SFSEA 2015/12/16 PV Hot Water

Hot Water: Doing It Wrong by Derek Stearns

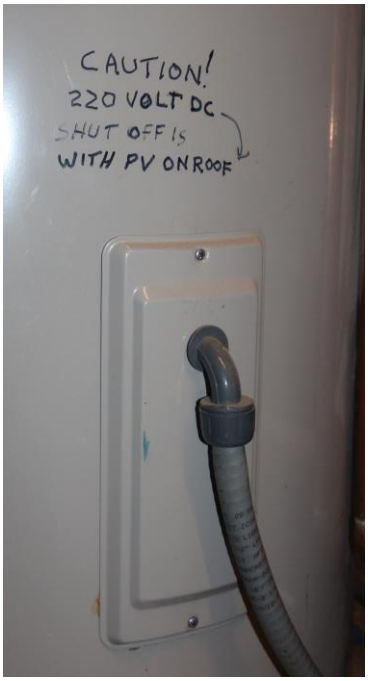
The smart people say it doesn't make sense to use photo-voltaic electricity to heat domestic water, such as you shower with, via electrical resistance. And they're right (that's why we call them "the smart people"). Electricity is a very high-grade, flexible form of energy, capable of being used in many ways that can reduce your carbon footprint. The water that you use in your shower is just about the least flexible, lowest energy item in your carbon budget, and a large fraction of that energy literally goes down the drain.

In spite of this sound reasoning, last spring we installed an electric hot water heater, and connected it to ten photo-voltaic panels (often called "solar panels"). We think it was an intelligent decision, because of our specific circumstances. Our situation isn't the norm, but it may be more common that one would think. Here are some factors that influenced our decision. We live well outside of town, and we were heating water with propane. This is expensive, and has a high carbon footprint, even among fossil fuels. We already have the maximum number of grid-connected solar panels that PNM will allow. We found a nearly new, 119 gallon high-efficiency electric water heater at the Habitat for Humanity ReStore. It fit in our utility room, was still under warranty, and sold at a good price. Our utility room is located in a place very inconvenient for connecting to solar thermal collectors, which would normally be a better choice for heating domestic water. We had space for additional solar panels on a flat roof space with good southern exposure. Finally, and most importantly, we had ten, slightly outdated photo-voltaic panels sitting around doing nothing.

The last item may seem the strangest, but I know at least three other families who also have extra solar panels that are looking for a reasonable use. Photo-voltaic panels may be stranded by system upgrades, remodeling, friends who move away, or other circumstances. If, like us, you have access to some unused solar panels at no cost, connecting them to a domestic hot water heater may be a reasonable, carbon-reducing choice.

We were able to use the same racks that came with the solar panels. Having verified that the roof had sufficient load capacity, we installed the panels in two rows on the flat roof, the racks connected to railroad ties placed on the roofing material, with cement-block ballast. Each row of five panels generates roughly 250 Volts maximum, which is just what our electric water heater elements are designed for. The two rows of panels are connected in parallel, so the voltage is still 250 Volts at the water heater. It was easy for our solar installer to run the wires in conduit from the south roof to the inconvenient utility room on the north side of the house. It only took part of a day to remove the old water

heater, install the new one, and get it wired to the solar panels. Note that our system is independent of the grid, and has no batteries. It's just the photo-voltaic solar panels, the water heater, and a few wires connecting them.



It took a few days for the water in the tank to reach good shower temperature. Since that time, we have had solar heated water for all but about six days, when cloud cover was consistent enough to cut energy production below our use. We had planned for this, and we can connect the water heater to the 240 Volt AC supply, when needed. Since our grid-tied solar panels are generating more electricity than we use, calculated on an annual basis, I think we can still claim that we are heating our water carbon-free. But even if this wasn't true, getting rid of the propane water heater, and heating with solar for 359 days a year, would still produce a major decrease in our carbon footprint.

A few additional considerations: We allow the water in our tank to get up to 160 degrees Fahrenheit, although I'm not sure it has ever hit that peak. We have a thermometer installed in the outlet piping, and I've seen it at 155˚ multiple times. This is scalding temperature, so we have a thermal tempering valve that mixes cold water with the hot as it exits the water heater. This ensures that full hot water at the sink or shower is always less than 120˚, regardless of the temperature in the tank. Our temperature/pressure relief valve is piped to the outside, so that if the tank thermostats ever fail, and we generate too much heat in the tank, the water will be safely vented outside.

Finally, a word about legionella. This name is used for a small group of bacteria which can have a significant effect on human health, including death. Legionella is surprisingly frequent in water systems. A Canadian government group found legionella in 40% of the electric domestic hot water systems that they tested. Legionella loves warm to hot water. While it won't breed in cold water pipes, it can reproduce up to almost 120˚ F, and can survive in water up to almost 140˚. While the EPA and many energy conservation sites suggest turning your water heater thermostat down to 120˚, this won't kill legionella. To keep a domestic hot water system legionella-free, it's best to get the hot water up above 140˚ for at least a few minutes, every few days. In this regard, our solar-electric system is an improvement over our old propane system, since it runs the temperature up above 140˚ almost every day.