Comparing Heating Systems

Central heating systems have been considered a necessity in our homes and businesses for many years. When comparing available systems, consumers should carefully consider safety, installation cost, operating costs, maintenance costs, and comfort.

Types of Systems

There are two basic types of systems — those that require a flame to operate (i.e., combustion based), and those that do not. Most central systems presently installed create heat by combustion, just as they did in the early part of the century. These systems use a furnace to burn a fossil fuel (such as oil, natural gas or propane) or, in some instances, wood. More advanced, non-combustion systems operate by transferring or moving heat from one location to another.

Combustion-Based Systems

Until the last few years, combustion-based systems have been the preferred heating systems for home and business owners because of their moderate installation and operating costs, and wide availability in the market place. Unfortunately, there are a number of serious safety and related maintenance concerns with these systems.

Some combustion-based systems present an explosion hazard if the storage or delivery of their fuel is not carefully controlled. Explosions due to improperly installed or maintained gas pipes and delivery systems are often in the news. Since these systems require a flame to operate, failures or improper installation of system components (for example, heat exchanger, damper, chimney, or flue) can result in property loss to fire. Fortunately, smoke detectors have saved many lives that might have been lost to fires caused by combustion-based heating systems.

In addition to heat, combustion-based heating systems also create by-products such as carbon monoxide. Carbon monoxide is a result of the incomplete burning of fuel in combustion-based systems. Incorrectly installed systems, chimneys that are blocked by birds nests, or downdrafting can cause carbon monoxide to remain inside of buildings. This is especially dangerous in modern, well-sealed buildings, where it is

difficult for outside combustion air to reach the furnace, and where carbon monoxide can be trapped and build up over time. Furnaces, water heaters, and other appliances must be properly vented outside.

Combustion-based systems that deliver heat through ducts present occasional "blasts" of hot air. This not only reduces comfort directly, but tends to dehumidify the air. The addition of a central humidifier (with its associated installation, operating, and maintenance costs) can correct this humidity problem.

Combustion based central heating systems are often coupled with low-efficiency central air conditioners. This raises installation and operating costs significantly, while adding an entirely separate unit to be maintained.

Heat Transfer Systems

Non-combustion or heat transfer systems include heat pumps and geoexchange systems. Heat pumps operate by capturing heat from outdoor air and transferring it inside of a home or business. geoexchange systems capture and transfer heat from the earth.

Nearly all heat transfer systems can be reversed, providing central cooling as well as heating. Some heat pumps and most geoexchange systems also provide domestic hot water at low operating costs.

Heat Pumps

Beginning in the 1970s, air-source heat pumps came into common use. They have the advantage of no combustion, and thus no possibility of indoor pollutants like carbon monoxide. Heat pumps provide central air conditioning as well as heating as a matter of course. And they are installation-cost competitive with a central combustion furnace/central air conditioner combination.

Heat pumps operate by moving or transferring heat, rather than creating it. During the summer, a heat pump captures heat from inside a home or business and transfers it to the outdoor air through a condensing unit. During the winter, the process is reversed. Heat is captured from outdoor air, compressed, and released inside.

Much less electricity is used to move heat rather than create it, making heat pumps more economical than resistance heating. However, in all but the most moderate climates, the heating ability of the heat pump is limited by freezing outdoor temperatures. So electric resistance heat is used to supplement outdoor-air-source heat pump during the coldest weather, preventing "cold blow."

Depending on climate, air-source heat pumps (including their supplementary resistance heat) are about 1.5 to 3 times more efficient than resistance heating alone. Operating efficiency has improved since the 70s, making their operating cost generally competitive with combustion-based systems, depending on local fuel prices. With their outdoor unit subject to weathering, some maintenance should be expected.

Geoexchange Systems

More recently, even more advanced and efficient heating and cooling systems have emerged using the geoexchange process. Sometimes called geothermal or ground-source heat pumps, these systems move or transfer heat like the air-source heat pumps. However, they exchange heat with the earth rather than the outdoor air.

Since earth temperature remains relatively constant throughout the year, geoexchange systems operate more efficiently than air-source heat pumps and generally without the use of resistance heat. And because they are working from those constant earth temperatures, there are no blasts of hot air or "cold blow" as with other systems.

About Carbon Monoxide

When inhaled, carbon monoxide interferes with the delivery of oxygen throughout the body, and can cause unconsciousness and death. Even all amounts of this colorless, odorless gas cause symptoms ranging from headaches, dizziness, weakness, nausea, confusion, and disorientation, to fatigue. Prolonged exposure may cause permanent brain damage. Children, pregnant women, the elderly, and people with anemia or with heart or respiratory problems are especially sensitive to carbon monoxide exposure.

Over 1,500 people die and over 10,000 reportedly take ill from carbon monoxide exposure each year. Many carbon monoxide poisonings are not detected, as doctors confuse its symptoms with influenza or food poisoning.

The U.S. Consumer Product Safety Commission and others recommended the installation of carbon monoxide detectors, although it is not clear that detectors will protect consumers from low levels of carbon monoxide over long periods of time. Detectors have also been the subject of recalls by their manufacturer due to failure to alarm at dangerous levels of carbon monoxide.

Carbon monoxide is an insidious killer. To help assure safe operation, combustion-based heating systems should be checked frequently for indoor air pollution hazards. Other sources of carbon monoxide, such as barbeque grills and automobiles, should never be operated in enclosed spaces.

Nearly all geoexchange systems on the market have the ability to provide low-cost domestic hot water, further increasing their operating efficiency. Thus, geoexchange systems are generally 2.5 to 4 or more times more efficient than resistance heating and water heating alone, and have no combustion or indoor air pollutants.

Since there is no outdoor unit (as with air-source heat pumps or the central air conditioners used with combustion-based systems), no weather-related maintenance is required.

Although their installation cost is somewhat higher due to the required underground connections for heat transfer to and from the earth, geoexchange systems provide low operating and maintenance cost and greater comfort.

Conclusions

When comparing heating systems, safety, installation cost, operating costs, and maintenance costs must be considered. To simplify the selection process, installation, operating, and maintenance costs can be combined into a life-cycle cost — the cost of ownership over a period of years. The table below compares the various types of central heating systems:

	Safety	Installation Cost	Operating Cost	Maintenance Cost	Life-Cycle Cost
Combustion-based	A Concern	Moderate	Moderate	High	Moderate
Non-combustion					
Heat pump	Excellent	Moderate	Moderate	Moderate	Moderate
GeoExchange	Excellent	High	Low	Low	Low

Consumers who take the necessary steps to insure the safety of combustion-based systems (frequent inspection and maintenance, smoke detectors, carbon-monoxide detectors, and other safety precautions) may wish to consider these moderate life-cycle cost systems. Others should consider more advanced heat transfer systems — heat pumps (with their moderate installation, operating, and maintenance costs), or geoexchange systems (with their low operating and maintenance costs and high levels of comfort).

A study by the U.S. Environmental Protection Agency showed that geoexchange systems have the lowest life-cycle cost of all systems available today. The study also shows that geoexchange systems have the lowest impact on our environment. And consumers rank their comfort and satisfaction with geoexchange systems higher than all others. While a higher initial investment is required, the investment is paid back through low energy bills (enhancing resale value), excellent family safety, and real comfort.