



# HOME HEATING

Minnesota Department of Commerce Energy Information Center

**A comfortable and healthy home environment requires an efficient and sound heating system. Such a system heats the home without using large amounts of energy, and it does not endanger the indoor air quality by overtaxing the supply of oxygen needed for combustion.**

## High efficiency furnaces

*It is important periodically to evaluate your heating system. It is especially important not to wait until a crisis occurs. A cold night in January, with the furnace faltering or failed, is not the time to assess your heating system. Do it now.*

## Electric heating systems

This guide is designed to help you assess your present heating system and determine if it is satisfactory, if improvements are needed, or whether the system should be replaced. If you determine a new furnace is needed, this guide will help you decide what type of unit to install. This guide also describes how to maintain your furnace and how to modify your current furnace to improve efficiency. The term “furnace,” as used in this guide, generally refers to both furnaces (which distribute heated air) and boilers (which distribute heated water). Recommendations or descriptions that apply specifically to boilers are noted.

## Furnace safety

Advances in technology have brought major improvements in heating systems over the past decade, including furnaces that use much less energy during a heating season and furnaces that bring in air from outside and supply it directly to the combustion process.

In assessing your present system, compare it with new, improved systems. An old furnace, even when it's running well, may extract only 60 percent of the available heat from the fuel over the heating system. That means only 60 cents of your heating dollars is going into the house as heat; the rest is going up and out the chimney. In contrast,

the best of the new furnaces are so efficient that they waste less than a nickel of very dollar spent.

You should also consider the amount of electricity used by a forced-air furnace, which can add significantly to the monthly costs of your heating system. Some new high efficiency gas furnaces have features such as a variable speed motor that reduce electric use.

You will also want to consider your present heating system in the context of the entire home. If, for example, you have added insulation, tightened up air leaks, or taken other measures to improve energy efficiency, it is critically important to ensure that fuel-burning appliances such as furnaces and water heaters have an adequate supply of combustion air. The section on safety (page 10) can help you determine whether your present heating system poses a health threat.

## Repair vs replacement

Your first step is to decide if your present furnace operates properly. If your furnace is old, or has a serious malfunction that will cost several hundred dollars to fix, it may be wise to replace it. As a general rule of thumb, if your furnace is more than ten years old and costs more than \$500 to fix, it should probably be replaced in place of repair.

If your furnace is old but not broken, deciding when to replace it can be difficult. Average life expectancy of furnaces in homes today is between 16 and 20 years. If your furnace is close to this

### Related Guides:

Home Cooling  
Home Insulation  
Combustion Air  
Wood Heat  
House Diagnostics  
Basement Insulation

## Look For:

Kitchen Exhaust Fans

Clothing Dryers

Whole house vacuums.

All exhaust air from you home

Anything that exhausts air from your home affects the operation of furnaces water heaters and fire places.

If and when you make a change you need to be assured the other appliances will be working properly.

age or older, begin shopping. This holds true for boilers as well, although boilers have greater life expectancy, 30 years. Be prepared to replace your furnace or boiler. Shopping for a replacement furnace in an emergency does not allow time to get fair market pricing.

The design of your house and the size of your utility bills may be deciding factors. Generally, if you have a large house with high heating bills, it could be more cost-effective to purchase a high efficiency furnace now rather than wait for your present furnace to wear out.

If you decide to repair your furnace, look for a heating professional who has experience with your type of heating system.

### Buying a new furnace

Whenever you purchase a new heating system the primary factors to consider are: the type of fuel you are going to use, how the heat will be distributed throughout the house, what size furnace to buy, and the efficiency rating.

**Type of fuel.** If you have a choice of fuels, you will want to consider which is the most affordable in the long run. See the table Comparing Fuel Costs.

**Heat distribution.** Consider the opportunities offered by different distribution systems. The primary difference between ‘furnaces’ and ‘boilers’ is that a furnace uses air to distribute heat throughout the house and a boiler uses water. Forced air systems allow easy installation of traditional central air conditioning, since the same ductwork can be used to distribute warm or cool air. This makes a forced air systems more economical if you plan to install central air conditioning.

**Furnace size.** Furnace size is almost as important as the efficiency rating. The most common mistake is buying a heating system too large for your home. Remember, the notion that ‘bigger is better’ does not apply to heating or air conditioning systems. If your heating system is oversized, it can create temperature swings in your home and reduce comfort.

Unfortunately, there are no simple rules for furnace sizing. The Energy Information Center recommends that you ask a heating professional to

do a heat loss calculation to ensure that you are buying the right size. Many municipalities require a heat loss calculation at the time the contractor requests a permit to install your heating system. A heat loss calculation includes factors such as the window area, type of windows, insulating properties of the wall, and the amount of heat loss through air leakage. Discuss any remodeling plans with your contractor. Ask any contractor who bases estimates solely on the square footage of your house to do a true heat loss calculation. If you are considering buying a central air conditioner at the same time as a new furnace, be sure that the air conditioner is sized properly. If your cooling unit is sized too large, it will not do a good job of dehumidifying.

**Furnace efficiency.** The Energy Information Center recommends that you look for a furnace with an AFUE (annual fuel-utilization efficiency) of more than 90 percent and a sealed combustion system (see figure 1). In addition, consider buying a furnace with a variable speed blower motor to improve electrical efficiency. Our recommendation for boilers is an AFUE of 84 percent or greater, with a sealed combustion system or a mechanical exhaust. If a high efficiency heating system is out of your price range, consider those furnaces and boilers with mechanical venting (see description of mechanical venting further on in this booklet). The more efficient a unit, the more heat (Btus) you will receive from your fuel. See the Sidebar on Understanding Efficiency Ratings. Remember, however, that an efficient heating system is only one component contributing to your home’s efficiency.

**Choosing a heating contractor.** A new heating system costs money – anywhere from \$2,000 to more than \$4,500. When buying a new heating system, you should compare prices. It isn’t unusual for bids to differ by as much as several hundred dollars. You should receive written bids on the cost of equipment and installation from at least three contractors, and ask each for the names of customers who have had their heating system for a few years. When evaluating bids, look at prices but also pay attention to and compare quality, energy savings, and warranties. If you are putting in a high efficiency furnace or boiler, ask if the contractor has special training in this type of installation. If you think your old heating system is covered with asbestos insula-

tion, discuss this with the contractor. Make sure they follow the proper procedures in dealing with asbestos removal.

A new heating system must be installed properly. Furnaces and boilers should be tuned and a combustion efficiency test performed after installation.

Make sure the contractor is fully bonded and insured. Heating contractors are licensed by your city, not the state. Your local licensing office may be a good resource for information on contractors in your area. Another source for a listing of contractors is the Sheet Metal Air Conditioning and Roofing Contractors Association (SMARCA), phone 612-593-0941. Look for a company that does installation and repairs. For more information on selecting a contractor, ask for a copy of "Hassle-Free Home Building and Remodeling" from the Minnesota Attorney General's Office, 651-296-3353, or 800-657-3787. Also available at [www.ag.state.mn.us](http://www.ag.state.mn.us).

### New high efficiency furnaces

A high efficiency furnace with sealed combustion or mechanical venting saves you money over the life of the furnace, reduces the chances of backdrafting furnace gases into the home, and contributes to a healthier environment.

The economic benefits can be surprising. For example, if you change from a furnace with 60 percent efficiency to a furnace with a 90 percent or higher efficiency, it is possible to save 30 to 40 percent on your annual fuel costs. Depending on whether you heat with gas, oil or propane, savings could be \$250 to \$500 per year. From a safety standpoint, efficient furnaces and water heaters with mechanical venting or, better yet, a sealed combustion system, greatly reduce the danger of backdrafting.

Some of the features to look for in a new furnace are described below and illustrated in Figure 1.

**Mechanical vent.** Forced draft or induced draft refers to the use of a fan or blower to push or pull the exhaust gases out of the chimney rather than relying on natural draft. The term "mechanical draft" is also used to describe this feature. Forced draft is necessary in today's furnaces. As more heat is extracted from combustion gases, they are cooled and become less likely to rise nat-

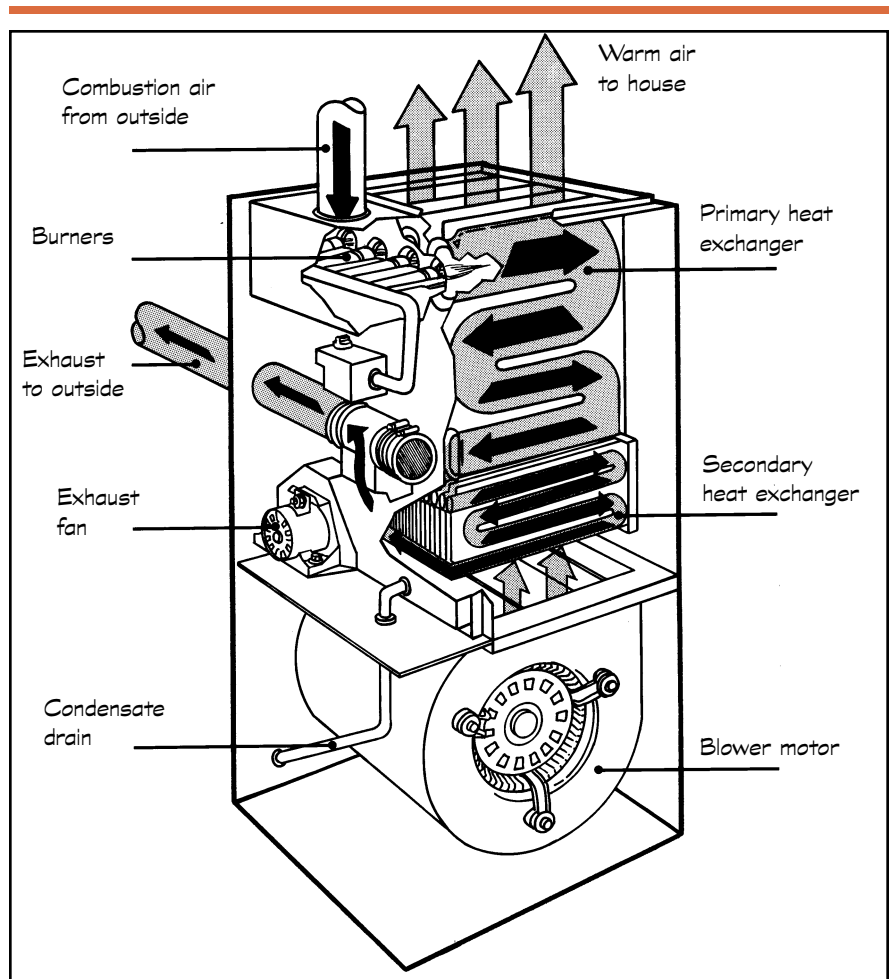


Figure 1

This typical high efficiency furnace has a second heat exchanger that extracts more heat from the combustion gases before exhausting them to the outside. It also has a sealed combustion chamber that allows for a consistent, reliable source of outside air for combustion and a means of venting the combustion gases directly out the side of the house.

## Ensure Safety!

Ensuring the safety of a home heating system is essential. Buying a furnace with a sealed combustion system and equipping your home with a carbon monoxide detector are two ways to protect yourself from carbon monoxide poisoning. See page 10 sidebar Safety is Number One Concern for more information.

usually up the chimney. The exhaust of indoor air by other appliances compounds the problem. Bath and kitchen exhaust fans, cook top exhaust systems, clothes dryers, and loss of indoor air through attic bypasses all contribute to the danger of an inadequate supply of indoor air. Forced draft is an important feature to look for in any furnace, water heater, or boiler. Some forced draft furnaces provide for venting combustion gases out the wall rather than up the chimney. If you purchase that type of furnace and you have a combustion water heater, the water heater exhaust vent may need to be readjusted (see “one important caution” under Sealed combustion below).

**Sealed combustion** is especially recommended. This feature dramatically increases safety and efficiency since there is no mixing of the air in the furnace with the air in your house. You will not be using your warm room air for combustion. Because the exhaust is usually vented directly out the sidewall through a plastic pipe, you do not need a traditional chimney connection. This allows more flexibility in where you place your furnace. Sealed combustion also keeps indoor air pollutants from entering the furnace, causing corrosion or other damage to the furnace. *One important caution: if you replace your furnace with a furnace that is vented out the side of the house, it is especially important to have your heating contractor assess and readjust, if necessary, the flue or vent on the water heater to help safeguard against backdrafting.* Recent studies indicate that fuel-burning water heaters are a significant source of backdrafting in Minnesota homes.

### Electric and other types of heating systems

The efficiency of electric heating equipment is measured in terms of Coefficient of Performance (COP). A COP of 1.0 means that the heat energy the appliance delivers is the same as the electrical energy it uses: it operates at 100 percent efficiency. Heat pumps that extract heat from the ground or earth can actually operate at greater than 100 percent efficiency and many have a COP of higher than 3.0.

Despite their high efficiency, electric units – at current prices of electricity – may cost more to operate than oil, natural gas, or propane furnaces. Energy- and cost-saving options are available,

however, that may make electric heating cost competitive. For example, many utilities offer a discount rate to customers willing to have a portion of their power cut off during periods of high demand, usually somewhere between 8 a.m. and 8 p.m. daily. To qualify for these rates usually requires having a back-up fuel source or a thermal storage system. Call your utility to see if discount rates are available.

A back-up fuel source such as fuel oil or propane can be used when electricity is interrupted. The main considerations are availability and cost of the back-up fuel as well as how the heat would be distributed throughout the house. Under this agreement, the customer’s power may be interrupted any time the utility experiences a high demand for power.

Another way to qualify for discount rates is with a thermal energy storage system. This system requires a large thermal mass to absorb heat and store it for release during the utility’s daily peak demand period, when power from the utility is shut off.

Various types of electric systems are listed below.

**Baseboard resistance heaters** are the least expensive to install, but they are the most expensive to operate. They usually do not allow taking advantage of special low electric rates, since they lack the capacity to store heat.

**Electric furnaces**, in addition to supplying heat, also allow for air conditioning to be added, and some models can accommodate thermal storage devices. Since electric furnaces can lose a significant amount of heat through the seams in ductwork, make sure these points are well sealed.

**Radiant heating.** Electric heating cables, in the past mainly installed in ceiling or wall panels, are now more often installed to provide radiant heat in floors. In-floor radiant heating also can be provided by water, heated by a boiler or ground source heat pump. The heated water circulates through plastic tubing fastened beneath a wood floor, in a cement floor, or in a lightweight cement overlay on an existing floor. In-floor radiant heating provides more constant heat than baseboard heaters, allows for a lower thermostat setting, but also takes a longer time to adjust to changes in temperature. Radiant heating is most easily

installed during new construction or major remodeling and is appropriate for energy-saving zoned heating.

**Electric thermal storage systems (ETS)** operate with resistive electric heat during the utility's off-peak hours, allowing homeowners to substantially reduce their heating costs by taking advantage of off-peak discount rates. ETS furnaces use either ceramic bricks or water to store heat and are available as a central furnace or room heater. If you are building a home, you can bury heating cables in sand or earth beneath concrete slab floors; however, if you choose this method you must insulate under the cables (R-10 is the recommended level) or you will lose a large amount of heat to the ground. ETS systems can prevent energy waste by varying the amount of heat stored according to the outdoor temperature.

**Heat pumps.** Unlike furnaces, heat pumps do not burn fuel to produce heat. Instead, they transfer heat from one place to another, much like your refrigerator does. To accomplish home heating, a pump extracts heat from the ground, air, or water and distributes warm air to your house, usually through a forced air system. Heat pumps can be reversed to provide air conditioning in the summer. The heating performance of air source heat pumps is rated by the HSPF (heating season performance factor), ground source heat pumps by the COP (coefficient of performance). HSPF is determined by the estimated seasonal heating output divided by the seasonal power consumption for the average U.S. climate. The Energy Information Center recommends that HSPF of 8.5 or higher for air source heat pumps and a COP of 3.2 or higher for a ground source closed loop heat pump.

Although a variety of heat pumps are available, a horizontal closed loop ground source heat pump appears to be the most practical for Minnesota because deep earth temperature remains at a fairly constant 50° F. year round. Heat pumps are more expensive to buy and install as a retrofit.

Keep in mind that whenever your heat pump or air conditioner is serviced, the refrigerant should always be recovered and properly recycled and never vented into the air.

Recent advances in technology have produced some totally new types of heating systems. These include:

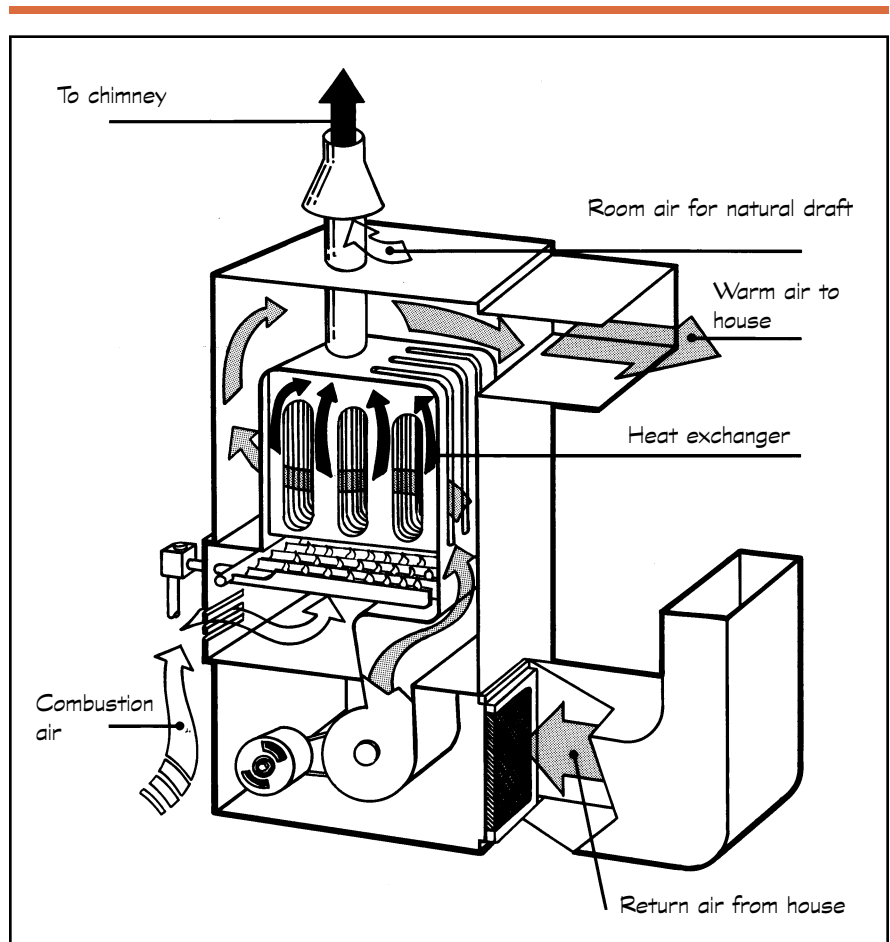


Figure 2

This traditional, low efficiency furnace uses room air for combustion, has a single heat exchanger, and relies on natural buoyancy to exhaust the combustion gases through the chimney.

## Understanding Efficiency Ratings

**AFUE** (annual fuel utilization efficiency) applies to gas and oil furnaces and measures efficiency over the entire heating season, telling you how much of your fuel dollar is converted into heat. Similar to a miles-per-gallon rating for your car, the higher the AFUE the more efficient the furnace. An old, poorly maintained gas forced-air furnace may have an AFUE of only 50 to 60 percent, while the most efficient of the new designs have ratings of higher than 90 percent. The AFUE does NOT include Electrical Energy Consumption.

According to federal law, all gas or oil burning furnaces manufactured after January 1, 1992, require a minimum of AFUE of 78.2 percent.

**Steady-state** applies to gas and oil furnaces and measures how well your heating system operates while it is running. Use this rating to compare the combustion and heat exchanges efficiency of different models.

**COP** (co-efficient of performance) measures the efficiency of electric heating equipment. A COP of 1.0 indicates 100 percent efficiency, meaning that the heat energy you receive from the furnace is exactly equal to the energy it consumes. Heat pump equipment usually has a COP of greater than 1.0 because it acquires heat energy from an external source and uses electrical energy to move that heat indoors in winter - outdoors in summer.

**SEER** (seasonal energy efficiency ratio) measures efficiency of central air conditioning or heat pumps in the cooling mode. Like AFUE, SEER measures how efficiently the equipment operates over the season. The most efficient models have SEERs of 13 to 14.

**HSPF** (heating season performance factor) measures the heating efficiency of air source heat pumps. It is the ratio of heating energy produced to energy consumed: it is determined by dividing the seasonal heating output in BTU's by the seasonal power consumption in watts.

**Combined space heating/water heating systems** combine water and space heating into a single unit. Although the cost of space heating remains about the same as with a high efficiency furnace, the cost of water heating is significantly reduced – up to 40 percent. If your household uses a lot of hot water (if you have teenage children, for example), this type of system could bring considerable savings.

**Variable rate furnaces** use considerably less electricity – as much as 60 percent less – than other forced-air furnaces. Features include microprocessor controls, which automatically adjust air flow to achieve maximum efficiency. In addition to saving energy, these furnaces are quieter in operation and increase comfort by eliminating the rush of cold air (cold shot) when the furnace cycles on.

## Maintaining your furnace and duct system

Keeping your heating system well maintained and properly adjusted is important for every system – new or old. A qualified service person should periodically check, clean, and tune your furnace, not only for energy efficiency but also for safety. Make sure the duct is sealed. Sealing duct work with aluminized duct tape can improve the efficiency of your cooling system and reduce heat loss. It may be a good idea to ask a heating specialist to balance the heating system.

All oil and gas furnaces should be tuned every year, unless the manufacturer directs otherwise.

Do-it-yourself maintenance measures include:

- Change the furnace filter once a month.
- Clean the blower at least once a year.
- Make sure registers and radiators are not blocked by furniture or draperies.
- Bleed radiators, baseboard heaters, and other systems that use heat radiation once a year.

## Operating your furnace

How you operate your heating system affects how much energy you use. Follow these suggestions to lower your heating bill:

- Turn down thermostats in unused rooms, at night, and when you are going to be gone for

more than four hours during the day. Automatic setback thermostats can do this for you (see below).

- Have your heating contractor adjust the fan thermostat for an efficient on-off temperature.
- Close off both the supply and return registers to the basement or other unused rooms.

### Modifying your furnace

If you decide not to replace your furnace, you might think about modifying it to improve efficiency.

**Warning:** Furnaces are designed with safety in mind. Changing the way a furnace operates may upset its operation, which can have dangerous repercussions.

If your furnace is more than 10 years old, the better investment is to put the money proposed for improvement toward a new high efficiency furnace. Because boilers have a longer life expectancy (30 years), the cut off for improvements would be between 15 and 20 years.

Interest in improving efficiency has spawned dozens of devices to modify existing furnaces. Beware of add-on devices that claim to save energy. Some of these products might work, but others will actually raise your fuel bill, damage your heating system, or pose a danger to your family.

Whether or not a device is good or bad depends on the characteristics of your furnace. It is therefore important to consult a qualified heating contractor or service person before using any of these products.

The equipment and alterations that are known to be safe and effective in some situations are:

**Automatic setback thermostat.** Lowering the thermostat at night or during the day while you are away will save one percent for every one-degree-Fahrenheit per eight hours of setback. Manually resetting the temperature twice a day will not cost anything, but this can be inconvenient. Instead, you can get an automatic setback thermostat to do the work for you. Some are relatively inexpensive and pay for themselves in a very short time.

## How a Furnace Works

The basic operating process is the same for all furnaces and boilers regardless of the type of fuel they use.

- The thermostat calls for heat and starts the ignition and combustion process. Fuel is delivered to the combustion chamber, mixed with air, and ignited to produce heat in the form of hot gases.
- These hot combustion gases flow through the heat exchanger, warming it. The combustion gases exit the furnace and are exhausted from the home.
- A control with the heat exchanger starts the fan.
- This process continues until the room thermostat anticipates enough heat is left in the furnace to bring the house up to the temperature set by the thermostat. The thermostat then tells the burner to shut off. The furnace fan continues to run until the heat exchanger thermostat turns the fan off.

Older furnaces and boilers depend upon natural buoyancy of the hot air or hot water to distribute heat within the home. This same natural buoyancy is depended upon to exhaust gases from furnaces and boilers. Changes in efficiency of equipment and in the characteristics of homes require that furnaces manufactured today use fans to push the exhaust out of the home.

## Comparing Fuel Costs

In deciding which heating fuel to use, a comparison of costs helps.

To compare costs, you must first convert the fuels into a common unit - BTUs, which is a measure of heat energy. Below is a list of fuels and the amount of each required to produce 1 million BTUs:

Natural Gas	10 therms or 10 mcf	=	1 million BTUs
Electricity	293 kilowatt-hours	=	1 million BTUs
Propane	10.9 gallons	=	1 million BTUs
Heating Oil	7.21 gallons	=	1 million BTUs

The average Minnesota home uses 80 to 100 million BTUs annually for heating. Using statewide averages for fuel costs, the table below lists the cost per million BTUs of the various fuels and calculates the annual cost of producing 100 million BTUs of heat. It is important to note that only an electric heating system operates at 100 percent efficiency. To determine the annual cost of providing 100 million BTUs of usable heat from all the other fuels, the efficiency factor of the heating system must be considered. For example, a natural gas furnace with an AFUE of 90 delivers 90 percent of the BTUs into the home as heat. To provide 100 million BTUs of usable heat, therefore, the furnace must produce 111.1 million BTUs for an annual cost of \$555. On the other hand, a ground source heat pump with a COP of 3.2 uses only 31.2 million BTUs of purchased electric energy to produce 100 million BTUs of usable heat; the annual heating cost would be \$640.

Fuel	Cost per unit	Cost per million BTU	Annual fuel costs*
Natural gas	\$0.50 per therm	\$5	\$500
[furnace with AFUE of 90]	\$0.50 per therm	\$5	\$555]
Electricity	\$0.07 per kWh	\$20.51	\$2,051]
[ground source heat pump]	\$0.07 per kWh	\$20.51	\$640]
Propane	\$0.80 per gallon	\$8.72	\$872
Heating oil	\$0.90 per gallon	\$6.50	\$650

\*for 100 million BTUs of delivered heat



**Vent dampers.** This device automatically blocks off the vent pipe after the burner shuts off. This prevents warm air from escaping up the vent when the furnace isn't running. On the average, you will save about six percent on your fuel bills with a vent damper.

Dampers are either thermally or electrically operated. Thermal dampers, the cheapest but least effective of the two, open and close by the change in exhaust gas temperature. Electric dampers are much more effective, since they are timed to go on and off with the burner. They also have a built-in safety feature that prevents the burner from lighting if the damper fails to open.

All vent dampers must pass certain safety standards before installation is permitted by the State Building Code. If they are not up to standard, or are improperly installed, they can be extremely dangerous. If the damper doesn't open when the burner comes on, combustion gases will build up in the house.

**Chimney liners.** An oversized chimney wastes heat and drafts poorly. One solution is to put in a correctly sized metallic liner to reduce air flow. A liner also extends the life of masonry chimneys by preventing deterioration from the flue gases. Liners must be properly installed and tested by a qualified service person to make sure combustion gases do not spill into the living space. This is especially important if you are replacing your furnace but not the combustion water heater; in some cases the chimney liner may have to be replaced to reduce the risk of backdrafting (see the caution under the description of sealed combustion furnaces earlier). If you have a gas furnace with a masonry chimney, you must have a metallic liner. Have your contractor inspect for this.

**Oil burner replacement.** In most cases, replacing the old burner with a new high efficiency burner is the most economical modification that can be made to an oil furnace. In fact, you can expect a new burner to increase the efficiency of your present furnace by about 15 percent. Have your heating contractor assess the possibility of making this improvement.

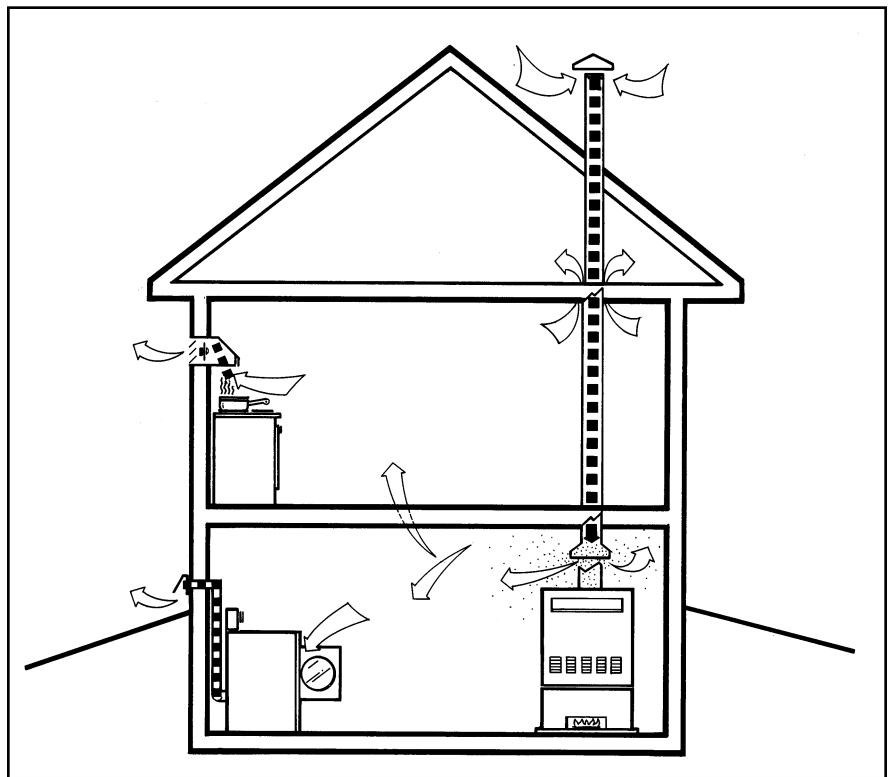


Figure 3

Arrows show pattern of home air movement. Exhaust fans for stove, clothes dryer, and other appliances reduce the amount of fresh air in the home and can result in furnace exhaust gases backdrafting.

## Safety Is a Number One Concern

When a fuel such as gas or oil is burned, the main combustion products are water vapor, carbon dioxide, and nitrogen oxides. If these gases are not vented properly to the outside, serious problems can develop - problems that affect your personal health, your furnace, and your home.

The most publicized - and most serious - of these problems is carbon monoxide poisoning, which causes illness or death among Minnesotans every winter. If there is too little oxygen to burn the fuel, combustion is incomplete, producing carbon monoxide, a colorless, odorless gas that can quickly build up to dangerous levels. Other dangerous gases, including nitrogen oxides, formaldehyde, and other aldehydes, can also build up and cause serious health problems, especially when combined with poor ventilation.

An indicator of a serious problem is the buildup of moisture in the house. Backdrafting of combustion appliances such as a water heater or furnace, and a leaky cracked heat exchanger, will increase moisture in the house. One hundred cubic feet of natural gas produces more than a gallon of water in the form of vapor. If not vented, this vapor condenses on any cool surface (and incidentally, can cause serious damage to the house structure.)

Because this moisture normally exhausts out of the chimney, excessive humidity in your house may be a warning sign that your gas furnace or other fuel-burning appliance is not venting properly. Other indicators of gas furnace problems are frequent headaches, a burning feeling in nose and eyes, nausea, disorientation and other flu-like symptoms, and a yellow rather than blue combustion flame. With an oil furnace, warning signs are black chimney smoke, a fuel smell in the house, soot accumulation, and a popping or banging sound caused by late ignition or insufficient combustion air.

If you suspect a problem, air out your house, open a window near the furnace room, and immediately call your heating contractor, utility, or service technician.

For help in preventing combustion air problems, call the Energy Information Center. We recommend buying a furnace that has a sealed combustion system or, at a minimum, a furnace that forces the exhaust gases out of the home with a fan. We also recommend that you install a carbon monoxide detector in your home.

**Combustion air test.** You can perform a simple test yourself to see if your furnace is venting properly. There are more details available in our *Combustion Air Guide*.

- Close all windows, exterior doors, and bedroom doors.
- Open all interior doors.
- Turn on all exhaust fans, the clothes dryer, and waterheater.
- Turn on the furnace and wait a minute for the draft to stabilize.
- Hold a smoking object (incense stick or match) about two inches from the draft hood opening. If the smoke is drawn into the hood, the furnace is venting properly. If the smoke is blown away from the hood, combustion gases are spilling out and you must correct the problem. Open a window a crack in the furnace room and call a heating contractor at once.

## Be wise: weatherize

Whether or not you buy a new furnace, it is a good idea to weatherize your home. Adding insulation and strategically caulking and weatherstripping will make your home more comfortable, save energy, and reduce the size of the furnace you need if you are going to purchase a new system. As your heating load decreases, the size and cost of a heating system required to meet that load also decreases. You might consider having a home energy efficiency analysis performed. Sometimes referred to as an energy audit," this is a detailed examination of your home's energy use often provided at no or low cost by utilities. Check with your utility to see if it provides an audit.

It is important to remember that if you tighten your home you must make sure that you have adequate indoor ventilation.

## Bibliography

American Council for an Energy-Efficient Economy (ACEEE) 6th edition, *The Most Energy Efficient Appliances 1995*, available from bookstores for \$8.95 or from 1001 Connecticut Avenue N.W. Suite 801, Washington, D.C. 20036, 202-429-0063 or [www.aceee.org](http://www.aceee.org)

Energy Information Center publications are available free. They include *Combustion Air*, *Home Energy Guide*; *Drafthood Test for Combustion Air*, a check for homeowners; and *Furnace and Boiler Tune-Up*, a check-list for homeowners.