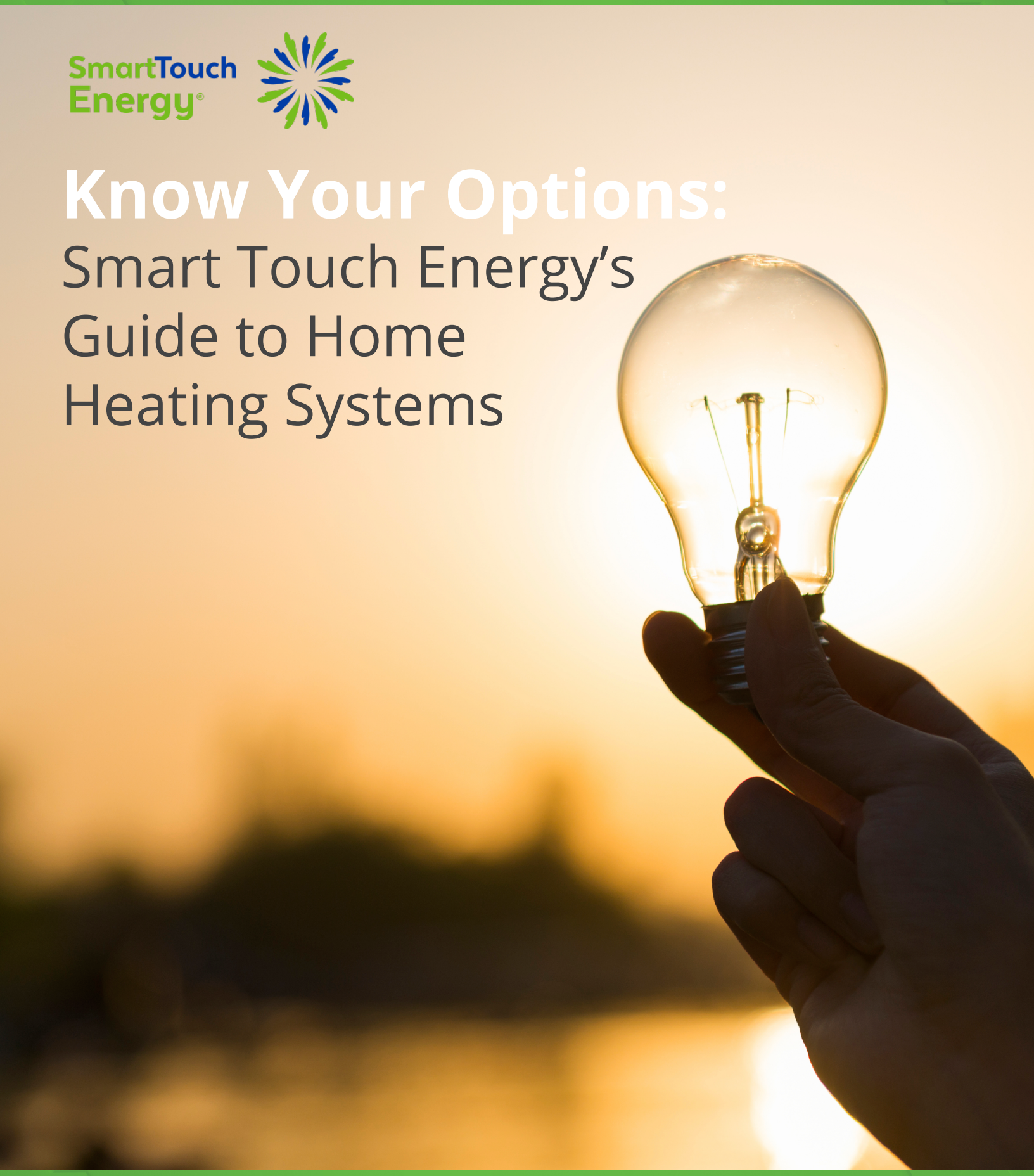
SmartTouch Energy®

Know Your Options:

Smart Touch Energy's Guide to Home Heating Systems



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Introduction

Unless you live in the tropics, you'll probably need to heat your home at least part of the year. The farther north you go, the more you likely rely on your heating system when the weather turns cold. Luckily, consumers have several home-heating options — but there's a lot to know about each one. Some of the questions commonly asked include:

- What is the average cost of electric heat for harsh winters?
- Why is the use of natural gas declining?
- Can you heat an entire house with wood?
- How long do propane systems last?
- Where does heating oil come from?
- What solar energy systems are good for homes?
- How efficient is geothermal energy?
- In northern regions, the cost of home heating can put a significant dent in your budget. Home energy comparisons give you vital information to help control energy costs.

That's why we at Smart Touch Energy created this guide to house heating options. In it, you'll learn about seven different energy systems:

- Heating oil
- Electricity
- Natural gas
- Propane

- Solar
- Wood
- Geothermal

By comparing heating fuel options, this guide will help you understand the ins and outs of energy choices. This knowledge can help you select the best home heating systems for your particular situation.

Maybe you're building a home and want to be sure you install a heating system that best fits both your needs and your budget. Perhaps your current system is aging to the point of needing repair or replacement, or maybe you are just not satisfied with your current system. No matter what the circumstance, an alternative might heat your home more efficiently and at a lower cost.

This Smart Touch Energy guide describes how these seven energy systems work. See what variations are available for each — and find out their benefits and drawbacks. You'll also be able to study energy price comparisons and more effectively balance those with systems' efficiency levels. With all this information, you'll have the knowledge to make an informed decision for your home.

Along the way, you'll also pick up answers to some interesting energy questions. For instance:

- Why is heating oil dyed red?
- What heating systems will never let you down during power outages?
- How much energy can the sun really supply?

In addition to this guide, we also provide an online oil price-checking tool. Enter your location, and you'll receive an instant local heating oil quote.

You need to weigh many variables when you're choosing a system for heating your home. Your house size, location, climate, finances, preferences, current situation and long-term plans all come into play.

Another important consideration is the options that are available where you live. For example, natural gas is not a choice for everyone because it must travel through a pipeline. You also might not get enough sunlight in your area to make solar heating practical, or you might not have easy access to fuel for a wood-burning furnace.

Smart Touch Energy has been in the heating, cooling and plumbing business for 85 years. We serve many parts of the country, including Pennsylvania, New York and Maryland, and we offer home heating energy options that include oil, natural gas and propane. We're also in the business of helping customers decide which home heating system is best for them.

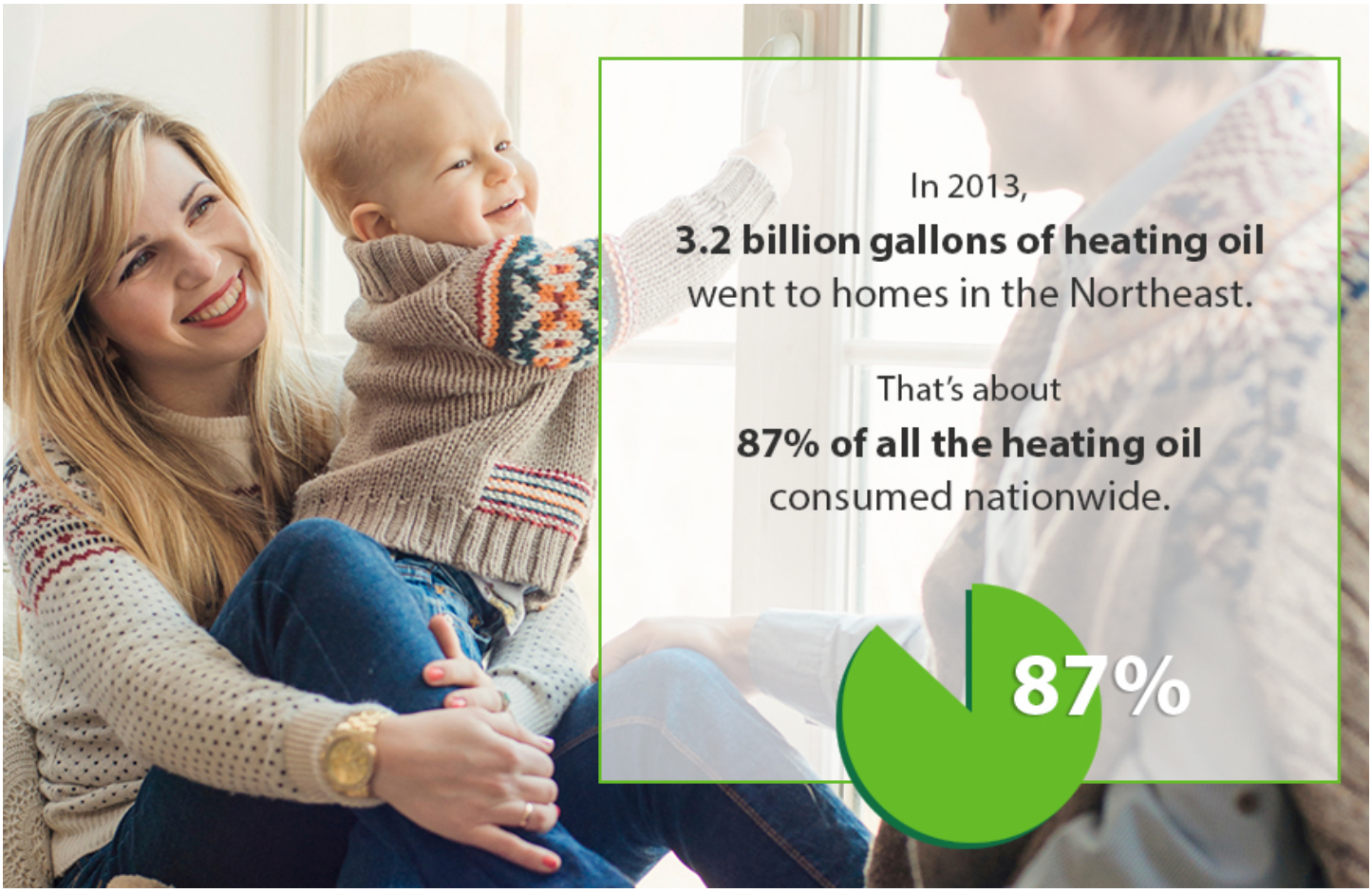
Heating systems are significant investments. The more details you have about all your choices, the better equipped you will be to make a decision you'll be happy to live with for many years.

Chapter 1: Introduction to Heating Oil

In the United States, during the winter of 2013-2014, about 6.5 million homes used heating oil.

The Heating Oil Market: Who Uses Heating Oil?

Heating oil usage is not distributed evenly across the U.S. In 2013, 3.2 billion gallons of heating oil went to homes in the Northeast. That's about 87 percent of all the heating oil consumed nationwide. October through March are the months with the highest heating oil consumption as well.



Heating oil customers also deal with price differences from year to year. The reasons why prices fluctuate can vary, but a major factor is supply and demand. If sellers have a large amount of oil available, prices are stable.

However, colder weather means homeowners need more oil. For instance, the winter of 2014-2015 created a much higher demand than normal for heating oil in the Northeast due to extended cold temperatures in the 20s and 30s.

Though the demand for heating oil usually peaks in January and February — the coldest months of the year — during normal winters, in winter 2014-2015, the demand was even higher than that normal average. Over the previous five winters, demands peaked at an average of 1.5 million bbl/d, but with the extreme cold in February 2015, that number rose to 1.8 million bbl/d.

In addition to demand fluctuations, general operating costs differ among dealers. Largely, location plays a part in determining fees, equipment and building prices, insurance, salaries and benefits.

In areas with several local oil distributors, prices might be lower because of increased competition. However, regions with fewer oil outlets could have higher prices. These are often rural locations. Delivery tends to be more expensive in rural areas, too, because they're farther from dealers. Hauling costs figure into the final pricing.

The source of oil impacts costs as well. For example, heating oil is derived from crude oil, and bad weather sometimes disrupts the manufacturing of U.S. supplies. Political circumstances, production levels and climate issues can also affect crude oil prices from

countries that are part of the Organization of the Petroleum Exporting Countries, or OPEC. Most of these nations are in the Middle East, Africa and South America.

Where Does Heating Oil Come From?

Both domestic and foreign refineries supply heating oil for the U.S., with most imports coming from Canada, the Virgin Islands and Venezuela. Heating oil arrives by pipeline, tanker, barge, truck or train.

Though heating oil begins with crude oil, some heating oil companies combine their fuel with products that burn cleaner, which improves air quality. These supplements include animal fat or oils like soybean, corn or other vegetable oils.

How Is Heating Oil Produced?

Heating oil is just one of many products made from crude oil. Gasoline, diesel, jet fuels, kerosene and lubricating oil come from the same source. Refineries distill heating oil when they manufacture other petroleum products. Therefore, their production levels determine, in part, the amount of available heating oil.

Sometimes heating oil is distilled during the summer and stored for winter usage. However, if supplies of oil run low during cold weather months, refineries make more only when they have markets for other petroleum products.

Interestingly, the Internal Revenue Service, or IRS, influences how oil heating works, too. The IRS requires distilleries to add a distinctive red color to heating oil. This signifies that road vehicles may not use the product. The color also means the oil is exempt from taxes levied on fuels for road use.

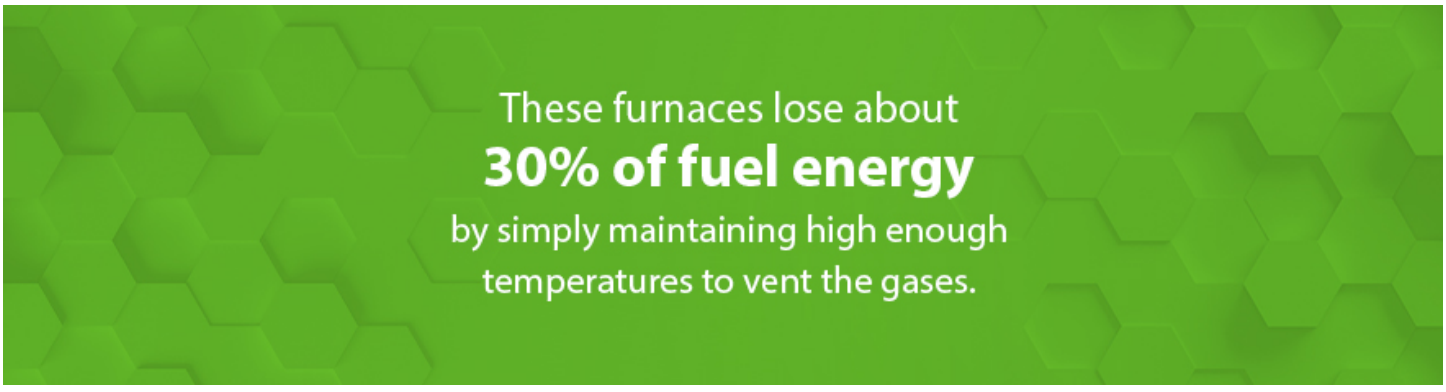
Chapter 2: How Oil Heat Works

One of the advantages of oil heat is that you have options as to how you use it. Heating oil can be used in furnaces or oil systems. But how does heating oil work exactly?

How Does Oil Heat Work? Types of Oil Heating Systems

For both furnaces and boilers, you keep extra oil in outdoor storage tanks. However, there are several key differences to note in each of these types of oil heating systems:

- **Furnaces.** Atmospheric furnaces are older, less efficient models. Their name is derived from their venting system, where their gases go up through chimneys — and exhaust air has to be very hot in order for the venting process to work correctly. These furnaces lose about 30 percent of fuel energy by simply maintaining high enough temperatures to vent the gases.



Modern minimum-efficiency furnaces are more effective. A fan pulls exhaust air through a heat exchanger. The fan creates a draft, and gases go up the chimney. When heating with oil, the most efficient furnaces are newer condensing models. Less heat escapes to the outside. Instead of immediately venting hot exhaust, these

furnaces cool gases first. Therefore, water vapor condenses and exhaust travels outside through a plastic pipe in the sidewall.

- **Boilers.** Boilers are another type of oil heater. While furnaces heat air, hydronic boilers warm up water. The liquid travels through the house, providing heat through equipment such as radiators or baseboards. Cooled water then cycles back to the boiler for reheating.

A less common oil heater is a steam boiler. After water boils, steam moves through the system, bringing heat to radiators. Steam then condenses, and the gases are vented through a sidewall or chimney.

The Oil Heat Mechanism

For both furnaces and boilers, the explanation for how oil heat works begins with a combustion chamber, where the oil ignites. Then a heat exchanger warms the gases or water flowing through the component.

In a furnace, a fan, or blower motor, pulls in household air from cold air return ducts and sends it through the heat exchanger. Heated air then goes through warm air ducts and circulates throughout the house. Cooled air cycles back to the furnace.

Boilers use pumps to propel heated water through pipes to radiators. Cooled water returns to the boiler for reuse.

Oil Heat Maintenance

Homeowners can take protective measures to keep their oil heaters in good shape, like

noting the color of the chimney smoke. For instance, black smoke indicates wasted fuel and reduced system efficiency.

Homeowners can take proactive steps as well when they are heating with oil. Cleaning the thermostat before heating season starts helps to regulate temperatures. Both the blower and the stack control component, which monitor the burner, benefit from cleaning halfway through the season. Regular upkeep removes particles and deposits that impede function.

Though both types of oil heaters should be examined and refreshed annually, sometimes a professional must step in. Even with regular yearly checkups, a homeowner could need a technician to handle a specific problem, such as cleaning a burner, unblocking the fuel line or fixing a faulty ignition spark.

Chapter 3: Benefits of Oil Heaters

The benefits of oil heaters begin with efficiency. Oil heaters offer more heat per BTU than natural gas, propane, electric, solar, geothermal or wood-burning systems.

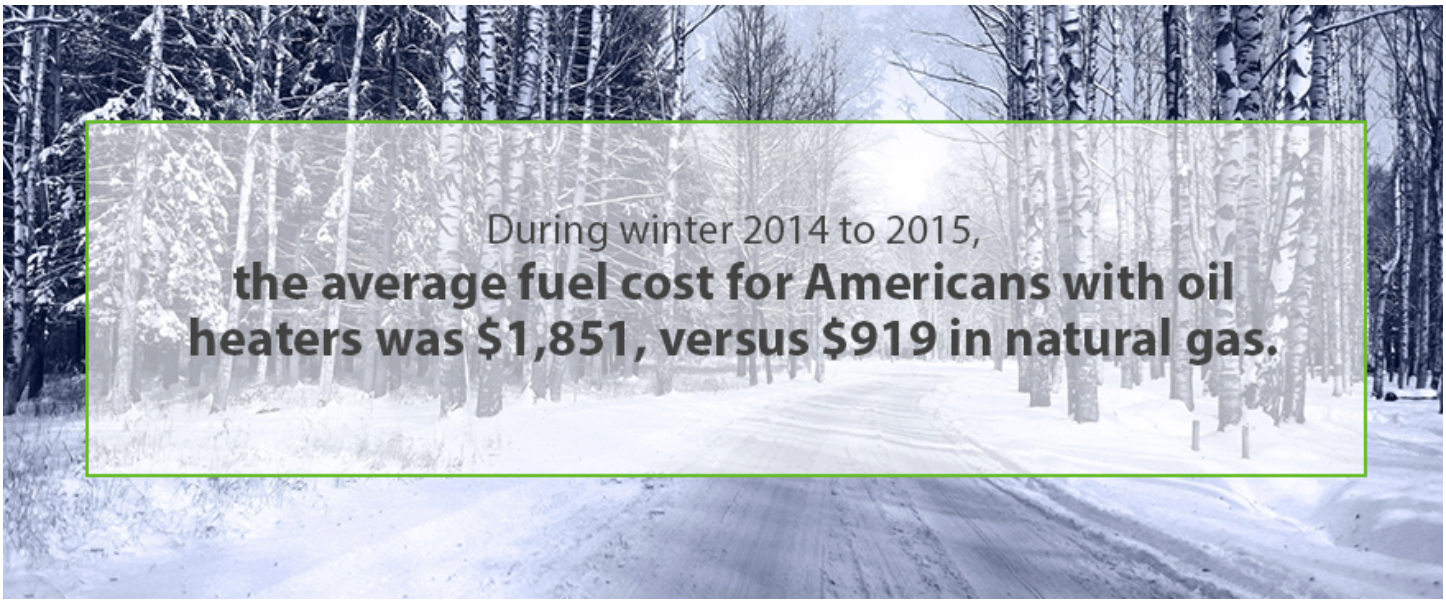
Heating Oil Efficiency

Heating oil efficiency is high, especially with newer furnaces. The capabilities of heating systems are typically described by the annual fuel utilization efficiency, or AFUE. This yearly measurement compares how much heat a system emits to how much fossil fuel it uses.

Contemporary oil heaters score well on the AFUE. They typically have ratings between 80 and 90 percent. What does that mean for oil heat efficiency? It means only 10 to 20 percent of the heat produced escapes through the chimney or other vent.

Cost Concerns

Some consumers are uneasy about the cost of heating with oil because it can be higher than with other systems. During winter 2014 to 2015, the average fuel cost for Americans with oil heaters was $1,851, versus $919 in natural gas. However, the purchase price of an oil furnace is usually less expensive than a gas device.



Homeowners using oil heat are not helpless when it comes to controlling their energy costs, however. For instance, the timely purchase of heating oil makes a significant difference in price.

Heating oil costs are often lower in late summer or fall, so those are good times to fill tanks. In some cases, dealers offer fixed prices so customers can lock in oil fees for the season. These clients are not affected by price variations caused by weather, market factors or oil supplies. Other dealers have budget plans that spread the cost of oil throughout the year.

Homeowners who weatherproof their homes can also help lower the cost of heating with oil. Putting caulking or weather stripping on doors and windows and insulating attics and walls helps to prevent cold air from getting in and warm air from leaving — and vice versa in the warmer months. And like with any heating system, a lower thermostat temperature setting saves energy.

Individuals who heat with oil and have limited incomes benefit from state and federal

energy assistance policies. The Low Income Home Energy Assistance Program is a federal plan that helps with heating bills. In addition, government agencies or oil dealers sometimes enact special programs to help with cold weather heating bills.

Considering Oil Heat

If you're considering heating with oil, you should know the basic facts about oil heating systems. For example, your house will need an on-site storage tank. A local dealer delivers the oil based on estimated usage or if you call for delivery. This storage tank keeps you from running out of oil.

Oil furnaces are usually taken care of through a service contract signed with the oil provider. With a service contract, you must call for a yearly cleaning and checkup. The company may also promise regularly scheduled maintenance visits.

Oil heaters are generally easy to service because their components are accessible. Oil heating also means periodic chimney cleaning and regular filter changes.

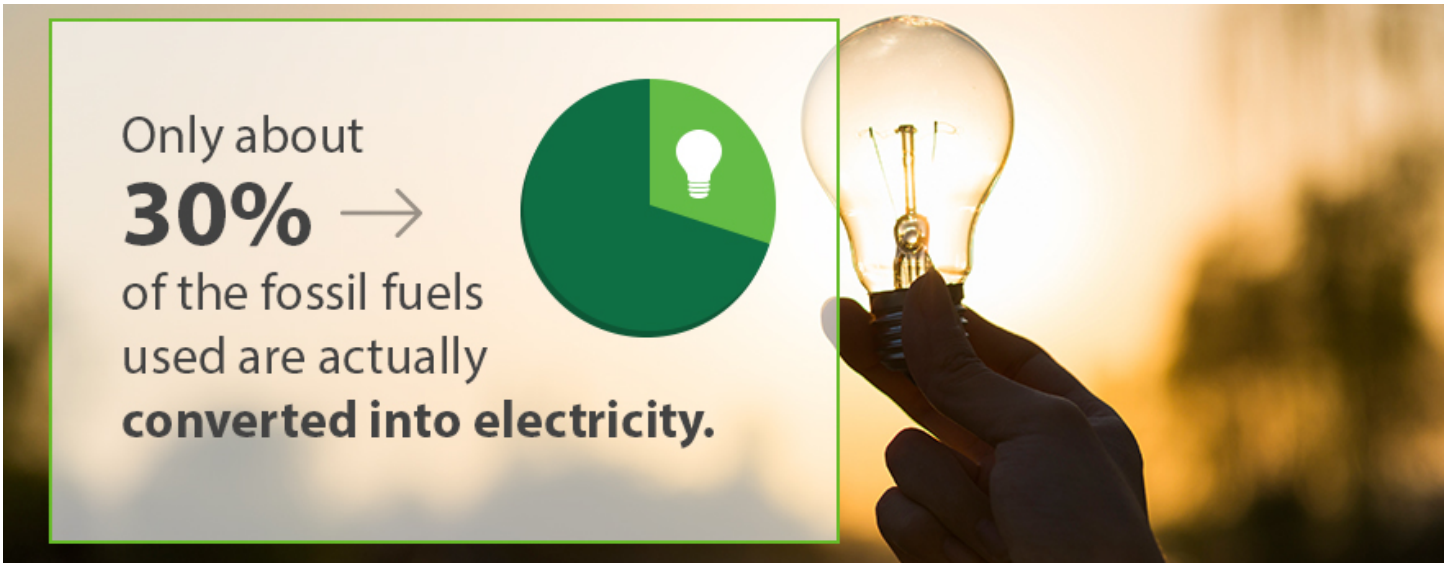
Chapter 4: Oil Heating Versus Electric Heating

When you look at oil heating versus electric heating, it's important to understand how electric power works.

The Basics of Electric Heating

Efficiency is a two-sided issue. Within a household electric system, all incoming electric energy changes to heat energy. At this level, it's 100 percent efficient.

However, electricity usually originates from power plants with coal, gas or oil generators. Only about 30 percent of the fossil fuels used are actually converted into electricity. Less common sources of electricity are nuclear plants, wind farms and hydropower plants — which use water.



Electric Resistance Heating

An electric heat versus oil heat comparison must examine respective heating methods. Electrical systems incorporate either resistance heating or heat pumps. Resistance heating comes in two forms: forced air furnaces and zonal heaters.

Electric furnaces have blowers that send cool air over several heating elements. Warmed air travels through supply ducts to the house, and the air loses heat during this journey. Cooled air comes back to the furnace in return ducts. These ducts are sometimes part of a home's central cooling system. One thermostat typically controls the heat for the entire house, so heating is often uneven.

Zonal heaters are more efficient than forced air furnaces because each room has an independent thermostat. Since zonal heaters don't use ductwork, heat also doesn't escape along the way.

Electric baseboard heaters are an example of a zonal heater. Each has a heating element within its housing. Another zonal format is the wall heater, which typically sits within interior walls. A fan moves air through the heater, while a reflector sends heat back into the room.

Though is it not common, some resistance heaters permit thermal storage. These make use of electric companies' differences in rates between day and night — electricity is more expensive during peak daytime hours.

Electric thermal storage heaters collect electricity at night, when rates are lower,

and store it for later use. Heating elements usually rest within heat-storing ceramic components.

Electric Heat Pumps

Air-sourced heat pumps move warm air from one area to another. In cooler weather, a pump brings warmth from the outdoors to inside the home since even cold air contains heat energy.

The process reverses itself for cooling — the pump sends warm air from inside a house to the outside.

People who live in mild climates have more success with traditional heat pumps because efficiency drops significantly in regions where temperatures go very low. However, some modern heat pumps work well even when temperatures are below freezing. While standard heat pumps are either off or on, newer models have variable speeds.

When a house reaches a satisfactory temperature, contemporary motors have the option of continuing to run slowly. This helps to maintain continual warmth in very cold weather.

Though many air-sourced heat pumps use ductwork, mini-split heat pumps don't need those conduits. Another air-sourced variation, a reverse-cycle chiller, heats and cools water. These systems often work in tandem with radiant floor heating.

Geothermal heat pumps work by moving heat between a ground or water source and a house. Installation costs are higher, but they are more efficient and less expensive to run.

The Electric Edge

In an electric versus oil heat price contest, electricity comes out ahead. Heating a home with electricity is less expensive. For winter 2014 to 2015, the average cost of using electric heat was $960. For the same period, heating oil costs averaged $1,851.

Another advantage is that electric heaters are available for either whole houses or individual rooms. This makes them useful for heating additions or seldom-used rooms.

Electric furnaces are also very safe, as they don't produce dangerous gases as by-products. There is no combustion in electric heaters, so the chance of a home fire is remote as well.

In the oil versus electric heat debate, however, oil sometimes gets the upper hand. Electric heaters are significantly less efficient than their oil-burning counterparts are, and the air that's delivered is also cooler than in oil systems.

Chapter 5: Natural Gas Compared to Oil

To effectively understand heating oil versus natural gas, you'll first need some background on natural gas.

Use of Natural Gas

Natural gas has historically been a popular home heating fuel. However, during the second decade of the 21st century, its market has declined, as electricity is eroding natural gas's share.

This is due, in part, to relocation of the American population. Many residents are moving to western and southern states where natural gas is not a common heating fuel. However, in the Northeast, use of both natural gas and electricity is growing.

Types of Natural Gas Heating Systems

There are three natural gas whole-house heating options:

- **Forced air.** The most common way to heat with gas is the forced air system. This consists of a furnace with a natural gas burner. Cool air enters a heat exchanger, where a burner warms the air. A blower or fan then sends the air through ductwork all over the house.

The burning of natural gas creates water vapor and carbon dioxide. These escape outside. More efficient forced air furnaces use wall vents, while chimneys remove gases for less efficient models.

- **Hydronic.** In hydronic systems, natural gas boilers produce steam or hot water, which moves through pipes to radiators, baseboard units or radiant flooring. Byproducts are typically vented through the wall.

- **Combination system.** Combination systems incorporate a forced air furnace with hydronic baseboards. Water sits in a storage tank, and when it's needed, water is pumped through a heated metal coil. A fan carries air across the coil, and the hot air moves through the house's ducts.

Benefits and Drawbacks of Natural Gas

Next up in the natural gas versus oil match are the benefits of natural gas. Compared to oil, natural gas is less expensive. The average natural gas bill in winter 2014 to 2015 was $642, and natural gas tends to be one of the least expensive fuel options overall.

The efficiency of natural gas systems varies. The best quality systems are more than 90 percent efficient. Less expensive models rate at the lowest acceptable standard: 78 percent. Oil heaters, however, emit more heat per BTU than any type of gas furnace.

Efficiency also depends upon the location of ductwork. Ducts within interior walls or basements are most efficient. If the passages go through a poorly insulated attic or crawlspace, efficiency drops. Leaky ductwork reduces efficiency and increases utility bills.

Gas heating systems cannot be used everywhere in the U.S., either. A piped supply system must be in place to carry gas to buildings.

Safety is also a concern. Natural gas systems need proper maintenance, and a significant gas leak could cause an explosion and fire. In addition, without adequate venting, carbon monoxide — a poisonous gas — can spread through the house. People can become seriously ill or even die from carbon monoxide poisoning. Take proper safety measures and preventive precautions, such as installing a carbon monoxide alarm or detector.

When natural gas is compared to oil, there are certain advantages. However, just like with any system, those advantages need to be weighed against the disadvantages to decide which heating system will work best in your particular situation.

Chapter 6: Propane Versus Oil Heat

Are you wondering about heating oil versus propane? Let's look at propane usage in the United States.

Using Propane

Though it's a clean fuel, propane has become less popular as a heating option during the 21st century. However, propane is still often used to run appliances, such as stoves, clothes dryers and hot water heaters.

Propane for home heating is stored in tanks on homeowners' properties. Residential tanks can vary in size from 100 gallons up to 1,000 gallons or more. Most tanks rest on the ground, although certain models are buried.

While some individuals own some tanks, many homeowners rent receptacles from fuel companies that supply propane. In these cases, the companies are responsible for tank maintenance.

Types of Propane Systems

Propane systems include a few different ways of warming air:

- **Central furnace.** Central furnaces are the most common propane option. These forced air furnaces are space savers.

Modern central furnaces have electronic ignitions for safety reasons. These heaters do

not need pilot lights, so no continual flame burns.

Newer central furnaces also have vent dampers. When the desired temperature is reached, the damper activates, keeping gases and heat from escaping up the chimney. Just before the burner ignites again, the damper opens, and gases go up and out.

- **Wall furnace.** Propane wall furnaces are useful in small rooms in modest-size houses. However, they are also installed in areas of older homes where existing systems are unable to heat adequately.

These furnaces run quietly, venting their fumes outside. They have built-in thermostats and need no electricity to run. Therefore, they are helpful when power goes out.

- **Combo heater.** Combo heaters warm air and water, and they are up to 90 percent efficient. Heat that escapes from the water heater is redirected into the house, warming rooms.

Combo models vent directly outside, and they often take up no more space than a typical water heater. In addition, their combustion chambers are sealed. This, along with their size, makes installation practical anywhere in the house.

Propane Comparisons

The benefits of propane focus on efficiency and price:

- **Efficiency.** The most efficient propane heaters have an AFUE rating of 90 percent. They use no electricity, so they function properly during power outages. Propane

heaters also have long lives, lasting twice as long as electric heat pumps.

- **Pricing.** Consumer costs of heating with propane vary by geographic area, season and supplier. For instance, the average annual cost for Northeasterners during Winter 2014 to 2015 was $919. Midwesterners averaged significantly less at $711.

Propane heating systems are also relatively affordable to install and require little maintenance during their lives.

- **Safety.** The propane versus oil heat contrast should examine safety issues as well. Propane is under a great deal of pressure. A propane leak that reaches a furnace or water heater pilot light could cause an explosion. In addition, above ground tanks are susceptible to damage during fires, floods and tornados.

Chapter 7: Energy From the Sun

To analyze solar energy versus oil, it's important to understand how solar power works.

Overview of Solar Energy

Solar systems are clean sources of energy. They do not cause air or water pollution, and they don't emit gases that contribute to climate change.

The sun has great potential as a source of home heating. Eighteen days of sunshine equal the earth's entire supply of coal, oil and gas.

Solar power works because of energy conversion. Light energy changes into heat or electrical energy.

Solar Heating Options

Solar heating systems classify as either active or passive:

- **Active.** Active systems have mechanisms such as electrical pumps that contribute to energy conversion, and they warm liquids or gases. Systems that heat liquids are better suited to handle whole buildings. In these liquid systems, water, antifreeze or another solution heats up and is either used immediately or stored until needed.

A circulating pump moves the liquid through a collector that resembles a very large, glass-covered box. The sun warms the liquid there. To immediately heat indoor air, liquid goes through an energy exchanger. Otherwise, a water tank or radiant system stores heat energy.

Another type of active system uses photovoltaic cells. They are made from materials, such as silicon, that generate electricity when exposed to sunlight. Cells are typically a few inches square. To create a solar energy system, numerous cells are placed together to form a panel. Groups of panels create arrays. Panels are then often placed on rooftops to make electricity. Batteries store this energy until it's needed.

- **Passive.** In homes with passive solar heating system, the sun shines through windows with southern exposures. These windows receive full sun daily from mid-morning to mid-afternoon.

Sunlight heats dark thermal masses, which are commonly walls or floors made from concrete, brick, stone or tile. The masses store heat and release it when needed. Fans or blowers sometimes help distribute warmed air. In other cases, heat flows through convection. Air moves from areas of higher temperatures to spots that are cooler.

Evaluating Solar Energy

Solar energy systems are not efficient, but under some circumstances, they keep energy costs down. Here is a breakdown of their efficiency, cost and disadvantages:

- **Efficiency.** Though solar energy is a renewable energy source, it is not very efficient. For instance, when sunlight hits solar panels, only about 14 percent of the sun's energy creates electricity.

- **Cost.** Even though solar systems are not highly efficient just yet, once the system is paid for the energy they generate is essentially free. However, some systems do use electricity for blowers or fans.

Passive systems are less expensive, but even photovoltaic systems have dropped in price significantly — 45% since 2010. Companies may also offer deals for financing and leasing. In addition, federal tax credits and state incentives are available for some structures.

Solar energy works best in regions that receive a great deal of sunlight annually, such

as southwestern states. Since solar energy does not always provide sufficient warmth, some homes need backup heating systems.

- **Disadvantages.** The availability of sunlight affects the solar power versus oil debate. Naturally, solar energy is not collected at night, so round-the-clock home heating relies on energy that has been stored. Though the sun still shines on cloudy days, the amount of solar energy that can be collected in bad weather is reduced.

Chapter 8: Wood as a Heat Source

How does heating with wood stack up? It depends somewhat on the method you use to heat with wood.

Ways to Heat With Wood

Wood-burning systems can be located indoors or outdoors, and there are a variety of systems available for wood heat, including:

- **Stoves.** The most popular option is an indoor wood- or pellet-burning stove. These function as space heaters because they need no ductwork. They are often located in the center of a house.

Placement is important because a pellet or wood heater needs space for both the stove and the chimney. The room with the stove is the warmest spot of the house. Therefore, the stove should be in a busy area, such as a family room, dining room or kitchen.

Open concept floor plans are well suited for wood stoves because warm air flows freely. A 2,000 square-foot house needs a stove rated at 60,000 BTU.

- **Indoor forced air furnaces.** The design of a wood or pellet forced air furnace includes a firebox to burn the fuel, a blower to disperse the warmed air and a chimney or smokestack to handle gas emissions. These furnaces are usually in basements or utility rooms, and the system pushes warmed air through ductwork.

Heat cannot be stored, so homeowners must add fuel regularly to maintain heat. This necessity is inconvenient for people with schedules that vary significantly or keep them away from home a great deal.

- **Hydronic systems.** A hydronic system, or wood-fired boiler, sends hot water through pipes. Individual room radiators often distribute the heat.

Many of these boilers also heat water for the entire house. Some systems have hot water storage tanks that help maintain consistent temperatures throughout the day.

- **Outdoor wood furnaces.** As indicated by their name, outdoor wood furnaces are not located inside the homes they heat. Instead, they consist of a firebox surrounded by water, and warmed water goes through underground pipes to the home. Once there, radiators or heat exchangers with ductwork distribute the heat.

Outdoor furnaces have some advantages. Wood, ash and dirt are kept outside the home. The firebox usually also has enough space to burn large or oddly shaped wood chunks. Unseasoned or wet wood is usable with outdoor furnaces as well.

Wood Burning Worries

While there are advantages to wood burning systems, there are also many concerns. On the whole, they generate more air pollution than other heating fuels. The circulating particles and soot can also lead to respiratory issues if people inhale them.

Vulnerable populations, such as infants, children and people with heart or lung disease can be seriously affected by wood-burning byproducts.

Both the U.S. Environmental Protection Agency (EPA) and individual state bureaus have set emission standards for wood burning systems.

Fire is also a potential hazard if homeowners do not properly operate wood-fueled heating systems. Outdoor furnaces have a better reputation because if a fire occurs, it is outside the house. Precautions should still be taken even if the furnace is not located inside the home.

On the whole, they generate more air pollution than other heating fuels.
The circulating particles and soot can also lead to respiratory issues if people inhale them.

Wood Pros and Cons

What's the heating oil versus wood synopsis? Depending on the model, wood- or pellet-burning stoves are 65 to 83 percent efficient. Indoor furnaces come in a little lower. An outdoor furnace has a 50 percent efficiency rate.

One advantage to heating with a wood burning system is if the wood is readily available, it's traditionally less expensive than electricity, natural gas or heating oil. However, installing a wood heating system can be a significant expense. Homeowner's insurance may go up as well. Another concern is the increased air pollution from using wood as heat above other methods of heating.

The average annual cost to heat with wood is difficult to determine. Wood fuel prices differ greatly by location. In addition, some individuals harvest their own supplies at no cost.

Chapter 9: Advantages and Disadvantages of Geothermal Energy

Air temperatures vary. In some locations, seasonal differences are great. However, four to six feet underground, temperatures are relatively consistent year-round, and geothermal energy harnesses this heat.

To scrutinize geothermal versus oil heat, it's necessary to understand geothermal basics.

Geothermal Essentials

Geothermal systems operate because the earth's temperature remains stable all year long a few feet underground. Temperatures vary by location but are generally between 45 and 75 degrees Fahrenheit.

Geothermal pumps provide both heating and cooling. Some also warm household water. Geothermal systems are effective in most climates, but sometimes homeowners may keep a back-up heating source for extremely cold weather, especially if their geothermal system is a bit smaller.

The different types of geothermal pumps are:

- **Closed loop.** In a closed loop pump, antifreeze runs through tubing that is underwater or underground. The system lies vertically or horizontally.

When the antifreeze reaches the house, a heat exchanger moves heat between the antifreeze and liquid in a heat pump. Heat travels through the building in ductwork or

radiant heating systems in floors or walls.

Horizontal arrangements are often least expensive for homes. Two pipes stretch four to six feet underground. In vertical systems, pipes run 100 to 400 feet into the earth.

When a pond or lake is nearby, a low-cost closed loop system is possible. An underground pipe connects the house to the water source. The pipe is coiled at least eight feet below the water's surface.

- **Open loop.** An open loop system requires surface water or a well. Water goes from the source, through a heat exchanger, throughout the house and back to its point of origin.

- **Hybrid**. In some cases, geothermal systems are combined. Other times geothermal heating works together with an air source. Hybrids are most useful in regions where cooling is more important than heating.

Assessing Geothermal Energy

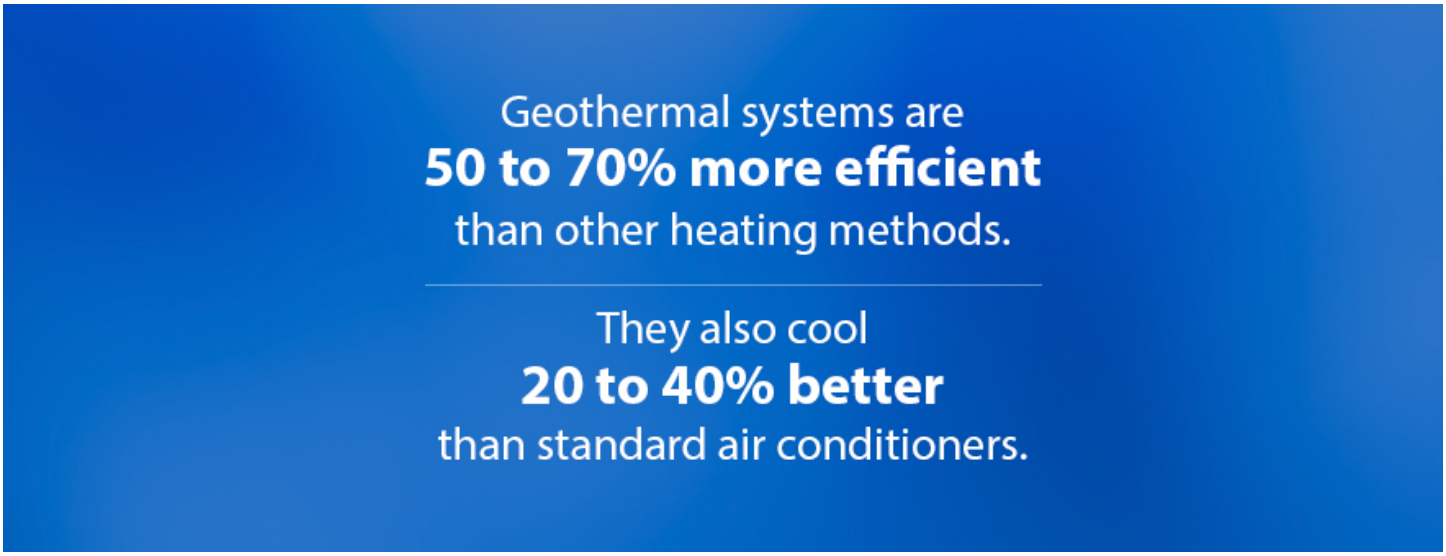
While efficiency and cost are important factors to consider, location is also an issue when evaluating geothermal systems. Like other heating systems, there are advantages and disadvantages of geothermal energy. Deciding if this type of heating works for you involves taking all the factors into consideration and weighing the pros and cons.

Efficiency

All heat pumps, including geothermal models, report their efficiency through a coefficient of performance, or COP. This compares the number of units of energy used to create power to the number of units of power actually generated.

Usually, for every unit of power needed to run a geothermal pump, the mechanism produces three to five units of energy. This means the COP of most geothermal pumps is between 3 and 5.

Geothermal systems are 50 to 70 percent more efficient than other heating methods. They also cool 20 to 40 percent better than standard air conditioners.



Geothermal systems are more expensive to install than air heating systems. Pond or lake geothermal versions are less costly if a water source is convenient. If there is no water source readily available, the next option is to use the horizontal option to keep costs as low as possible.

However, due to lower annual operating and maintenance costs, homeowners recoup their investments within five to 10 years. In addition, some federal and local government agencies offer incentives that bring the initial price down significantly.

Geothermal systems have long lives as well. Indoor parts are good for about 25 years, while underground components last at least 50 years. These systems also generally have low operating and maintenance costs.

The expense of heating and cooling with geothermal energy varies by model and capacity of the pump. For 2016 Energy Star certified pumps, the national average annual cost to run ranges from just under $100 to less than $600.

Disadvantages

One of the primary disadvantages of geothermal energy is that homeowners must have sufficient room to install the system, and there is an expensive upfront cost.

However, even with enough land, setting up the equipment disturbs the environment. Geothermal heating is also a relatively new process, so there are comparatively fewer installers than with more established systems.

Chapter 10: Consumer Choices

Consumers have many aspects to consider when selecting a home heating system.

Heating Options Summary

When it comes right down to it, all heating systems have advantages and disadvantages. Electric heat is both safe and inefficient. Natural gas is one of the least expensive options, but consumers must be located in areas that have gas utility supply systems. Propane heaters usually need little maintenance, but severe weather or fire can damage above ground tanks. Solar energy is inexpensive once the system is in place, and wood costs little if homeowners harvest the fuel themselves. However, neither heating method is very efficient.

Oil Heat Review

Safety and efficiency are just two of the benefits of oil heat. It produces more energy per BTU than other heating methods. Oil furnaces and boilers also require little upkeep from homeowners, and professionals regularly provide service through contracts.

In some areas, oil heat has a reputation of being one of the more expensive fuels, but that's not the whole story. Consumers who know how heating oil works have a lot of input into how much they pay. Oil suppliers offer a variety of payment options, such as locked-in rates, year-round budget plans and lower summer prices.

Making houses weatherproof helps to control heating costs as well. Weather stripping,

caulk and insulation keep heat in and cold out. Also, lowering the temperature on the thermostat significantly impacts what consumers pay annually to heat with oil.

Installing an oil heat system is more affordable than ever before. It's usually less than a comparative gas furnace. The northeastern United States has a strong tradition of heating with oil. Because of its high-energy output, oil heat can handle extremely cold winters. Now add on the convenience, safety and low maintenance that come with oil furnaces and boilers, and you have an ideal heating system.

Consumers who evaluate their options and choose oil heat have made a conscientious choice. Overall, oil systems meet their heating needs while keeping costs reasonable.

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