Question:
What is the cost of heating water?

Answer:
Calculate the energy required to heat a quantity of water. Calculate the cost of that quantity of energy. Adjust calculations for variables.
As a starting point, assume;

Usage of 20 gallons of water per day of hot water
Entering water temperature is 75°F
Water is heated to 125°F
Water weights 8.34 pounds per gallon
The specific heat of water is 1 BTU/#°F
There are 3,413 BTU/hour per watt
There are 1,000 watts in a kilowatt
Electricity is priced at $0.16 per kWh

The energy required to heat water is given by this equation.

$$Q = m \cdot Cp \cdot \Delta T$$

$$Q = 20\left(\frac{Gal}{Day}\right) \bullet (8.34)\left(\frac{\#}{Gal}\right) \bullet (1)\left(\frac{BTU}{\# F}\right) \bullet (125 - 75F)$$

Q = 8,340 BTU per day

The dollar cost per day to heat the water will be;

$$\$ = 8{,}340\left(\frac{BTU}{Day}\right) \bullet \left(\frac{watt\_hour}{3.413BTU}\right) \bullet \left(\frac{kilowatts}{1{,}000watts}\right) \bullet \left(\frac{\$0.16}{kWh}\right)$$

$ = $0.39 per day

The annual cost will be

$ = $142.71 per year

The ten (10) year life cost will be

$ = $1,427.06

Question:
Rework the above problem and heat the water with natural gas. Now what is the cost?

Answer:
Use the same BTU/day calculated above. Calculate the cost of that quantity of energy. Adjust calculations for variables.
As a starting point, assume;

100,000 BTU per hour is one Therm
Natural gas is priced at $1.30 per Therm
As a start ignore the fired heater efficiency which is typically between 85% and 90%

The energy required to heat water is.

Q = 8,340 BTU per day

The dollar cost per day to heat the water will be;

$$\$ = 8{,}340\left(\frac{BTU}{Day}\right)\bullet\left(\frac{Therm}{100{,}000\,BTU}\right)\bullet\left(\frac{\$1.30}{Therm}\right)$$

$ = $0.11 per day

The annual cost will be

$ = $39.57 per year

The ten (10) year life cost will be

$ = $395.73

Question:
Rework the above problem and heat the water with Solar energy. Now what is the cost?

Answer:
zero ($0.00)

Question:
Rework the above problem and heat the water with natural gas. This time assume that the fired heater efficiency is 85% . Now what is the cost?

Answer:
Use the same BTU/day calculated above.

The energy required to heat water is.

Q = 8,340 BTU/0.85

Q = 9,812 per day

The dollar cost per day to heat the water will be;

$$\$ = 9{,}812\left(\frac{BTU}{Day}\right)\bullet\left(\frac{Therm}{100{,}000\,BTU}\right)\bullet\left(\frac{\$1.30}{Therm}\right)$$

$ = $0.13 per day

The annual cost will be

$ = $46.56 per year

The ten (10) year life cost will be

$ = $465.57

This calculation with fired heater efficiency is not contained in the spreadsheet. It is provided here as a reference for those that want a fuller understanding.

Question:
Can a solar thermal panel provide domestic hot water without any energy use?

Answer:
Yes, if you use a solar panel that is mounted on the roof and it has internal water storage that permits natural thermal siphon of potable water to be heated. This panel would provide hot water to a conventional hot water heater storage tank any time the shower or hot water facet is turned on.

No, if it is a solar panel only with no internal storage then a small 1/20 horsepower hot water circulating pump would be required to move the water in the storage tank to the panel and back for heating. Also a small electronic controller would be required to circulate water when the sun is hot during the day.

Question:
If a circulator pump is needed what is the annual energy cost of operation?

Answer:
As a starting point, assume;

That the hot water circulating pump is a 1/20 horsepower electric motor
There are 1,000 watts in a horsepower (assumes efficiency, and power factor)
Water is circulated four hours per day
There are 365 days in a year
There are 1,000 watts in a kilowatt
Electricity is priced at $0.16 per kWh

The energy required to pump the water is.

$$Watts = 0.05Hp \bullet \left(\frac{1{,}000Watts}{Hp}\right) \bullet \left(\frac{4Hours}{Day}\right) \bullet \left(\frac{365Days}{Year}\right)$$

Watts = 73,000 Watt hours per year

The annual cost will be

$$\$ = 73{,}000\,WattHours \bullet \left(\frac{1Kilowatts}{1{,}000watts}\right) \bullet \left(\frac{\$0.16}{kWh}\right)$$

$ = $11.68 per year

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