Taos Home Heating with Furnace or Boiler

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Most U.S. homes are heated with either furnaces or boilers. Furnaces heat air and distribute the heated air through the house using ducts; boilers heat water, providing either hot water or steam for heating. Steam is distributed via pipes to steam radiators, and hot water can be distributed via baseboard radiators or radiant floor systems, or can heat air via a coil. Steam boilers operate at a higher temperature than hot water boilers, and are inherently less efficient, but high-efficiency versions of all types of furnaces and boilers are currently available.
Understanding the Efficiency Rating of Furnaces and Boilers A central furnace or boiler's efficiency is measured by annual fuel utilization efficiency (AFUE). The Federal Trade Commission requires new furnaces or boilers to display their AFUE so consumers can compare heating efficiencies of various models. AFUE is a measure of how efficient the appliance is in the energy in its fuel over the course of a typical year. Specifically, AFUE is the ratio of heat output of the furnace or boiler compared to the total energy consumed by a furnace or boiler. An AFUE of 90% means that 90% of the energy in the fuel becomes heat for the home and the other 10% escapes up the chimney and elsewhere. AFUE doesn't include the heat losses of the duct system or piping, which can be as much as 35% of the energy for output of the furnace when ducts are located in the attic. An all-electric furnace or boiler has no flue loss through a chimney. The AFUE rating for an all-electric furnace or boiler is between 95% and 100%. The lower values are for units installed outdoors because they have greater jacket heat loss. However, despite their high efficiency, the higher cost of electricity in most parts of the country makes all-electric furnaces or boilers an uneconomic choice. If you are interested in electric heating, consider installing a heat pump system. The minimum allowed AFUE rating for a non-condensing fossil-fueled, warm-air furnace is 78%; the minimum rating for a fossil-fueled boiler is 80%; and the minimum rating for a gas-fueled steam boiler is 75%. A condensing furnace or boiler condenses the water vapor produced in the combustion process and uses the heat from this condensation. The AFUE rating for a condensing unit can be much higher (by more than 10 percentage points) than a non-condensing furnace. Although condensing units cost more than non-condensing units, the condensing unit can save you money in fuel costs over the 15- to 20-year life of the unit, and is a particularly wise investment in cold climates.

You can identify and compare a system's efficiency by not only its AFUE but also by its equipment features, listed below.

Old, low-efficiency heating systems:
- Natural draft that creates a flow of combustion gases
- Continuous pilot light
- Heavy heat exchanger
- 68%–72% AFUE

Mid-efficiency heating systems:
- Exhaust fan controls the flow of combustion air and combustion gases more precisely
- Electronic ignition (no pilot light)
- Compact size and lighter weight to reduce cycling losses
- Small-diameter flue pipe
- 80%–83% AFUE

High-efficiency heating systems:
- Condensing flue gases in a second heat exchanger for extra efficiency
- Sealed combustion
- 90%–97% AFUE Retrofitting Your Furnace or Boiler

Furnaces and boilers can be retrofitted to increase their efficiency. These upgrades improve the safety and efficiency of otherwise sound, older systems. The costs of retrofits should be carefully weighed against the cost of a new boiler or furnace, especially if replacement is likely within a few years or if you wish to switch to a different system for other reasons, such as adding air conditioning (see the section on selecting and replacing heating and cooling systems). If you choose to replace your gas heating system, you'll have the opportunity to install equipment that incorporates the most energy-efficient heating technologies available.

Since retrofits are fuel-specific, see the following sections for retrofit information:
- Gas-Fired Furnaces and Boilers (includes units fired with natural gas and propane)
- Oil-Fired Furnaces and Boilers

Other retrofitting options that can improve a system's energy efficiency include installing programmable thermostats, upgrading ductwork in forced-air systems, and adding zone control for hot-water systems, an option discussed in the Heat Distribution Systems section. Replacing Your Furnace or Boiler Although older furnace and boiler systems had efficiencies in the range of 56%–70%, modern conventional heating systems can achieve efficiencies as high as 97%, converting nearly all the fuel to useful heat for your home. Energy efficiency upgrades and a new high-efficiency

heating system can often cut your fuel bills and your furnace's pollution output in half. Upgrading your furnace or boiler from 56% to 90% efficiency in an average cold-climate house will save 1.5 tons of carbon dioxide emissions each year if you heat with gas, or 2.5 tons if you heat with oil. If your furnace or boiler is old, worn out, inefficient, or significantly oversized, the simplest solution is to replace it with a modern high-efficiency model. Old coal burners that were switched over to oil or gas are prime candidates for replacement, as well as gas furnaces with pilot lights rather than electronic ignitions. Newer systems may be more efficient but are still likely to be oversized, and can often be modified to lower their operating capacity.

Before buying a new furnace or boiler or modifying your existing unit, first make every effort to improve the energy efficiency of your home, then have a heating contractor size your furnace. Energy-efficiency improvements will save money on a new furnace, because you will need a smaller furnace. A properly sized furnace will also operate most efficiently. You'll also want to look for a dependable unit and compare the warranties of each furnace or boiler under consideration. When shopping for high-efficiency furnaces and boilers, look for the ENERGY STAR label. If you live in a cold climate, it usually makes sense to invest in the highest-efficiency system. In milder climates with lower annual heating costs, the extra investment required to go from 80% to 90%-95% efficiency may be hard to justify. You can estimate the annual savings from heating system replacements by using Table 1. The table assumes that both furnaces have the same heat output. However, most older systems are oversized, and will be particularly oversized if you significantly improve the energy efficiency of your home. Because of this additional benefit, your actual savings in upgrading to a new system could be much higher than indicated in the table. Specify a sealed combustion furnace or boiler, which will bring outside air directly into the burner and exhaust flue gases (combustion products) directly to the outside, without the need for a draft hood or damper. Furnaces and boilers that are not sealed-combustion units draw heated air into the unit for combustion and then send that air up the chimney, wasting the energy that was used to heat the air. Sealed-combustion units avoid that problem and also pose no risk of introducing dangerous combustion gases into your house. In furnaces that are not sealed-combustion units, backdrafting of combustion gases can be a big problem. High-efficiency sealed-combustion units generally produce an acidic exhaust gas that is not suitable for old, unlined chimneys, so the exhaust gas should either be vented through a new duct or the chimney should be lined to accommodate the acidic gas (see the section on maintaining proper ventilation, below). Table 1. Annual Estimated Savings for Every $100 of Fuel Costs by Increasing Your Heating Equipment Efficiency* Existing System AFUE New/Upgraded System AFUE 55% 60% 65% 70% 75% 80% 85% 90% 95% 50% $9.09 $16.76 $23.07 $28.57 $33.33 $37.50 $41.24 $44.24 $47.36 55% ---- $8.33 $15.38 $21.42 $26.66 $31.20 $35.29 $38.88 $42.10 60% ---- ---- $7.69 $14.28 $20.00 $25.00 $29.41 $33.33 $37.80 65% ---- ---- ---- $7.14 $13.33 $18.75 $23.52 $27.77 $31.57 70% ---- ---- ---- ---- $6.66 $12.50 $17.64 $22.22 $26.32 75% ---- ---- ---- ---- ---- $6.50 $11.76 $16.66 $21.10 80% ---- ---- ---- ---- ---- ---- $5.88 $11.11 $15.80 85% ---- ---- ---- ---- ---- ---- ---- $5.55 $10.50 90% ---- ---- ---- ---- ---- ---- ---- ---- $5.30

*Assuming the same heat output Maintaining Furnaces and Boilers

The following maintenance should be provided by a heating system professional.

All systems:
- Check the condition of your vent connection pipe and chimney. Parts of the venting system may have deteriorated over time. Chimney problems can be expensive to repair, and may help justify installing new heating equipment that won't use the existing chimney.
- Check the physical integrity of the heat exchanger. Leaky boiler heat exchangers leak water and are easy to spot. Furnace heat exchangers mix combustion gases with house air when they leak—an important safety reason to have them inspected.
- Adjust the controls on the boiler or furnace to provide optimum water and air temperature settings for both efficiency and comfort.
- If you're considering replacing or retrofitting your existing heating system, have the technician perform a combustion-efficiency test.

Forced-air Systems:
- Check the combustion chamber for cracks
- Test for carbon monoxide (CO) and remedy if found
- Adjust blower control and supply-air temperature
- Clean and oil the blower
- Remove dirt, soot, or corrosion from the furnace or boiler
- Check fuel input and flame characteristics, and adjust if necessary
- Seal connections between the furnace and main ducts.

Hot-water Systems:
- Test pressure-relief valve
- Test high-limit control

- Inspect pressure tank, which should be filled with air, to verify that it's not filled with water
- Clean the heat exchanger.

Steam Systems:
- Drain some water from the boiler to remove sediments. This improves the heat exchange efficiency
- Test low-water cutoff safety control and high-limit safety control
- Drain the float chamber to remove sediments. This prevents the low-water cutoff control from sediment clogs
- Analyze boiler water and add chemicals as needed to control deposits and corrosion
- Clean the heat exchanger
- See also the section on steam radiators. Maintaining Proper Ventilation for Combustion Systems Anytime you maintain, retrofit, or replace a gas heating system you also need to be concerned with air quality. Combustion air is needed by all oil and gas heating systems to support the combustion process. This air is provided in some homes by unintentional air leaks, or by air ducts that connect to the outdoors. The combustion process creates several byproducts that are potentially hazardous to human health and can cause deterioration in your home. You can protect yourself from these hazards, as well as maintain energy efficiency, by ensuring that your chimney system functions properly and that your gas heating system is properly ventilated. In some cases, installing a sealed-combustion furnace or boiler can also help. Chimneys Properly functioning chimney systems will carry combustion byproducts out of the home. Therefore, chimney problems put you at risk of having these byproducts, such as carbon monoxide, spill into your home. Most older gas furnaces and boilers have naturally drafting chimneys. The combustion gases exit the home through the chimney using only their buoyancy combined with the chimney's height. Naturally drafting chimneys often have problems exhausting the combustion gases because of chimney blockage, wind or pressures inside the home that overcome the buoyancy of the gases. Atmospheric, open-combustion furnaces and boilers, as well as fan-assisted furnaces and boilers, should be vented into masonry chimneys, metal double-wall chimneys, or another type of manufactured chimney. Masonry chimneys should have a fireclay, masonry liner or a retrofitted metal flue liner. Many older chimneys have deteriorated liners or no liners at all and must be relined during furnace or boiler replacement. A chimney should be relined when any of the following changes are made to the combustion heating system:
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When you replace an older furnace or boiler with a newer one that has an AFUE of 80% or more. These mid-efficiency appliances have a greater risk of depositing acidic condensation droplets in chimneys, and the chimneys must be prepared to handle this corrosive threat. The new chimney liner should be sized to accommodate both the new heating appliance and the combustion water heater by the installer.
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When you replace an older furnace or boiler with a new 90+ AFUE appliance or a heat pump. In this case, the heating appliance will no longer vent into the old chimney, and the combustion water heater will now vent through an oversized chimney. This oversized chimney can lead to condensation and inadequate draft. The new chimney liner should be sized for the water heater alone, or the water heater in some cases can be vented directly through the wall. Other Ventilation Concerns Some fan-assisted, non-condensing furnaces and boilers, installed between 1987 and 1993, may be vented horizontally through high-temperature plastic vent pipe (not PVC pipe, which is safely used in condensing furnaces). This type of venting has been recalled and should be replaced by stainless steel vent pipe. If horizontal venting was used, an additional draft-inducing fan may be needed near the vent outlet to create adequate draft. Floor furnaces may have special venting problems because their vent connector exits the furnace close to the floor and may travel 10 to 30 feet before reaching a chimney. Check to see if this type of venting or the floor furnace itself needs replacement. If you smell gases, you have a venting problem that could affect your health. Contact your local utility or heating contractor to have this venting problem repaired immediately.