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Cost to heat Water:

To evaluate the cost of DHW and its relationship to the cost of a solar hot water system, we can use several methods. The easiest and most prone to error is to assume that 20% of the fuel bill is for purposes of heating DHW.

Example: Natural gas bill equals $100; therefore the fuel bill for DHW equals $20.

A better method would be to estimate the average hot water requirement and convert that to BTU's, then convert that to an equivalent amount of fuel (or dollars) currently in use.

The average household consumes about 20 gallons of hot water per person per day for the first two people and 15 gallons for each additional person. This is an average so use with caution and correlate with actual utility bills.

To convert to BTU's we need to know the supply temperature of the water (usually around 45^0F), and the desired temperature (usually about 120^0F). The difference we will call delta-T or ΔT for short. One BTU will heat one pound of water 1^0F. One gallon of water weighs 8.33 pounds and therefore takes 8.33 BTU's to raise the temperature 1^0F.

So the energy in BTU's required is: BTU's = Gallons x ΔT x 8.33

Example: Family of four, 70 gallons DHW per day, ΔT = 75^0F

BTU's = 70 x 75 x 8.33

Btu's = 43,732 per day

Over the course of a year they would use 15,962,180 BTU's (43,732 BTU's day x 365 days year).

Common fuels and the BTU equivalency are:

1 Kwh electricity =	3412 BTU's
1 Therm Natural Gas =	100,000 BTU's
1 Gallon Propane =	91,500 BTU's

If our family uses Natural Gas, than 15,962,180 BTU's year ÷ 100,000 BTU's per Therm equals 159 therms per year.

The actual number will be higher due to water heater inefficiencies and standby losses. Also consider the current and future cost of fuel to better approximate DHW fuel costs over time.

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Overheat protection in closed loop systems revision 9-25-09

Heat transfer Fluid (HTF) that is composed of a mix of propylene glycol is subject to failure if exposed to high temperatures. In this context, failure of the fluid refers the tendency of the HTF to become acidic, and contaminated with sludge. System performance may suffer and the fluid can stop circulating due to pump cavitation. The damage due to stagnation depends on the duration of exposure, maximum temperature reached, and the quality and age of the glycol. Transient high temperatures are usually tolerated well by quality glycol products. With that in mind it is always advisable to include some form of overheat protection in the design of most closed loop systems. A failure of the electrical supply or pump failure will result in stagnation and possible fluid failure of even the most carefully designed system. Regular checks of HTF quality are recommended. Following are some common approaches.

1. Consider a drain back system if possible. Overheating is not an issue for Sunda models Seido 1 and Seido 5. These collectors are capable of continuous dry stagnation.
2. Proper collector tilt. Latitude plus 15^0 will mitigate summer BTU production and improve winter performance.
3. Adequate storage volume. Sunda evacuated tube collectors work well with 2 gallons of storage for each square foot of collector area. More storage volume will mitigate overheating but may prevent storage from reaching desired temperatures.
4. Heat dump loop. This may consist of a pool, spa, or other heat sink. Another method is to use a section of finned radiant baseboard tubing. Control of the heat dump loop can be achieved with a motorized 3-way valve. The valve is actuated using a relay from the solar controller or a dedicated relay such as an Aquastat. See illustration #1.
5. The use of a thermostatic mixing valve may be a simple solution in some situations. It is not field tested and is subject to verification. Commonly available mixing valves limit the output temperature to 150°F, and this may diminish its applicability. The Cash Acme Heatguard Thermostatic Mixing Valve, Model 110HX, has an increased outlet temperature range extending to 176°F (80°C). Available from www.houseneeds.com. See illustration #2.

Illustration #1

3-Way motorized valve

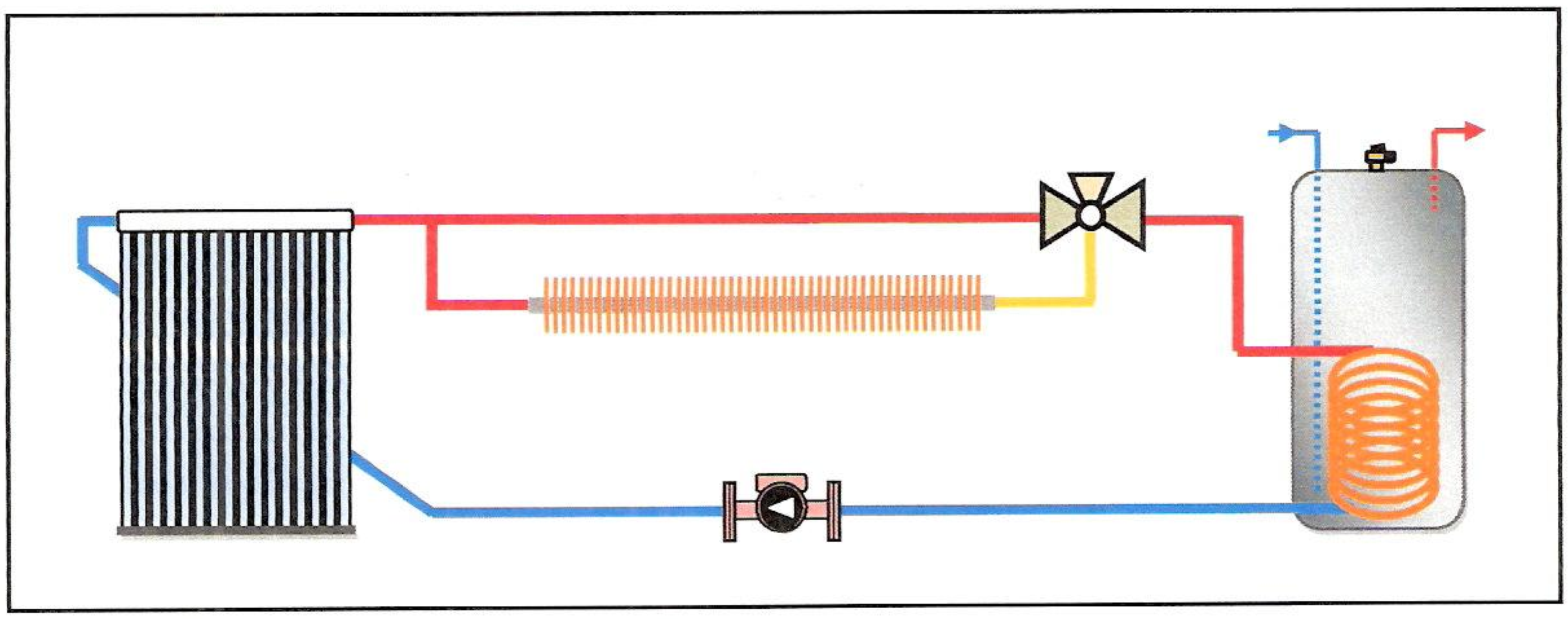

Illustration #2

Thermostatic mixing valve