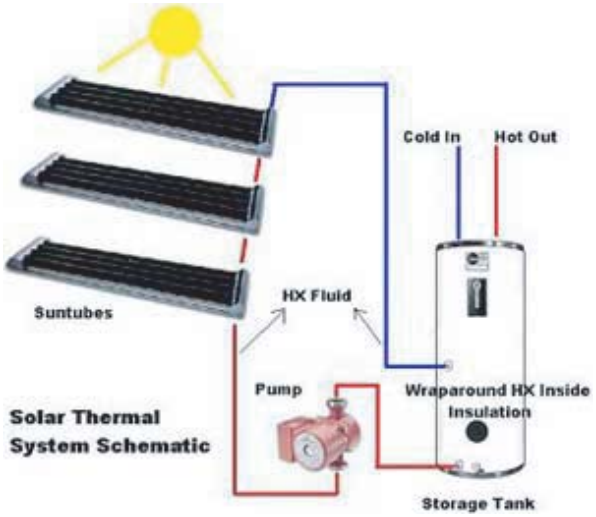
Solar Thermal Water Heating is a Success

The University of Colorado's house meets its domestic hot water needs with an unusual and innovative collector technology and strategy. In colder climates such as Washington, DC and Boulder, CO, solar collectors called evacuated tubes are more effective than more traditional flat plate collectors. In order to understand the reasons for their superior performance, it is necessary to first understand their design. For the Sun Utility system the CU team used, a vacuum is drawn in a glass tube approximately nine feet long and four inches in diameter. Inside the glass tube lays a small copper pipe attached to a black painted aluminum absorber plate. Depending on the climate, either water or an antifreeze solution is pumped through the copper tubes as solar energy is collected. The vacuum is the key to the performance of this collector in cold climates since the hot fluid in the copper pipe is not able to conduct its heat through the vacuum to the cold outside air. Flat plate collectors simply depend on an insulation material such as fiberglass to retain heat.

The most unique aspect of the CU team's evacuated tube collectors from Sun Utility is that the collectors can be mounted together on a flat roof surface with little performance degradation. Performance is maintained because the absorber plate in each tube can be rotated toward the South. Having a flat roof surface that contained significant solar collection was essential to the architectural appearance and engineering performance of the CU house.

An AC pump is used to circulate the fluid through the collectors on the roof and through a copper coil heat exchanger that wraps around the storage tank. This heat exchanger transfers the heat that was collected on the roof to the water in an 80-gallon storage tank. The tank is well insulated and large enough to ensure that several days of hot water are available during a period of consecutive cloudy days. The following components complete the system:



· Controller: Turns the pump on when the collector fluid is warmer than the tank water and turns the pump off when the opposite is true

· Pressure/Temperature relief valves: Protect the system from catastrophic failures due to excessively high pressures and temperatures

· Tempering valve: Mixes cold water with scalding hot water in the tank to provide the house with water at a useful and safe temperature.

· Electric resistance backup: A heating element at the top of the storage tank that activates when the solar energy collection is not sufficient to heat the water

Simulations of CU's solar thermal system show that the sun will provide 83% of the energy required to supply the house with hot water over the course of the year. The electric resistance backup will meet the remaining 17%. Not surprisingly, almost all the electric resistance backup use will occur in the two or three coldest winter months due primarily to more overcast skies, lower ambient temperatures, and shorter days.