Active Solar Heating
Factsheet

EEM-01256

Active solar heating is one of the primary ways most residential housing can employ solar energy. In active solar heating applications, heat from the sun is collected, stored and used primarily for domestic hot water heating but also can be used for space heating. The reason the system is called active is because pumps and fans are used to transfer the captured heat to an area where it can be stored or used. The main components of an active solar system are the collectors, the collector controls, the heat storage system, and the distribution system. This factsheet is designed for an introduction to the use of active solar heating systems in an Alaskan context.

Solar Collectors

A flat-plate collector is the most common choice for domestic heat and hot water from solar energy. Either liquid or air acts as the heat absorbing medium. Fluid-filled collectors can utilize a mixture of antifreeze and water, necessitating the use of a heat exchange loop in the system to avoid contamination.

Recently, solar collector technologies have been improved in addition to being less expensive. Solar heating systems must eliminate freezing risks in any Alaskan application. Collector systems engineers are eliminating equipment and moving parts, which have made modern active collectors more efficient and maintenance-free.

While solar active heating systems are most appropriate for heating hot water for domestic use, they are becoming more adaptable to all types of applications. A backup heating system is necessary in all situations, however, to ensure annual service.

The Solar Energy Resource

In Alaska, active solar heating will not economically meet all required domestic hot water and space heating needs. But, it can significantly reduce dependence on fossil fuels, especially when used in conjunction with passive solar heating and conservation. It is especially appropriate in areas without available utility power or where connecting to an existing utility is extremely expensive.

Solar radiation is measured in terms of the number of BTUs striking a square foot of surface during a specific time period. The amount of radiation received at a given point in a day is dependent upon the percentage and thickness of cloud cover, as well as the sun angle and the number of hours of available sunlight. Because of the interplay of these factors, insolation statistics do not correlate strictly with latitude. For example, Juneau does not necessarily receive more solar radiation than Fairbanks. In Alaska, this means those regions with continental (Interior) and transitional (Southcentral, Southwest, and Northwest) climates are the area where solar heating would most likely be practical.

Maximum and minimum average monthly insolation data for Anchorage, Bethel, and Fairbanks are presented for a vertical, south-facing surface. The average solar radiation varies considerably with the seasons in a pattern that is out of phase with the highest heating loads. Economically, active solar heating cannot totally replace the use of fossil fuels for either space heating or domestic hot water in Alaska. Technologies are well developed for collectors and distribution systems. There is a need for

Average Solar Radiation on a
*South-Facing Vertical Surface

			BTU/ft^2/day
Anchorage	Max.	April	1205
	Min.	December	190
Bethel	Max.	April	1364
	Min.	December	349
Fairbanks	Max.	April	1554
	Min.	December	95

*90° tilt (Andrew-Walker National Renewable Energy Laboratory - 2001)

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462/6-85/RS/600 Revised April 2001

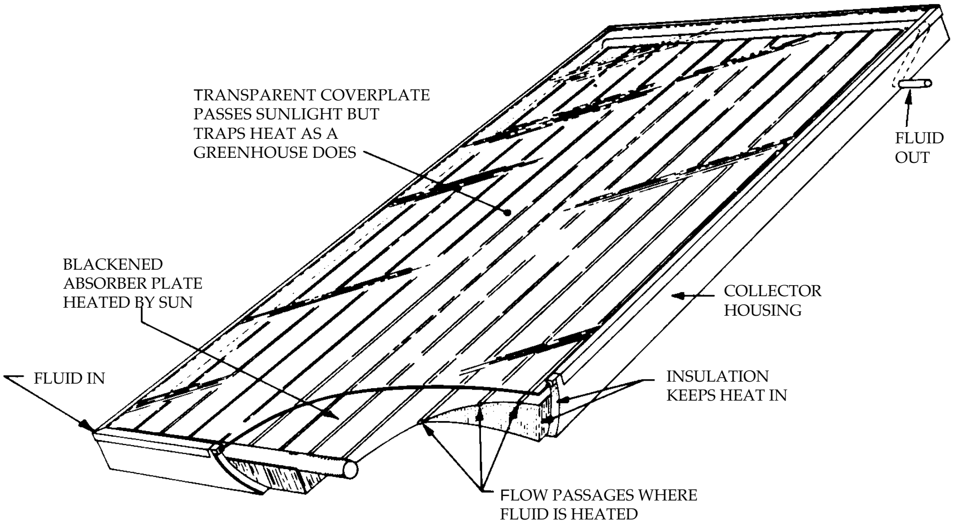

Figure 1. Schematic view of a typical flat-plate solar collector. Solar radiation (primarily visible wavelengths) strikes the surface of the glazings and is transmitted through them with a loss of 10-13 percent for each layer of glazing (only one glazing is illustrated). About 95 percent of the solar radiation striking the blackened collector plate is absorbed. This surface reradiates energy in the form of infrared radiation, which is trapped between the glazings and the absorber plate; this causes the collector plate to get hot. The collector fluid (liquid or air) is pumped through the collector to move the heat to where it is needed.

seasonal storage capacity to even out the seasonal fluctuations in resource availability. The ability to effectively store summer heat for winter use would make solar applications much more satisfactory.

Sizing a Collector

Numerous factors must be considered in sizing an active flat-plate solar collector such as the available solar energy, the efficiency of the collector, local energy costs and the heating needs of the building. Collector efficiency, in turn, depends on location, orientation and collector surface tilt angle as well as the workmanship and insulation on all parts of the system. Computer programs have been developed to predict optimum collector size for particular combinations of physical and economic factors. Simulations have been run for several Alaskan locations. (See Seifert, 1981.)

Economics

Home-built solar energy collectors have been made out of copper pipe, fiberglass and wood for $7.50/ft^2, excluding labor. Commercial costs range from $15 to $60/ft^2.

Solar radiation is at its minimum in Alaska during November, December and January. This does not mean that no energy can be extracted from the short, low travelling winter sun—it can, but the amount of heat energy gained per dollar invested in the system falls short economically. During these months a back-up system is necessary. An active solar hot water heating system, however, appears to be practical in some regions of Alaska where fuel prices are high and the climate is constant. Why does a solar hot water heater work when solar space heaters won't? We use hot water in the summer when more sun is available, and in the winter. So more solar heat is available for hot water heating than for space heating.

For more information about solar heating technologies and applications, call the Cooperative Extension Service's statewide energy specialist at 474-7201 or 1(800)478-8324, or contact your local extension office.

References

Seifert, R. *1981. A Solar Design Manual for Alaska.* Fairbanks: University of Alaska, Institute of Water Resources, Bulletin No. 1.

Beckman, Klein and Duffie. 1977. *Solar Heating Design by the F-Chart Method.* John Wiley & Sons.

Web sites: www.uaf.edu/coop-ext/faculty/seifert
www.nrel.gov; www.ases.org; and
www.eren.doe.gov/millionroofs

This publication was revised and updated in 2001 in support of the Alaska Million Solar Roofs Coalition funded by the U.S. Department of Energy. It is an effort of Cooperatitve Extension and the University of Alaska Fairbanks to support a developing solar applications and commercial industry for Alaska to better serve our energy needs with renewable energy.