

BayREN Codes & Standards

Heat Pump Technology and the Electrification of Homes

BAY Regional
AREA Energy
Network

Heat Pump Technology

- The Title 24, Part 6, Energy Code must consider the economic aspects (costs) of energy consumption.
- Electricity and gas can both be converted to Btu units for comparison.
- Electricity, on a Btu-by-Btu basis is more expensive than gas. (~3x)
- This is reflected in a “source energy multiplier” in the energy code compliance calculations.

Heat Pump Technology

- “Efficiency” of a heater is a measure of what you get out (heat) vs. what you put in (gas or electricity).
- $\text{Btus out} / \text{Btus in} = \text{efficiency}$
- It does not consider cost.
- Even though **electric resistance** heaters, for example, are more ***efficient*** than **gas** heaters they cost much more to operate.

Heat Pump Technology

- Electric resistance heaters are close to **100% efficient**. Essentially **all** of the electricity consumed is converted to heat.
- Heat pump efficiencies are generally **2 to 3 times** as efficient as a conventional electric resistance heaters. Efficiencies $> 100\%$!
- How can this be?

Heat Pump Technology

- Realize that:
 - Gas ***creates*** Btus when it is burned.
 - Electric resistance ***creates*** Btus by passing current through an element.
- Heat pumps don't ***create*** heat.
- They just ***move*** it from one place to another

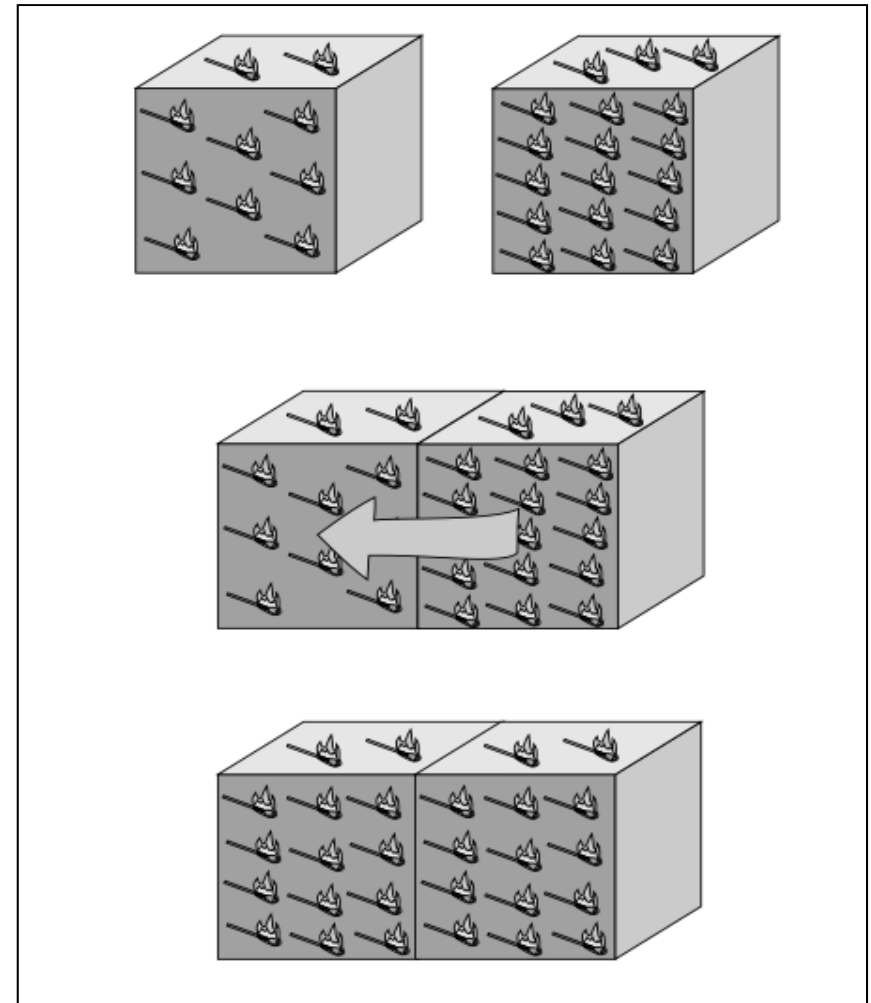
Heat Pump Technology

- Everything in the world has *some* Btus in it.
- The warmer an object is, the more “dense” the Btus are and the easier they are to extract.
- Cooling an object is the act of removing Btus.
- Heating an object is the act of adding Btus.

Heat Pump Technology

Principle #1

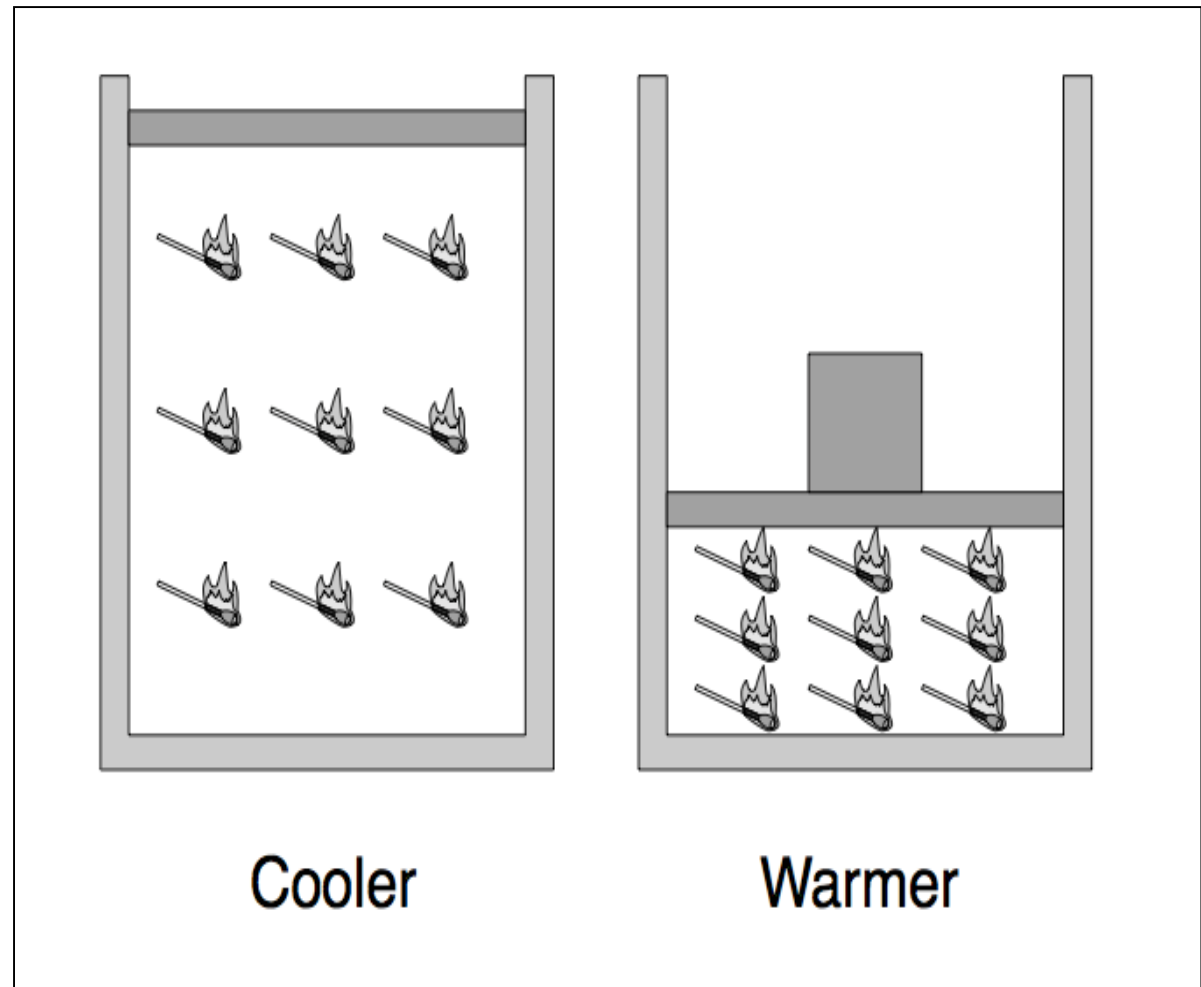
Heat will move from a warmer object or fluid to a cooler object or fluid.



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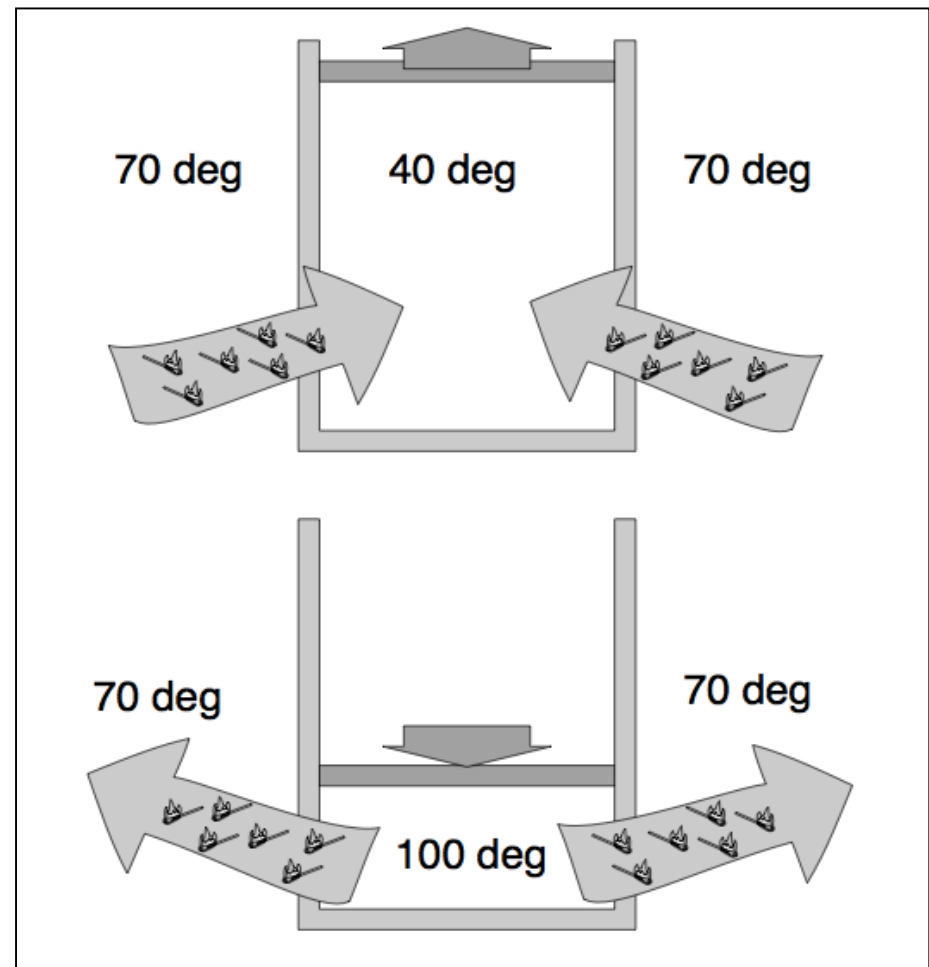
Principle #2

When you compress a fixed volume of gas, it gets warmer.

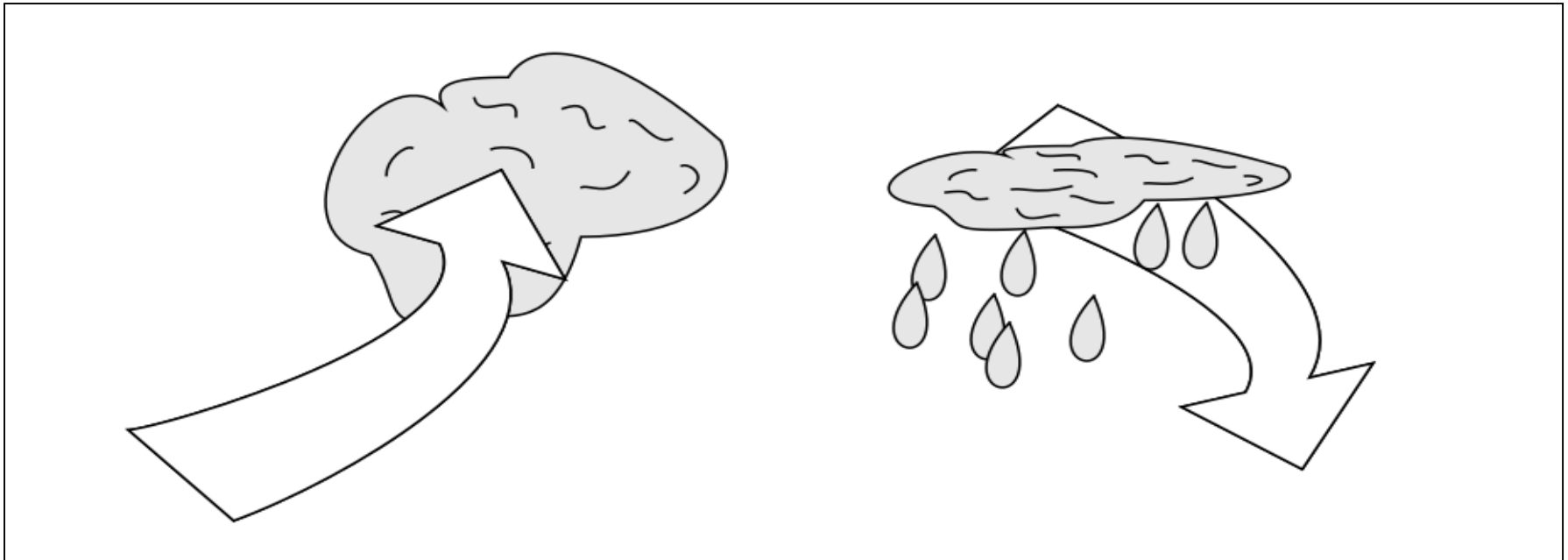


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If you combine **Principle #1** and **Principle #2**, you can cause heat to flow into and out of a gas by compressing and expanding it.

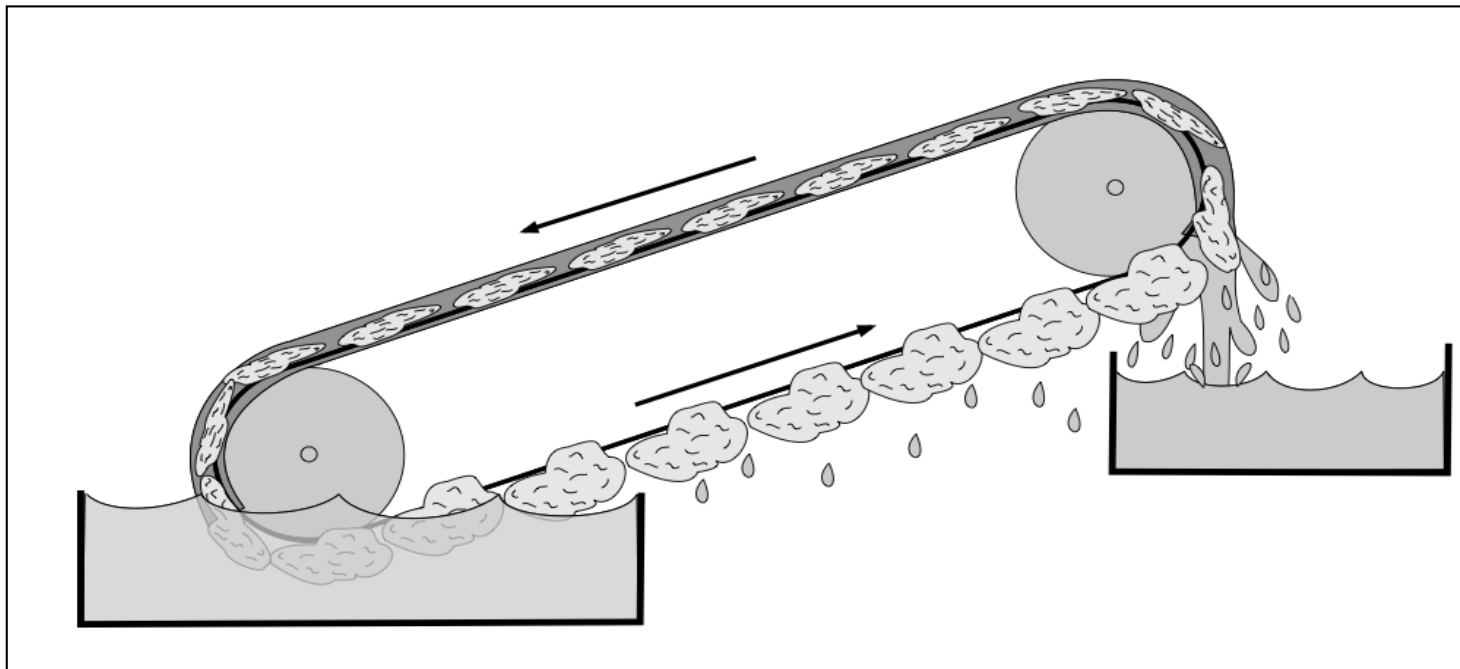


Heat Pump Technology



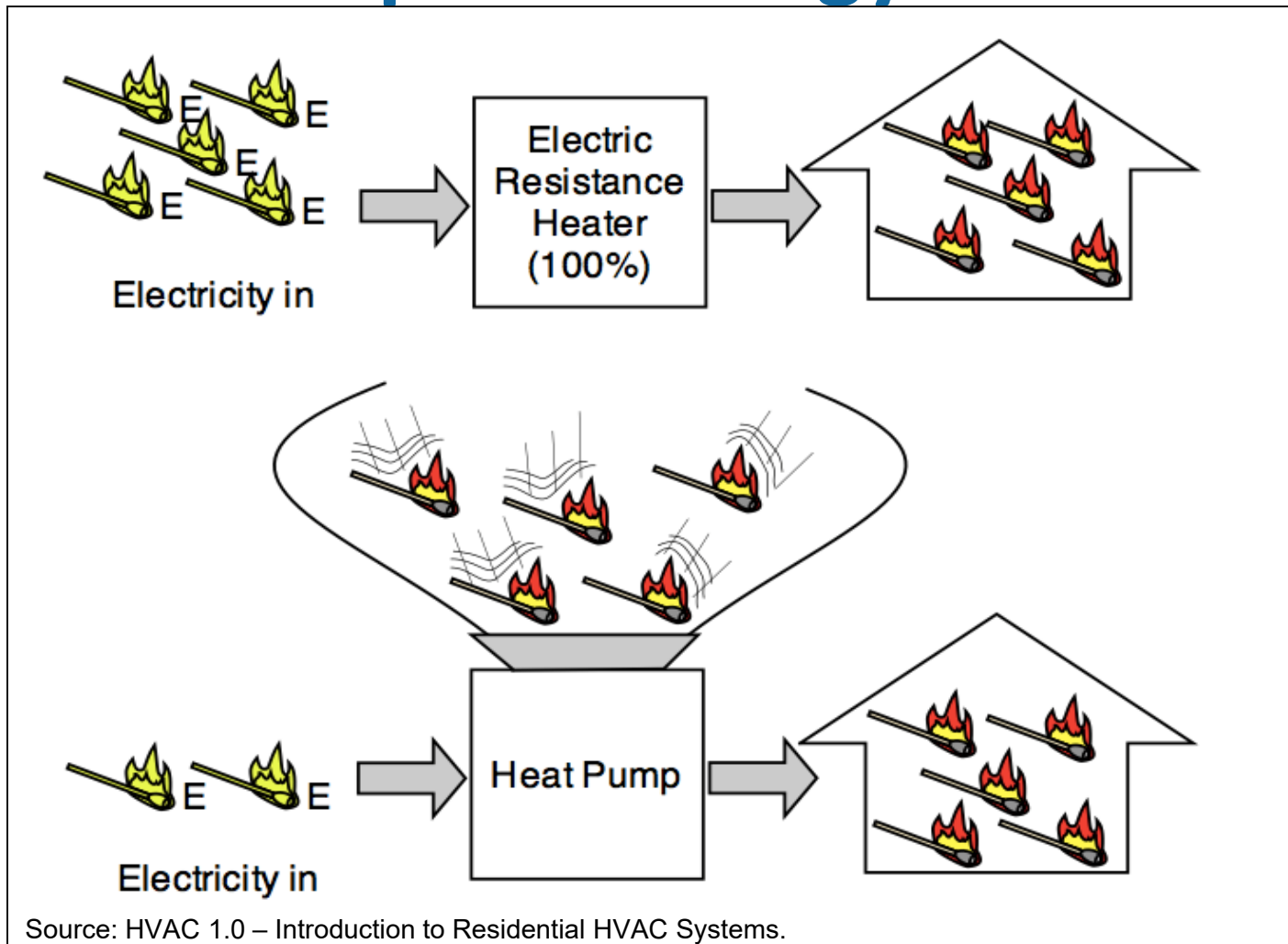
The gas is essentially acting like a “heat sponge”.
When you expand the sponge, water is absorbed.
When you squeeze a sponge water comes out.

Heat Pump Technology



You can use sponges to “pump” water from a lower level to a higher level by squeezing it in one place and expanding it in another.

Heat Pump Technology



Heat Pump Technology

- Heat pump **space heating** has been around for a while. It is basically an air conditioner that runs backwards in the winter time.
- Heat pump **water heaters** are fairly new, in terms of market availability.
- Until recently “electric water heater” meant *resistance* electric water heater.
- The very high efficiencies of HPWH makes them comparable to gas

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- Typical energy factors (EF) of new water heaters:
 - Gas storage 0.59 to 0.69+
 - Gas tankless 0.82 to 0.95
 - Electric resistance storage 0.99

Heat Pump Technology

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 - Gas tankless 0.82 to 0.95
 - Electric resistance storage 0.99
 - **Heat pump storage 2.00 to 3.40+**
- Heat pump water heaters are very competitive to gas water heaters plus have many other advantages.
- Especially when considering *time of use* electricity rates.
- Now there is a cost effective electric alternative for water heating.

Heat Pump Technology

Advantages

- Environmentally Friendly
 - No fossil fuel (fracking, drilling, pipelines, etc.)
 - No CO or CO² is generated by the equipment
 - Can be powered by renewable energy

- Safety
 - No gas lines = No gas leaks
 - No venting needed, no roof penetrations
 - No Carbon Monoxide (CO) risks
 - No flame - no explosion potential

Heat Pump Technology

Disadvantages

- First cost. They are more expensive than other water heaters.
- First hour delivery – generally considered slower to heat depending on the selected system.
- Storage tank capacities are generally larger than conventional to compensate for slower recovery rates.
- Requires an adequate volume of air and special clearances. Location is very important.

Heat Pump Technology

Here is an example of costs from major “big box” store:

- Energy Factor >3.0
- Family size : 4 – 6
- 240 Volts
- Add installation charges & other costs



GE GeoSpring 50-Gallon
10-Year Limited Regular
Electric Water Heater...

★★★★☆ (963)

\$1,399.00



GE GeoSpring 80-Gallon
10-Year Limited Regular
Electric Water Heater...

★★★★☆ (171)

\$1,899.00

Heat Pump Technology

Selling points

- Capitalize on a growing market share driven by:
 - Improved technology
 - A growing consumer awareness and demand
 - The constant move towards energy efficiency
 - Doing your part to help reduce **carbon footprint**
 - The “Nerd Factor”

Heat Pump Technology

Questions?