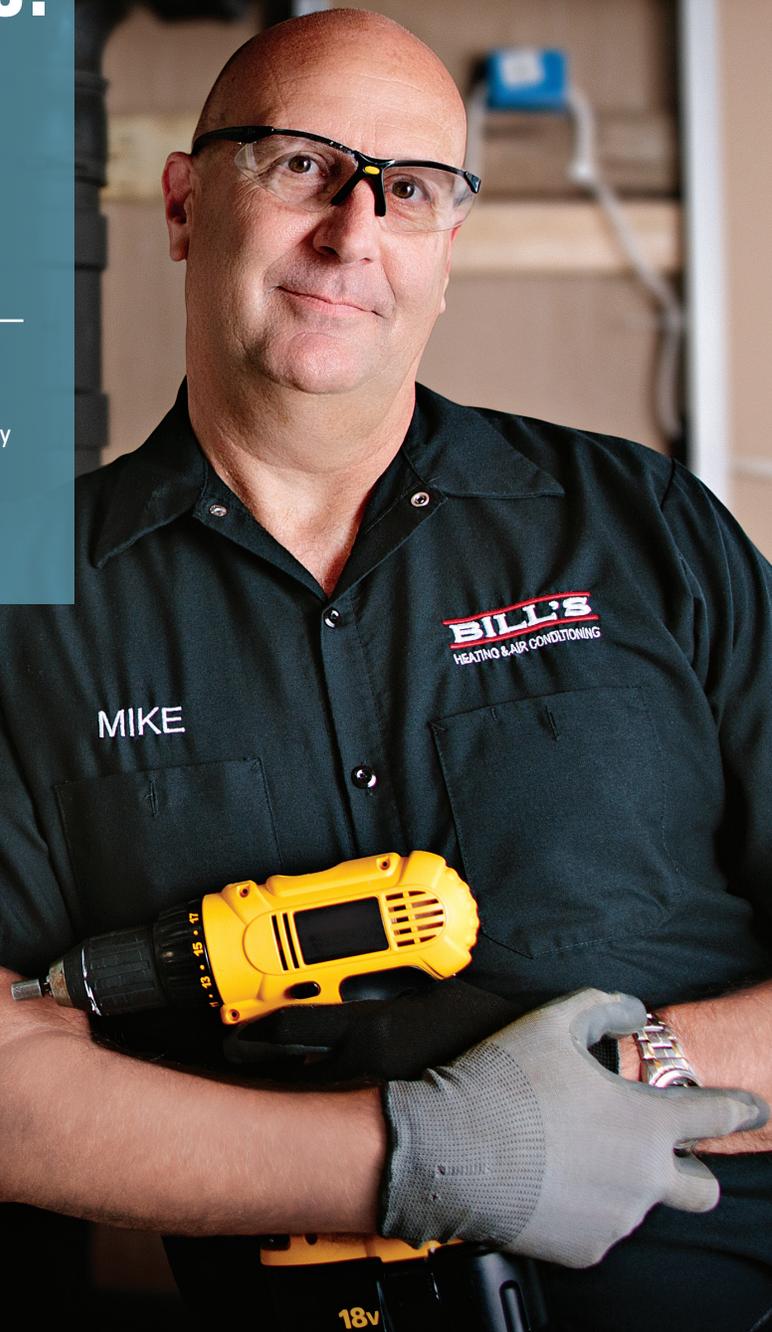


# HIGH EFFICIENCY PROPANE FURNACES VS. GROUND SOURCE HEAT PUMPS

## A COMPARISON GUIDE

The question of whether to select a high efficiency propane furnace, a ground source heat pump (GSHP), or even a hybrid combination of the two often comes down to first costs, resident comfort, and home energy performance. Understanding these factors allows energy influencers to make the best choice for their projects and see that when propane is built in, the value stands out.



**CAUTION**  
R-410A  
REFRIGERANT!  
HIGH PRESSURE  
OPERATING  
PRESSURE  
REPAIRS  
REQUIRE  
PROPER  
EQUIPMENT  
AND  
TECHNICIAN  
TRAINING  
TO  
PREVENT  
EQUIPMENT  
DAMAGE  
OR  
PERSONAL  
INJURY.  
ALSO LISTED  
SECTION 604  
HEAT PUMP

## TECHNOLOGY CHARACTERISTIC

## HIGH EFFICIENCY PROPANE FURNACE

## GROUND SOURCE HEAT PUMP

## KEY FACTS

### ENERGY SOURCE

Uses propane, primarily, with a small amount of electrical energy for the blower.

Uses electricity as the energy input, while making use of the ground's ability to act as a heat source or sink.

Propane furnaces use the thermal energy released by propane combustion to deliver hot air to the home, without the need for a back-up system.

GSHPs consume electricity to run pumps, compressors, and fans. While GSHPs may have high efficiency ratings, they also consume standard power from upstream power plants.

### EFFICIENCY RATING

Annual Fuel Utilization Efficiency (AFUE) is a measure of a furnace's efficiency in converting fuel to heating energy. The higher the rating, the more efficient the unit.

Coefficient of Performance (COP) is the measure of the heating efficiency of a GSHP. COP represents the ratio of total heating capacity to the unit's electrical energy input.

AFUE ratings account for fuel consumption directly related to space heating. However, they do not account for electrical use of the blower motor.

COP measures efficiency, but does not reflect the performance of the entire GSHP system, excluding the energy required to pump the ground loop and blower motor.

### ENERGY STAR PRODUCT CRITERIA

The Energy Star program certifies the following for high efficiency propane furnaces:

- ≥ 90 percent AFUE in Southern US
- ≥ 95 percent AFUE in Northern US

Furnace fans that use ≤ 2 percent of the total system energy consumption during heating mode.<sup>1</sup>

The Energy Star label approves 17.1 EER 3.6 COP for closed loop GSHP Systems, tested per ISO 13256-1-1998.<sup>2</sup>

Energy Star-qualified propane furnaces adhere to both AFUE and fan efficiency specs — so all major aspects of the furnace's energy use are ensured to be highly rated.

The Energy Star product criteria for GSHPs does not account for pump energy used to move refrigerant through the extensive ground loop. This is a factor adding to the overall energy consumption.<sup>3</sup>

### CO<sub>2</sub> EMISSIONS

Annual CO<sub>2</sub> emissions from heating are about 14,400 lbs/year for a typical new home in the Midwest.

Annual CO<sub>2</sub> emissions from heating are about 13,300 lbs/year for a typical new home in the Midwest.

Much of the electric power in the U.S. comes from fossil fuel-fired generation plants.

Even with high efficiency ratings, GSHPs are responsible for significant CO<sub>2</sub> emissions. For new Midwest homes, GSHP systems have about 8.5 percent lower CO<sub>2</sub> emissions compared with high efficiency propane furnaces, but still consume electricity — resulting in nearly 6 metric tons of CO<sub>2</sub>/year.<sup>4</sup>

1. Energy Star Furnaces Key Product Criteria. Available Online: [www.energystar.gov/index.cfm?c=furnaces.pr\\_crit\\_furnaces](http://www.energystar.gov/index.cfm?c=furnaces.pr_crit_furnaces).

2. Energy Star Geothermal Heat Pumps Key Product Criteria. Available Online: [www.energystar.gov/index.cfm?c=geo\\_heat.pr\\_crit\\_geo\\_heat\\_pumps](http://www.energystar.gov/index.cfm?c=geo_heat.pr_crit_geo_heat_pumps).

3. Performance Analysis of a Residential Ground Source Heat Pump System with Antifreeze Solution. Available Online: [www.hvac.okstate.edu/research/Documents/Khan\\_Spitler\\_2004.pdf](http://www.hvac.okstate.edu/research/Documents/Khan_Spitler_2004.pdf). Last accessed April 2013.

4. Performance Comparison of Residential Heating Systems: Energy, Economics, and Emissions. Available Online: [www.buildwithpropane.com/html/files/Heating\\_Systems\\_Analysis\\_2011.pdf](http://www.buildwithpropane.com/html/files/Heating_Systems_Analysis_2011.pdf). Last accessed April 2013.

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### FIRST COST

\$12,500  
[Average weighted first costs of entire system.]<sup>4</sup>

\$30,000  
[Average weighted first costs of entire system.]<sup>4</sup>

High efficiency propane furnaces are extremely common in the marketplace, with 1650 units at  $\geq 90$  AFUE listed in the AHRI product directory.<sup>5</sup> They are also straightforward to size and install, resulting in a very reasonable first cost.

The costs for a GSHP closed loop system are significantly higher, driven by the added costs of drilling, pumps, tubing, and other material needs. These costs were based on the experience of several dozen industry experts.<sup>4</sup>

### INCENTIVES AND CREDITS

A Federal tax credit of \$150 is available for furnaces  $\geq 95$  AFUE. Visit [energystar.gov](http://energystar.gov) for details.

A Federal tax credit is available for GSHPs with EER  $\geq 17.1$  and COP  $\geq 3.6$ . This credit covers 30 percent of the system first cost. For more information, visit [energystar.gov](http://energystar.gov).

High efficiency systems like propane furnaces and GSHPs can qualify for a variety of federal, state, and local incentives.<sup>6</sup>

However, even significant credits for GSHP systems — to the extent a homeowner is eligible — still result in a very high system first cost and lengthy payback period.

### SIMPLE PAYBACK FOR A GSHP SYSTEM

18-27 years to pay back the higher first cost compared with a high efficiency propane furnace.

8-14 years, if the 30 percent federal tax credit for GSHP systems can be applied.<sup>4</sup>

Simple Payback measures annual energy savings to calculate the amount of time it takes to recover the GSHP system's higher first cost compared with that of a high efficiency propane furnace and standard A/C system.

Despite high performance levels, GSHP systems mean lengthy payback periods — even if federal tax credits can be applied. These payback durations are often longer than many homeowners will reside in the home.

### COMFORT

Supply temperatures range between 120-140 degrees Fahrenheit.

Supply temperatures range between 90-120 degrees Fahrenheit.<sup>7</sup>

Equipped with a multi-stage burner system and a variable speed blower, high efficiency propane furnaces heat the home steadily and comfortably — generally delivering hotter air to the living space.

4. Performance Comparison of Residential Heating Systems: Energy, Economics, and Emissions. Available Online: [www.buildwithpropane.com/html/files/Heating\\_Systems\\_Analysis\\_2011.pdf](http://www.buildwithpropane.com/html/files/Heating_Systems_Analysis_2011.pdf). Last accessed April 2013.

5. Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Directory of Certified Product Performance. Available online: [www.ahridirectory.org/ahriDirectory/pages/home.aspx](http://www.ahridirectory.org/ahriDirectory/pages/home.aspx). Last accessed April 2013.

6. See: [www.dsireusa.org](http://www.dsireusa.org) & [www.buildwithpropane.com/?page=RebatesandIncentives](http://www.buildwithpropane.com/?page=RebatesandIncentives) for directories of rebates and incentives.

7. Temperature range based on data from International Ground Source Heat Pump Association ([www.igshpa.okstate.edu/geothermal/residential.htm](http://www.igshpa.okstate.edu/geothermal/residential.htm)) and manufacturer literature.

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### DESIGN

Furnaces are modular units allowing for quick installation and predictable system sizing.

GSHP systems typically require site-specific loop design and installation provisions. This can add cost and complexity.

HVAC contractors are well-versed in the design, installation, and maintenance of high efficiency propane furnaces.

In contrast, the maturity of the GSHP contractor workforce may vary in some areas.

### SYSTEM LOCATION

Propane furnaces are easily installed in basements, attics, equipment closets, and other locations. Direct-vent designs allow the furnace to take combustion air directly from the outdoors, helping to ensure indoor air quality.

GSHP system requires wells, or "loop fields," to be constructed. Loops may be run horizontally or vertically in trenches.

Space constraints are a significant issue in existing properties and urban areas.

GSHP loop fields are a series of piping that is placed underground. A larger loop field, needed to meet higher heating/cooling loads, may mean deeper wells, more wells, or more trenches in limited spaces.

## RAISE THEIR COMFORT, LOWER THEIR COSTS.

A high efficiency propane furnace can be combined with an electric ground source heat pump (GSHP) to form a hybrid heating system. When used in colder climates, hybrid systems optimize the best features of both units. The GSHP system can be downsized, reducing its initial cost. And homeowners will get warmer, more comfortable heat while also reducing energy costs.

### OPTIMIZING THE GSHP IN A HYBRID SYSTEM

A hybrid system is especially effective in heating-dominated climates. The GSHP's ground loop can be downsized to handle 50-70 percent of the heating load, with the propane furnace satisfying the remainder. The ground loop will still be adequate to cover cooling, but the initial cost of the system can be trimmed considerably — by nearly \$5,200 in one design example.<sup>4</sup> As a result, the payback period for a hybrid heating system is faster than a GSHP-only system.<sup>7</sup>

### ENERGY FLEXIBILITY AND COST SAVINGS

Typical GSHP systems use inefficient electric resistance backup heat for colder temperatures. In hybrid systems, a high efficiency propane furnace is used instead, maximizing the system's overall efficiency. In effect, homeowners get the comfortable heat of propane furnaces during colder temperatures while also reducing their energy bills. Additionally, a hybrid heating system gives homeowners the flexibility to optimize their system around changing energy prices. More of the heating load can be allocated to the system with the lowest energy cost.

4. Performance Comparison of Residential Heating Systems: Energy, Economics, and Emissions. Available Online: [www.buildwithpropane.com/html/files/Heating\\_Systems\\_Analysis\\_2011.pdf](http://www.buildwithpropane.com/html/files/Heating_Systems_Analysis_2011.pdf). Last accessed April 2013.  
7. Temperature range based on data from International Ground Source Heat Pump Association ([www.igshpa.okstate.edu/geothermal/residential.htm](http://www.igshpa.okstate.edu/geothermal/residential.htm)) and manufacturer literature.

### FOR MORE INFORMATION

To learn more about propane heating, building with propane, or the Propane Education & Research Council, visit [buildwithpropane.com](http://buildwithpropane.com).

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*The Propane Education & Research Council was authorized by the U.S. Congress with the passage of Public Law 104-284, the Propane Education and Research Act (PERA), signed into law on October 11, 1996. The mission of the Propane Education & Research Council is to promote the safe, efficient use of odorized propane gas as a preferred energy source.*