

In recent years, new technologies and construction methods have begun to change the way new housing is heated, cooled, and ventilated. No matter what the climate, houses are generally being built tighter. And many are being designed to take advantage of passive solar heating and new ventilation strategies. The new tight construction practices can save substantial amounts of energy; yet they warrant caution when selecting a heating system and other appliances. This fact sheet is designed to help consumers understand why caution is necessary when combustion devices are considered and how to choose appropriate combustion devices for tightly built energy-efficient housing. Combustion appliances are those which use a combustion fuel such as natural gas, oil, or bottled gas.

How Energy-Efficient Houses Can Differ from Conventional Houses

In conventional construction practices of the past, houses were built without much insulation, and the majority of the heat needed was supplied by the heating system. Today's new construction practices call for greater amounts of insulation and substantially reduced air leakage through tight construction. In some cases, houses are built virtually airtight, with ventilation being supplied through a controlled mechanical ventilation system. These new techniques and technologies can dramatically reduce the heating and cooling loads of these houses, making a smaller heating and cooling system possible, at savings to the consumer.

The biggest change, and the

Combustion Appliances in Energy - Efficient Homes

area that warrants caution, is the advent of tight construction and controlled ventilation systems. In the past, houses have been ventilated through cracks and leaks in the building shell. This controlled ventilation also provided the air needed for combustion devices to operate efficiently and safely.

By contrast, today's new housing may instead rely on a mechanical ventilation system to provide needed ventilation. In cold climates, air-to-air heat exchangers may be used to recapture heat from outgoing stale air. In warmer climates, exhaust ventilation equipment - either basic exhaust fans or newer exhaust ventilation systems that reclaim

heat from outgoing air - may be installed.

In the tightly built house, virtually any ventilation system has the potential to cause negative pressure, which means more air is leaving the house than entering it, causing an imbalance in air pressure (see Figure 1).

Not only can this deprive conventional combustion equipment of air for the combustion process, but it can lead to deadly flue backdrafting as pressure imbalances pull flue gases into the living area. In addition, conventional combustion devices produce carbon monoxide and other pollutants during the combustion process-pollution that can build to unhealthy levels in a tight house if ventilation isn't adequate.

Due to the potential for indoor pollution, inadequate combustion air, or dangerous flue backdrafting, many designers simply avoided combustion devices in energy-efficient housing, opting instead for electricity for all appliances and the heating system.

But more recently, combustion heating and water heating systems that are appropriately sized and have design changes that make them safe for use in tightly built new houses have become available. In these systems, the combustion process is completely sealed from the indoor air. These devices are discussed in the next section.

Selecting Appropriate Combustion Devices

Clearly, caution is required if a combustion fuel is to be used in new energy-efficient housing. Concerns related to wood burning must also be addressed.

To avoid potential problems, consumers should strive to meet

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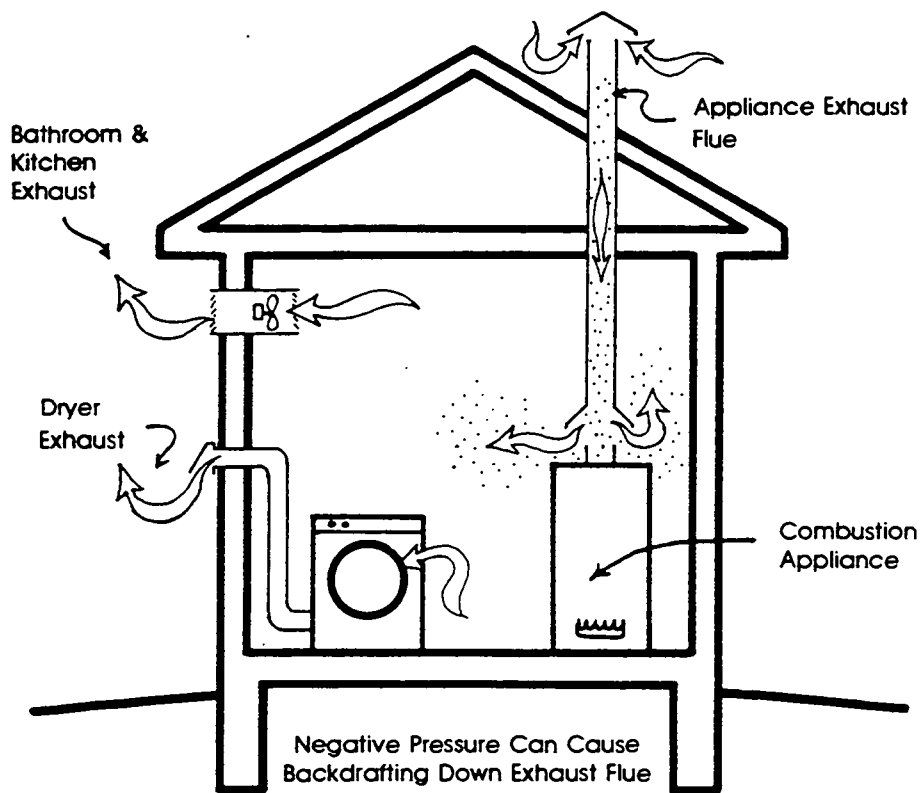


Figure 1. Operation of exhaust vent devices in tight houses creates negative pressure indoors, which can pull harmful exhaust gases down the flue into the home.

the following goals when selecting any combustion device for new, tightly built housing:

- the combustion process should be completely sealed from the indoor air, with combustion air drawn from outside the house;
- unvented devices should not be used to avoid indoor air pollution; and
- the device should be properly sized for the heating needs of the house.

Fortunately, manufacturers of heating and ventilation equipment are quickly moving to develop and market products that meet these goals.

Appropriate Combustion Products

At present, sealed combustion is available in a number of space heating systems and a few water heating systems. Combustion takes place in a sealed chamber; air for combustion is drawn directly from the outdoors, and combustion by-products also are directly vented to the outdoors (see Figure 2). Often, the efficiency is improved further through the use of electronic ignition and by the fact that incoming combustion air can be pre-warmed by the exiting exhaust.

These furnaces can now be purchased in sizes small enough for the energy-efficient house: 10-25,000 BTUs per hour.

By sealing combustion, manufacturers tackle two issues at once: no pollution enters the living space because of the combustion process and the device doesn't interfere with the house's pressure balance controlled by the ventilation system.

Woodburning and Other Combustion Devices

Not all types of combustion devices offer the sealed combustion feature. It is currently available in space heating systems that use natural gas, oil, and propane, as well as in a few water heating systems. But combustion cooking stoves, clothes dryers, and most woodburning devices, including fireplaces, are not yet available with truly sealed combustion, although some make provisions for adding extra outside combustion air.

Woodstoves and fireplaces can draw combustion air at a substantial rate and may overtax the tight house's ability to provide it. In some cases, occupants of tight homes have reported that a fireplace or woodstove won't stay lit and produces substantial amounts of smoke. This problem is usually handled by opening windows slightly to bring combustion air in. This solution can hardly provide for comfort or energy-efficiency, however. In addition, it is difficult to find a woodstove small enough or controllable enough to put out just a little heat, which is often all that's required in an energy-efficient house.

Virtually all conventional combustion devices introduce pollutants into the indoor air when they are in use. Over the years, numerous studies have shown that gas cooking stoves can produce substantial indoor pollution. Thus, if

the goal is to reduce sources of indoor pollution during the construction of new energy-efficient houses, special provisions for ventilation must be taken if gas cooking appliances are installed.

Thus, due to indoor air quality and safety concerns, many designers caution against the use of combustion devices in energy-efficient housing, except for sealed combustion space and water heating devices.

In the future, manufacturers may develop a wide variety of products with completely sealed combustion, but today, consumers should understand that the improper installation or use of conventional combustion devices could pose health and safety risks in tightly sealed houses.

Comparing Equipment and Fuel Costs

When choosing space and water heating systems, several factors should be considered, including fuel prices, equipment costs, and climate. In warmer climates where cooling is the major consideration, it may not be cost effective to install another type of fuel beyond electricity. The house must have electricity in any case, and cooling is typically provided through electricity, not a combustion fuel. However, a large house or anticipated larger-than-normal hot water consumption could make combustion fuels more competitive.

In most colder climates, natural gas is often seen as the best value in heating and water heating fuel. Builders and buyers should explore local fuel costs carefully and compare fuels including the installed cost of the heating equipment and water heating systems.

Sealed combustion space

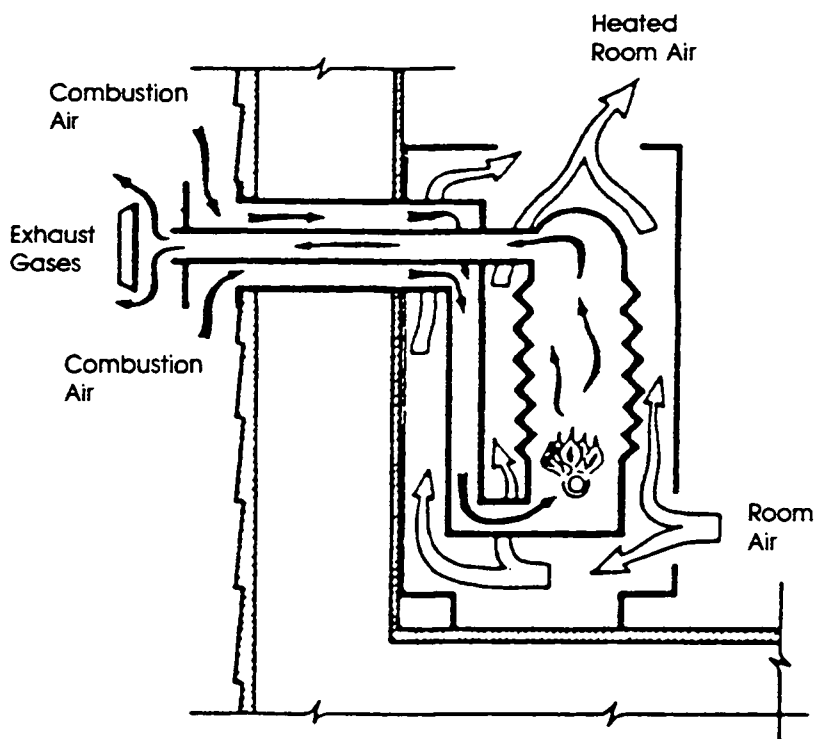


Figure 2. Sealed, direct-vented combustion systems are isolated from room air and are unaffected by negative pressure indoors.

heating equipment can be comparable in cost of equipment and installation to electric space heating. As for water heaters, sealed combustion units are still more costly than conventional electric or combustion models, but they may still be preferred if a combustion heating system is chosen or if local electricity rates are high.

Avoid Oversizing the System

Buyers of new energy-efficient housing should note that builders and heating contractors are sometimes unfamiliar with the new technologies in energy-efficient houses and will sometimes suggest use of a system that is much too

large for the house. The buyer should review the expected heat load of the new house and realize that a large heating system is not the only choice. An oversized system adds substantially to new construction cost and won't be as efficient as a properly sized system.

Beyond the size of the heating system, it should be noted that the heat distribution system of the energy-efficient house can also be simplified compared to those currently used in conventional houses. Even in Alaska, it has been shown that a single source of heat can suffice in a small, very well-insulated house. In larger houses in colder climates, a simple distribu-

tion system may suffice; the house may not need heat distribution to all rooms. For cost and comfort considerations, a close look should be taken at the specific need for heat distribution.

Zoned Systems Still Make Sense

Energy-efficient houses can realize further energy savings through the use of zoned heating or cooling. In this regard, a central system has the limitation of being difficult to control when compared to a dispersed electric system. When much of the space heat is supplied through direct solar gains or internal heat from appliances, it can be especially helpful to be able to manage different areas of the house for comfort considerations, as well as energy costs. Thus, it makes sense to explore the potential for zoned control with any heating system chosen for an energy-efficient house. With central combustion heating systems, this might be accomplished through the use of dampers on heat registers or other simple approaches.

Integrated Appliances - A Look to the Future

Many homebuyers are unaware that new technologies and products often precede changes in codes designed to protect consumers. Thus, it is possible that inappropriate equipment will meet local codes and yet result in an unsafe situation when

it comes to compatibility with controlled ventilation systems. It will be years before all changes in technology are reflected in codes, and thus builders and buyers should be aware that the use of new technology carries the responsibility to completely understand the technology and its implications.

However, new products are beginning to solve the conflicts. For example, at least one ventilation system combines heating and cooling with a whole-house ventilation system. This device also allows the space heat to be combined with water heating through the use of a heating coil from the domestic hot water heater.

This development indicates a growing trend and interest in combining a number of functions in one lower-cost system to meet the substantially reduced energy loads in energy-efficient housing, no matter what the climate.

Summary and Other Information Sources

When choosing heating systems and appliances for new energy-efficient housing, buyers, builders, and designers must recognize that they are still pioneering changes in technology. Those who wish to effectively and economically use combustion devices in these houses should understand that they stand at the forefront of change. It is likely that tremendous change will occur in the next several years.

In the meantime, consumers

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should exercise extreme care and caution in the selection and installation of combustion devices in new, tightly built housing. While it is entirely possible to safely use sealed combustion devices for space heating and hot water heating, not all combustion devices can be safely recommended for this type of housing at this time.

For More Information

For more information about fuel costs and other issues associated with the use of combustion devices in tightly built housing, state energy offices may be of assistance. Utilities can be another source of information in this regard. For individual assistance with selecting heating systems for new construction, and for information on heating systems in well-insulated existing homes, the National Appropriate Technology Assistance Service can be of help. Write or call toll free:

National Appropriate Technology Assistance Service

P.O. Box 2525
Butte, MT 59702
Nationwide: 1-800-428-2525
In Montana only: 1-800-428-1718

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