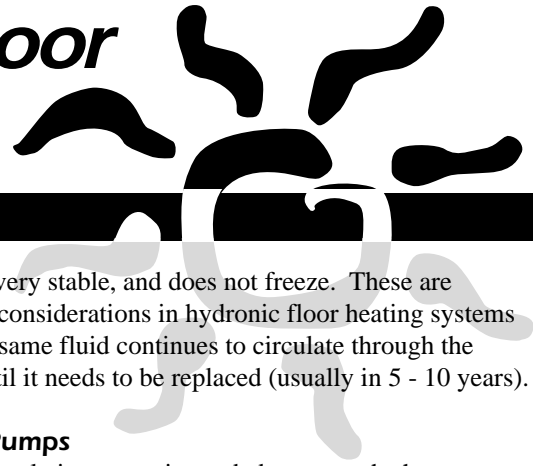


# Solar Hydronic Radiant Floor Heating Systems



## MIDWEST RENEWABLE ENERGY ASSOCIATION FACT SHEET

### Introduction

A solar hydronic radiant floor heating system uses the sun's energy to provide heat for homes and businesses. This fact sheet focuses on the design and installation of systems for new construction. With some modifications these systems can also be added to existing buildings.

Solar hydronic radiant floor heating systems are made up of solar collectors, heat transfer fluid, a circulating pump, tubing, and thermal mass for heat storage. The sun heats the heat transfer fluid in the collectors. The circulating pump brings the heated fluid into the home where the heat is transferred to the underfloor thermal mass through a grid of underfloor tubing. During the summer months the heated fluid is sent to a shunt loop that bypasses the house.

In cold climates, solar hydronic radiant floor heating systems are used to supplement traditional heating systems. These systems can provide anywhere from 50 - 70% of a home's heat. The actual amount depends upon the size of the system installed, and design and construction of the house.



MREA Solar Hot Water Workshop, Forestville, WI, 1997

nontoxic, very stable, and does not freeze. These are important considerations in hydronic floor heating systems where the same fluid continues to circulate through the system until it needs to be replaced (usually in 5 - 10 years).

### Circulating Pumps

A small circulating pump is needed to move the heat transfer fluid through the system. These pumps can be powered by either DC (direct current) or AC (alternating current) electricity.

A photovoltaic (PV) panel can be used to power a DC pump, thus producing a self-powered and self controlled system. These systems run when it is sunny and the fluid in the panels is hot. They shut off when it is dark or cloudy, therefore leaving the cooler fluid outside in the panels.

If the system is powered by standard AC electricity a controller is needed to turn the pump on and off at appropriate times.

### Underfloor Tubing

Hot fluid from the collectors is pumped through a grid of underfloor tubing. High performance flexible plastic tubing is used for these installations. This tubing is able to withstand the expansion and contraction that results from the repeated heating and cooling of the transfer fluid.

The tubing is laid out in loops to form a grid that will distribute heat evenly throughout the floor. The grid can be made up of one continuous loop of tubing, or several shorter loops. The loops of tubing are spaced approximately 12 to 18 inches from each other.

### Underfloor Thermal Mass

Heat from the collectors is transferred by convection from the underfloor tubing into the surrounding underfloor thermal mass. The thermal mass collects the heat during the day (while the sun is shining) and radiates it into the building at night.

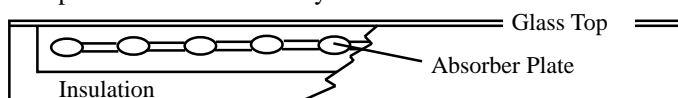
A common form of thermal mass used in new construction involves the creation of a sand bed under the home's floor slab. A pit is constructed below the floor level, typically 24" to 36" deeper than the normal excavation. The hole is lined with 2" of rigid foam insulation and a vapor barrier. 6" to 8" of sand is placed on top of the vapor barrier and compacted into place. The tubing is run on top of the sand bed

## System Components

### Collectors

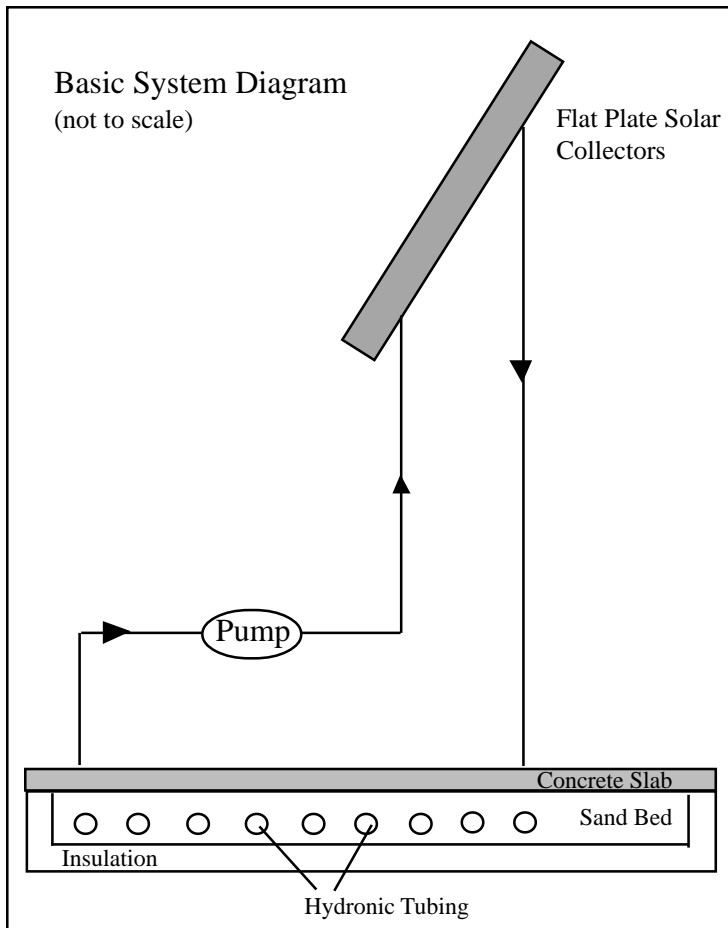
Most solar hydronic radiant floor heating systems use flat-plate collectors to capture the sun's heat. These collectors consist of a flat, insulated, weatherproof box containing a dark absorber plate. A heat transfer liquid runs through flow passages in the absorber plate, absorbing the sun's heat. The top of the box is sealed with clear or translucent glass or plastic. Flat-plate collector panels come in a variety of sizes including 3' x 8', 4' x 8', and 4' x 10'.

Flat-plate Collector Cut Away



### Heat Transfer Fluids

Inhibited propylene glycol (an antifreeze) is a popular heat transfer fluid in cold climate installations because it is



and then another 6" of fill is added and compacted on top of the tubing. This is followed by another layer of tubing. In this manner a total of 3 or 4 layers of tubing can be installed throughout the sand bed.

## Choosing a Site

The flat-plate solar collectors for the system can be installed either on the roof of the building, or on a stand alone rack in the yard.

When choosing a location for the installation the primary consideration should be the amount of sun exposure the panels will get. For maximum daily output the panels should face due south, be in the direct sun (no shading at all), and be mounted at an angle to the sun that will maximize their performance. For a system that will be used year-round a tilt angle equal to the site's latitude is considered best.

## System Costs and Maintenance

A typical 2000 square foot home in a cold climate will need between 6 - 10 solar collectors to be effective. A system of this size will generally cost between \$6,000 - \$10,000 for parts and installation. In order to get the most out of these systems many homeowners choose to use the same system to heat water for domestic uses (see MREA's Solar Domestic Hot Water Fact Sheet). This dual use of the system makes the technology more cost effective.

The maintenance involved with solar hydronic floor heating

systems is minimal. Owners will need to adjust the valves on the system seasonally to divert the fluid to the shunt loop in the summer, and back into the thermal mass in the fall. They also need to monitor the antifreeze in the system to look for consistency changes. The antifreeze will need to be drained and replaced every 5-10 years.

## For more information

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## References

- The New Solar Home Book*, Anderson, B & Riorden, M. Brick House, Amherst, NH 1987.
- Hydronic Heating Manual* Kitec Tubing Manufacturers, available through Jade Mountain, 800-442-1972.



Solar Hydronic Floor Heating System, ReNew the Earth Institute, Custer, WI

This document is funded in part by the Wisconsin Department of Administration, Division of Energy and Intergovernmental Relations through the Wisconsin Energy Bureau.

