

Humboldt Energy Task Force
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TO:

The Humboldt Energy Task Force (HETF) is a coalition of local government agencies working together to provide local energy conservation tools and solutions for Humboldt County. For more information please contact:

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Home Heating

Energy Brief # 1



***Strategy and Action to Reduce
Your Utility Bills and Heat Your
Home Safely***



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 releasing carbon monoxide into the heated space. It is important to evaluate your heating system periodically. 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.

In assessing your present natural gas-powered home heating 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. That means only 60 cents of each heating dollar is going into the house as heat and 40 cents 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 every 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. For example, if 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 instead of repaired.

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 age or older, begin shopping. Be prepared to replace your furnace. Shopping for a replacement furnace in an emergency does not allow time to get fair market pricing.

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 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.

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. 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

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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 kills or makes ill many people 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 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.

The Humboldt Energy Task Force recommends 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 you install a carbon monoxide detector in your home.

How a Furnace Works

The basic operating process is the same for all furnaces 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 switch activated by a temperature sensor in the heat exchanger starts the fan (in forced-air systems).
- This process continues until the air in the house reaches 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. Changes in efficiency of equipment, indoor air quality standards, and characteristics of homes require that furnaces manufactured today use fans to push the exhaust out of the home.

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 save you money 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 what size furnace to buy and the efficiency rating.

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 Humboldt Energy Task Force 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 considers factors such as the window area, type of windows, insulation in walls, and 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 Humboldt Energy Task Force 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. If a high efficiency heating system is out of your price range, consider those furnaces with mechanical venting (see description of mechanical venting on page 7). The more efficient a unit, the more heat (BTUs) you will receive from your fuel. See the sidebar on Understanding Efficiency Ratings on page 6. Remember that an efficient heating system is only one component contributing to your home's efficient use of energy.

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, ask if the contractor has special training in this type of installation. If you think your old heating system is covered with asbestos insulation, 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 should be tuned and a combustion efficiency test performed after installation. Make sure the contractor is fully bonded and insured.

- Turn down thermostats in unused rooms, at night, and when you are going to be gone for more than two 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.
- Unplug or turn off the electric power to your furnace blower and controls in summer to save some electric energy.

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.

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.

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.

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.*

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 gas furnaces should be tuned every year, unless the manufacturer directs otherwise. Do-it-yourself maintenance measures include:

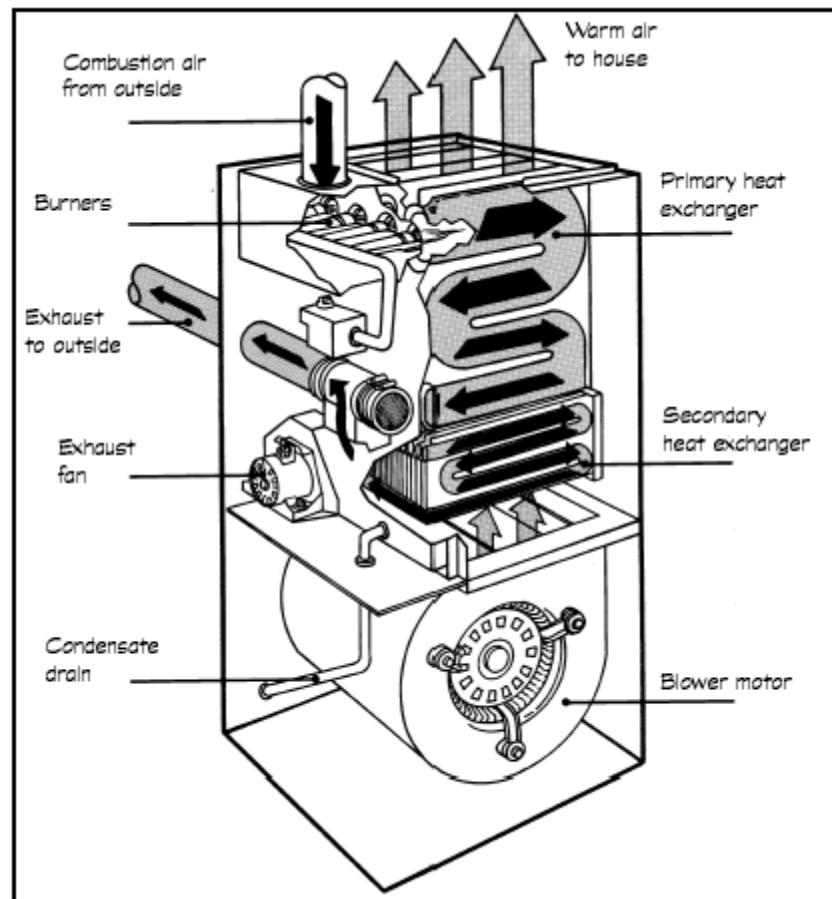
- Change the furnace filter at least once a year (some are washable).
- Clean the blower at least once a year with a shop vacuum cleaner.
- Make sure registers are not blocked by furniture or draperies.

Operating your furnace

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

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, worth up to \$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.

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.

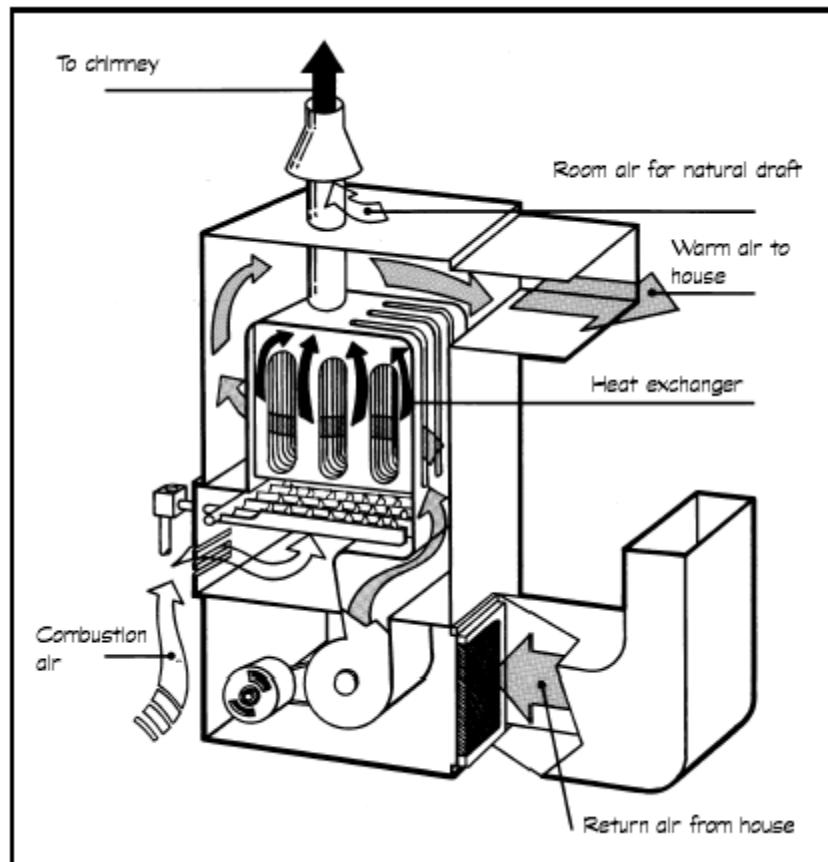


Figure 2

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.

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 naturally 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