

Ground-Source Heat Pumps Don't Save Energy

Ground-source heat pumps are sometimes seen as a magic technology that can provide an endless supply of environmentally friendly energy. There's only one problem: ground-source heat pumps aren't necessarily more energy efficient than traditional home heating systems.

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To understand how a heat pump works, imagine using your refrigerator to keep your kitchen warm all winter. Let's say you haul a bucket of 55° water from a backyard well and put it in your refrigerator to cool it down to 50°. Because the heat removed from the water escapes from the coils at the back of the refrigerator, you have just delivered heat to your kitchen. If you get tired of replacing the bucket of 50° water with new 55° water, you could just install a pump to circulate water to and from the pond.

With a large enough pump and a large enough refrigerator, this method could keep your kitchen warm all winter. A ground-source heat pump works in a similar way, except it has a larger refrigeration capacity and delivers its heat through ducts or radiators.

Do heat pumps save fossil fuel?

The catch is that while the heat in the groundwater is almost infinite, the electricity used to run the pump and the refrigeration unit is not. For a heat pump to actually save fossil

fuel, it must deliver more heat to the house than is consumed in the process of making the electricity it uses, including the electricity used to operate the water pump.

Burning fossil fuel in power plants and transporting it through the electricity grid is about 31% efficient. If fossil fuel is burned in your home using a good sealed-combustion boiler or furnace, the annual efficiency might be about 92%—almost three times more efficient.

A heat pump that delivers 3 watts of heat for every watt of electricity it consumes is said to have a coefficient of performance (COP) of 3. This is about the level necessary if the heat pump is to actually save fuel compared to a good (not even super efficient) boiler or furnace that burns natural gas or fuel oil.

Don't forget to factor in the water pump's energy use

Most ground-source heat pumps are rated by their manufacturers at a heating COP of about 3.5 to 4. There is a catch, though: COP ratings do not include the energy used by the water pumps. Because pump size and electricity use varies significantly from installation to installation, it is impossible to know the COP of an actual system without measuring. But, in general, when the electricity used by the pump is added to the picture, the COP probably drops to 3 or lower, which means that heat pumps actually use more fossil fuel than a furnace or boiler.

Surprisingly, there has apparently never been a U.S. study measuring the COP of randomly selected residential ground-source heat pumps. One study that came close (“Measured Performance of Five Geothermal Systems,” NAHB Research Center, November, 1999) was prepared for the Ground Source Heat Pump Consortium — surely not a neutral party. The studied heat pumps were not normal installations: the air-handler blowers had very efficient electronically commutated motors (ECM, which in 1999 were rare and are unusual today), and the ducts were PVC pipe cemented together (almost leak-free). Even under these best-case installations, the heat pumps only managed to produce COP values a little over 3.

In other words, the best-case installations the industry could come up with barely saved any energy compared to burning fossil fuel in the building. And those measurements were for new installations; after months of use the groundwater will cool off, lowering the COP still further.

Because ground-source heat pumps probably use more fossil fuel than simply installing a good boiler or furnace, green builders shouldn't see heat pumps as a renewable energy source. Remember, it's always better to reduce the amount of energy a building requires than to look for a new source of energy.

Source: <http://www.greenbuildingadvisor.com/blogs/dept/green-building-blog/ground-source-heat-pumps-don-t-save-energy>