Collector Sizing Calculations and system payback period:

Before making a solar hot water system solution, this article can help you to size the system appropriately. First, you should think about the season difference effect to the system size, there are 3 conditions can be taken into account:

1) It is wise to size a system which can provide enough hot water only during the months of mild-hot seasons, (such as May-Oct), however the system can not supply enough hot water in cold season months (such as Nov-Feb), that will need a auxiliary heating sources.

2) If the customer prefer a system which can also provide enough hot water in cold season months, we should size the system by average insolation during these months, however the system will provide excessive amounts of hot water in hot-summer months, therefore this option should be ok if the customer has other means of using or dissipating the additional heat created in summer, one way could be by using excess heat to warm a pool or spa.

3) It is recommended and economic to size the system by average solar insolation level of a full year, therefore the system will provide appropriate hot water both in summer and winter. (Not much lower temperature in winter, and no too much higher temperature in summer, approx. +/-5°C will be reasonable)

Here we will also takes a system installed in Guangzhou as an example, Before calculation, we must know about the required system details including the following information:

1) How much hot water need? (Here we take 250L for example)
2) The required hot water temperature needs to be heated. (Here we take 50°C for example)
3) Calculation by average insolation level of a full year.

Below table gives steps for calculation based on 3 different ways. (The calculation takes the efficiency data of SSC-02-2.0A collector)

	System1 provides 100% hot water only in Summer	System2 provides 100% hot water in winter	System3 provides appropriate hot water in a full year
Step 1	Cold water temperature: 25°C. Average summer insolation level: 5.03kWh/m2/day	Cold water temperature: 22°C. Average winter insolation level: 3.37Wh/m2/day	Cold water temperature: 23.5°C. Average annual insolation level of 4.2kWh/m2/day
Step 2	Determine energy gained by 1M^2 collector: 5.03kWh/M^2 /day x 61% = 3.07kWh/ M^2 /day	Determine energy gained by 1 sq. meter collector 3.37Wh/m2 /M^2 x 61% = 2.06kWh/ M^2 /day	Determine energy gained by 1 sq. meter collector 4.2kWh/ M^2 /day x 61% = 2.56kWh/ M^2 /day
Step 3	Convert energy from kWh to Kcal 3.07 x 860 = 2640Kcal (1kWh = 860kcal)	Convert energy from kWh to Kcal 2.06 x 860 x = 1771Kcal (1kWh = 860kcal)	Convert energy from kWh to Kcal 2.56 x 860 = 2201Kcal (1kWh = 860kcal)
Step 4	Determine how many Kcal needed for heat the water to the required temperature: 150L x 1Kcal x (50-25)=3750Kcal. (1kcal raises 1L of water by 1°C)	Determine how many Kcal needed for heat the water to the required temperature: 150L x 1Kcal x (50-22)=4200Kcal. (1kcal raises 1L of water by 1°C)	Determine how many Kcal needed for heat the water to the required temperature: 150L x 1Kcal x (50-23.5)=3975Kcal (1kcal raises 1L of water by 1°C)
Step 5	Determine how many M^2 collector is need (absorber area) 3750/2640=1.42M^2	Determine how many M^2 collector is need: 4200/1771=2.37M^2	Determine how many M^2 collector is need: 3975/2201=1.8M^2
Sum-up	This solution can meet required temperature during May-September, however, in other winter month, the water cannot reach the required value.	This solution can meet the required temperature during winter, however, in summer months, the water temperature will be excess the required value.	This solution is reasonable design for any season, the water temperature will be average around 50°C

SYSTEM PAYBACK PERIOD:
Take system 3 above as an example, choose 1 x SSC-02-2.0A collector for this system. (1.76M^2 absorber area)
During a full year, the solar system provides heat = 2.56Kwh/$M^{2/}$day x 1.76M^2 x 365 days =1645KWH

For the same amount water, if all the water heated by an electric water heater, it will consume 1687KWH of electricity power per year, in Guangzhou, price of electricity is US$0.1/Kwh. Total spending = US$0.1X1687=US$168.7
That means use a solar hot water system will save your heating cost US$168.7/ year.

System payback period = System investment/US$168.7

The more expensive the electricity power is, the shorter payback period you will get!

* Above calculation is just an example, as insolation level and climate condition varies a lot in different regions, when design a solar water heating system, please refer to your local solar irradiance level data for an accurate calculation.

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