SKIP'S TIPS: Solar Water Heating Sizing

I hope the following eases your sizing pains. There are many ways to determine the correct collector array size. Metering to determine the hot water load in gallons per day (GPD) is the most accurate method (especially when used with the FCHART computer simulation program). Metering is difficult and expensive, but the two methods listed below should provide guidance sizing of the array.

METHOD A: BILL ANALYSIS with the assistance of FCHART or similar program.

1. Look at three or four gas bills from the summer months.
2. Confirm no pool or spa heating or other large gas loads beyond cooking or clothes drying.
3. Assume that 90% of the summer gas bill is for water heating (so the "therms/mo" entry in the equation is 0.9 times the summer therms per month.)
4. Calculate:
   $$GPD = \frac{0.9 \times \text{billed summer therms/month} \times 100000 \text{ Btus/therm} \times 0.6 \text{ Energy Factor}}{30 \text{ days per month} \times 8.33 \text{ pounds per gallon} \times 70 \text{ degree temperature rise}}$$
5. As an example, let's say the summer bill averages 10 therms per month, and the water heater is in good condition (EF = 0.6). Enter these into the equation as
   $$GPD = \frac{0.9 \times 10 \times 100000 \times 0.6}{30 \times 8.33 \times 70} = 31 \text{ GPD.}$$

This seems reasonable for two conservative people or one person with higher consumption. If you have FCHART and know how to use it, use 31 GPD as an entry, plus the collector performance and other parameters to estimate how many square feet of collector would result in a Solar Fraction of 60-70%.

METHOD B: RULE OF THUMB based on number of occupants.

If you don't have FCHART you can be in the ballpark by using the following collector sizing Rule of Thumb: one square foot of collector per GPD to get 60 or 70% annual Solar Fraction. For this case, one 4'x8' collector should work (or one 4'x10' collector.) Scroll through SRCC's website (www.solar-rating.org) to find single-collector OG-300 systems. You'll find they usually have 50, 66 or 80 gallon solar storage tanks. Choose the system that best fits your installation goals. It's better to err on the side of a larger tank, than a smaller tank. A larger tank (1.5 or more gallons per square foot of collector) reduces the risk of overheating and boosts the efficiency of the solar collector. "Direct, Forced Circulation" freeze protection systems can only be installed in Climate Zone 7. You'll need to dig into the system descriptions to verify the type of freeze protection.

General Rules of Thumb: Residential

1. Assume 20 GPD for the first person, 15 GPD for the second, 10 GPD for each additional person.
2. Use about 1 square foot of SWH collector per GPD for the home
3. Use 1.5 to 2 plus gallons solar storage for each square foot of collector
4. 70% Annual Solar Fraction in moderate areas of California is a reasonable target to prevent severe overheating and to provide best lifecycle cost

For commercial applications, water heating GPD for various commercial customers can often be found in ASHRAE HVAC Applications Handbook, Chapter 45.

Tip: Avoid sizing based on the number of bedrooms. Tell the potential customer that you want to give him/her the best possible return on their investment, while avoiding over-sizing, which could cause overheating and reduce the life of the system. Size a system for the number of occupants and GPD of the current occupant(s). A system designed for one person in a 5-bedroom home may seem too small for making the house attractive to sell, but the new buyer can almost always invest in up-sizing the system for the new family. If your customer insists on a having a larger system, go with a larger storage tank to reduce overheating risk. The best way to reduce overheating risk is to install a drainback system. By draining the collector when the tank reaches its high limit temperature, only the dry collector (and the pipe insulation near the collector) is exposed to high temperatures, thus protecting other components and the occupants.

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