

DIY Solar Water Heater

The Energy & Heat chapter's Tier 3 Passive Solar Design item is about capturing the sun's heat without any powered equipment. Applied to water instead of a room, that same principle builds real hot water for washing, dishes, and hygiene, the kind of hot water the Bathroom & Hygiene Without Running Water guide assumes you'll need to heat some other way.

The simplest version: a solar shower bag

Before building anything, know the zero-construction version already exists: a black plastic solar shower bag, filled with water and left in direct sun for a few hours, works on the same principle as everything below and needs no tools at all. It's worth having a couple on hand as a Tier 1 stopgap even if you build a larger system.

A real build: the batch (ICS) heater

A batch heater, also called an ICS (integrated collector-storage) heater, combines the solar collector and the hot water storage into one insulated box. Cold water enters the bottom of a dark-painted tank or coiled tubing inside the box; sunlight passes through a glazed (glass or clear polycarbonate) lid and heats the dark surface; hot water rises to an outlet at the top. Ordinary household water pressure moves the water through the system, no pump, controller, or electricity required.

Component	What it's typically made from	
Collector/storage tank	A dark-painted metal tank (an old water heater tank works well, as long as its lining and any prior contents were potable-safe, never reuse a tank or drum that held fuel, chemicals, or anything non-food-grade) or a long coil of black polyethylene or PEX tubing	
Absorber coating	A high-temperature flat black paint, a silicone-based or selective coating rated for sustained collector heat, not ordinary spray paint	Flat finishes outperform gloss by several degrees since gloss reflects more light away instead of absorbing it
Enclosure	An insulated wooden box sized to the tank, insulated on the back and sides the same way a cooler is	
Insulation	Rigid foam board, extruded polystyrene (roughly R-5 per inch) or foil-faced polyisocyanurate (roughly R-6 per inch), 2 to 4 inches thick on the back and sides	
Glazing	Tempered glass, an old window, or clear polycarbonate sheeting on the sun-facing side	
Plumbing	Standard fittings tying the unit into the household's existing cold-water inlet and hot-water outlet lines, plus a check valve on the cold-supply line and a temperature-and-pressure relief valve on the tank itself	

Size the tank to the household's actual hot-water habit rather than guessing: a single batch heater built from a 40 to 80 gallon reused water-heater tank covers a typical household's daily hot-water draw for washing and dishes in good sun. Tilt the glazing to roughly your latitude, close to 40–41 degrees for most of Utah's Wasatch Front, angled south, for the most direct exposure across the year; a slightly steeper angle trades a little summer output for better results in spring and fall.

A well-built batch heater commonly reaches 110-160°F in good sun and can cover 70-90% of a household's hot water needs during peak summer months.

WARNING

A sealed tank tied into household plumbing needs real pressure and scald protection

This isn't optional hardware. A tank plumbed into a pressurized household water line and heated by the sun can build dangerous pressure with nowhere to go; fit a listed temperature-and-pressure

relief valve rated for the tank's working pressure, positioned to sense the top few inches of water, with its discharge piped safely away per normal plumbing practice, the same device a standard water heater already has. Water at the upper end of this design's range, 160°F, causes a real scald injury in under a second of contact; install a thermostatic mixing valve at the hot outlet to blend it back down to a safe delivery temperature before it reaches a shower or sink, rather than trusting the tank's own output temperature to stay in a safe range on its own.

Freeze protection: what "drain-down" and "antifreeze loop" actually mean

A drain-down system works by removing the water from the exposed collector entirely rather than trying to keep it from freezing in place: a valve, either a simple manual one you close for the season or an automatic one triggered by temperature or the absence of flow, lets the collector's water drain by gravity into an insulated indoor storage tank whenever the system isn't actively running or the temperature drops toward freezing. An antifreeze loop instead fills the collector permanently with a non-toxic propylene glycol mixture, the same type used in RV plumbing, that never freezes at outdoor temperatures, and transfers its heat to the household's actual drinking water through a separate heat exchanger rather than ever mixing the two. Either approach is a materially bigger build than the simple batch heater described above; for most households, planning to drain and store the unit before the first hard freeze and running it spring through fall is the more realistic option.

WARNING

This is a warm-season tool in most of Utah, not a year-round one, unless you build for winter

A simple batch heater is not freeze-safe. The tank and exposed plumbing sit outside, exposed to the same overnight cold as anything else outdoors, and a hard freeze can split a tank or pipe built for this design. Plan on draining the unit before a hard freeze, or simply treating it as a spring-through-fall supplement to your regular water heater.

Sources

- Batch/ICS heater design and mechanism: Alternative Energy Tutorials; Building America Solution Center (PNNL)
- Real-world output and seasonal coverage: SolarPoweredWaterHeaters.com
- Freeze protection requirements and drain-down/antifreeze-loop design: The Encyclopedia of Alternative Energy; WePowr; drainback mechanism detail: BuildItSolar

- Temperature-and-pressure relief valve requirements: UpCodes; International Code Council
- Scald risk and thermostatic mixing valve use: InterNACHI
- Reused tank potable-safety considerations: BuildItSolar
- High-temperature absorber paint selection: BuildItSolar
- Rigid foam insulation R-value by material: R-Value Associates
- Check-valve and backflow guidance for household plumbing tie-in: Energy Trust