COMMUNITY

Energy Function	Description of Solar Apparatus	Size of Solar System Required	Capital Cost/Unit (Approx.)	Capital Cost/Person
Cooking (Shared with family of 5)	Solar Steam Cooker (Locally Built)	0.4 m ² Solar Collector/person/day	\$120/m ²	\$48
	Solar Hot Box (Locally Built)		\$20/m ²	\$8
Distillation of Brackish or Salt Water (Shared with family of 5)	Solar Stills (Locally Built)	1 m ² /person/day (can serve in the extreme 1½ or 2 persons)	\$30/m ²	\$30
Water Heating* (Shared with family of 5)	Solar Water Heater (Locally Built)	0.2 m ² /person/day	\$100/m ² *	\$20
Solar Dehydration (family operation)	Solar Cabinet Dryer (Locally Built)	3 kg of fresh fish per m ² /day	\$50/m ²	—
Pumping of Water (Shared with community) 20 litres/person/day pumped through a 30 metre head	Solar Photo Voltaic Pumping System (Imported System)	0.0045 m ² /person/day	\$10,000/m ²	\$45
Lighting (Shares 100 Watts with family of 5 for 5 hours/day)	Solar Photo Voltaic System (plus battery storage) (Imported System)	0.2 m ² /person/day	\$15,000/m ²	\$3000

*Much more simple systems exist for \$20/m² to \$30/m²

dricl reflectors. One of the most successful, and perhaps the simplest, of the solar cookers is the "hot box", or solar food warmer. This is an insulated box with a multiple glass cover. The glass permits the passage of shorter wavelength solar radiation, which is converted to heat as it strikes the black painted interior and any pots located inside.

These solar food warmers are, of all solar devices, the simplest to build and offer the greatest advantage for the initiation and training of rural populations in the use of renewable energy technologies.

Solar Fish Dryers

Solar fish dryers are systems in which solar heated air passes over filleted fish located in protected surroundings. Air is heated in a solar collector, which may be a simple

layer of glazing covering any sloping dark painted surface, and is allowed to enter a chamber in which the fish is hanging or laying on drying racks. The warm air passing over the fish removes moisture from the flesh and carries this moisture out through the top of the chamber. The interior of this chamber is usually not exposed to the direct rays of the sun in order to reduce degradation of the quality and appearance of the flesh as it is being dried. The least reduction in nutritive values occurs when the material to be dried is not exposed to the direct rays of the sun.

Most simple types of solar dryers can be built of locally available materials (except for the transparent glazings—glass or plastics—which often have to be brought in specially, from the urban areas). These units can be easily maintained and operated with less skills.

Design Criteria for Solar Energy Use in Villages

As illustrated earlier, there is a wide choice of solar technologies for meeting village requirements. In designing systems for use in villages, it is important to recognize where direct solar energy can meet specific demands for energy.

In the Table, the various energy demands in villages have been tabulated. Not all of these demands occur in each village, as often these demands depend on climatic, geographical, local resource, cultural factors, etc. Some of the energy demands can be met in whole or in part through the utilization of a variety of solar technologies which are also listed in the Table. Some estimate has also been given indicating the state of development of these solar systems.