

A Shower Drain Has Triple the Power of an Electric Water Heater?

For anyone wondering how recovering heat from lukewarm drain water in a shower can triple the capacity of an electric water heater, the answer is quite simple, though not intuitive.

The hard part to grasp is that the drain water from an average shower contains an enormous amount of energy — around 19 kilowatts. This is three times the power in a typical 4.5-kW heating element in an electric water heater. If the GFX can recover two-thirds of that heat and return it to the water heater, it effectively triples the heater's capacity.

Here is the calculation:

$$Q = F \times [T_o - T_i] \times 8.34 \times 60$$

where

Q = power available from shower drain water in Btu per hour (Btu/hr)

F = flow rate down the drain in gallons per minute (gpm)

To = temperature of the drain water out (°F)

Ti = temperature of cold supply water (°F)

8.34 = the heat capacity of water in Btu per gallon per degree F temperature difference (Btu/gal-F)

60 = the conversion from minutes to hours

For a 3.0 gpm shower with 95°F drain water (105°F shower cooling to 95°F on the way to the drain) and 50°F cold water inlet temperature:

$$\begin{aligned} Q &= 3.0 \times [95-50] \times 8.34 \times 60 \\ &= 67,554 \text{ Btu/hr or } 19.8 \text{ kilowatts} \end{aligned}$$

With 60% recovery, the GFX can contribute 40,500 Btu/hr or 12.9 kW to the water heater.

Gives an electric water heater the capacity of a gas heater

The most difficult benefit to swallow is that a GFX can increase the effective capacity of an electric water heater more than 300%, giving a conventional electric heater more capacity than a similar size gas water heater.

One of the drawbacks of electric water heaters, compared to gas heaters, is their relatively low first-hour rating — a theoretical estimate of how much hot water a heater can put out under a specified draw schedule in one hour. Without GFX, the three 50-gallon water heaters had measured first-hour ratings between 46 and 60 gallons, which is typical. But when the GFX was added, the effective first-hour rating of the three heaters jumped to 180 gallons for two of the three heaters, giving them more than double the capacity of typical 50-gallon gas heaters (see Table 1).

Table 1 — First-hour ratings of 50-gallon electric water heater with and without GFX versus 50-gallon gas water heater.

	Electric water heater* (typical)	Gas water heater* (typical)	Electric water heater with GFX**
Power input	15,360 Btu/hr 4.5 kW	40,000 Btu/hr 11.7 kW	15,360 Btu/hr 4.5 kW
First Hour Rating (gallons)	55-60	75-80	108-180

* Source: Gas Appliance Manufacturers Association

** As tested in Virginia Power project at Old Dominion University

The GFX is now being demonstrated in several projects, including the National Association of Homebuilders Research Center Twenty-First Century Townhouse project and the Toronto Healthy House. Unless field monitoring turns up some negative surprises, this simple but innovative product is a no-brainer for homes with electric water heaters and a cost-effective energy saver for homes with gas heaters.