

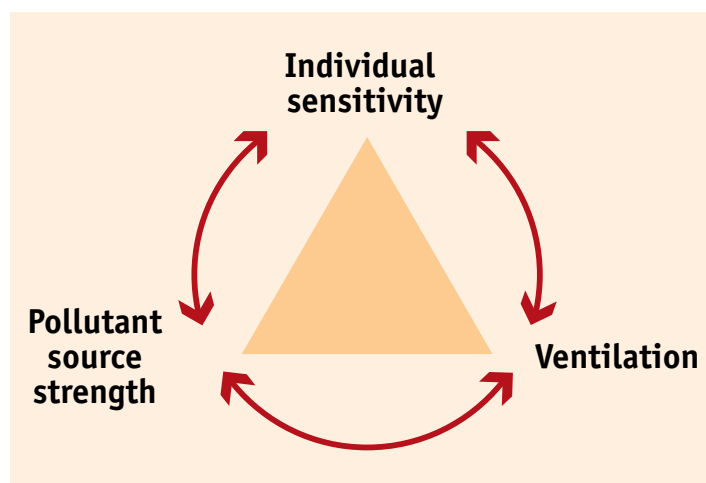
Energy efficiency and indoor air quality

Limiting uncontrolled air leakage in your home is one of the most cost-effective ways to reduce energy use. A well sealed home may also eliminate transfer for moisture from the interior of the home to the building components, reducing the chances of rot or frost damage. A tight building shell can reduce the amount of dust, pollen or other contaminants that enter the living space. Most of all, a tight home puts the occupant in control of the ventilation of the building. With the right ventilation strategy, the occupant can select when and where outdoor air enters the home.

To take advantage of the benefits of house tightening without adversely effecting indoor air quality the occupants need to take an active role in keeping the indoor air clean. The air inside a home contains substances that can potentially be either harmful to human health or damaging to the building itself. If one or more of these substances became concentrated enough, the home can have poor indoor air quality. By limiting the sources of indoor air contamination and providing an appropriate level of ventilation, an occupant can maintain a healthy indoor environment.

If you think you have an indoor air quality problem, a two-pronged strategy is recommended.

- First, limit the source of indoor air contaminants. Reduce or eliminate contaminants from your home.
- Second, further reduce the level of indoor air contamination by providing a consistent and reliable level of ventilation.



Air filters effective at removing particulates

Filters can be effectively used to remove particulates from the air. But most filters available to homeowners are not effective at removing other contaminants. While these filters are effective at reducing the quantity of pollens, spores or pet dander, they do not work very well for chemicals like formaldehyde or cleaning products.

To be effective, filters must be efficient at capturing small particles, move relatively high volumes of air and should capture and distribute air widely. Portable

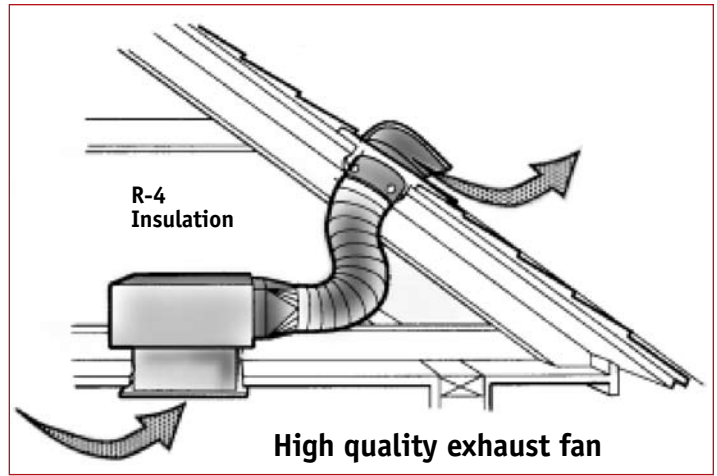
self-contained units can be effective at capturing particulates in a single room. Filtration units for use in central heating systems can also be effective. But central systems need to be sealed exceptionally well to assure they are not simply bringing more contaminants into the home.

For a complete review of residential air cleaning equipment read “Residential Air Cleaning Devices: Types, Effectiveness and Health Impact” available from the American Lung Association at www.lungusa.org.

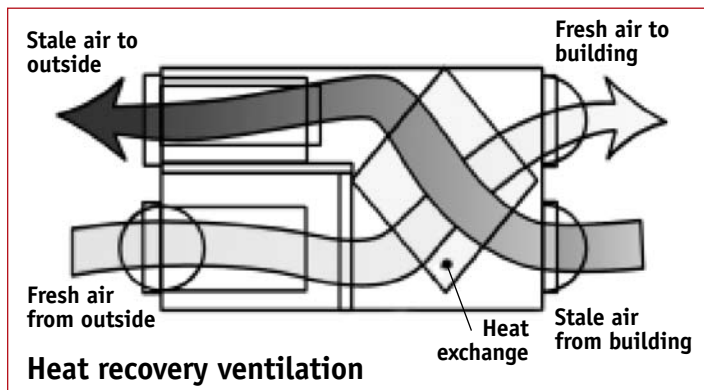
Ventilation

Ventilation is an important part of maintaining indoor air quality. To maintain a healthy indoor environment, it is recommended that at least 35 percent of the indoor air be exchanged with outdoor air every hour. For a typical 1,800-square-foot house, this is a volume of 85 cubic feet of air per minute.

If a home is not well sealed, wind and temperature differences would ventilate the home naturally. But it would be difficult to control the ventilation rate. In the winter, the home would over-ventilate, leading to high energy bills. When the weather is moderate, as is the case in much of the spring and fall, natural ventilation would not be enough. The source of natural ventilation would also be difficult to control. In leaky homes, the source of new air frequently comes from the basement or crawl space where undesirable molds, radon or household chemicals may be present.



High quality exhaust fan



Heat recovery ventilation

The recommended strategy for controlling the ventilation rate of a building is to construct a tight building shell and provide appropriate ventilation levels. Because opening and closing windows can not always provide appropriate ventilation levels, mechanical ventilation systems are recommended. For many homes a mechanical ventilation system may simply be a high-quality bath fan. In homes with forced air heating or cooling, ventilation can be incorporated into the ductwork. In cold climates, sophisticated heat recovery ventilation systems may be desirable. Heat recovery ventilation systems can provide prescribed volumes of ventilation without significantly increasing the winter heating requirements of the home.

Ventilation systems provide appropriate volumes of fresh air to the home regardless of the weather. This puts the homeowner in control of indoor air quality.

Exhaust fans

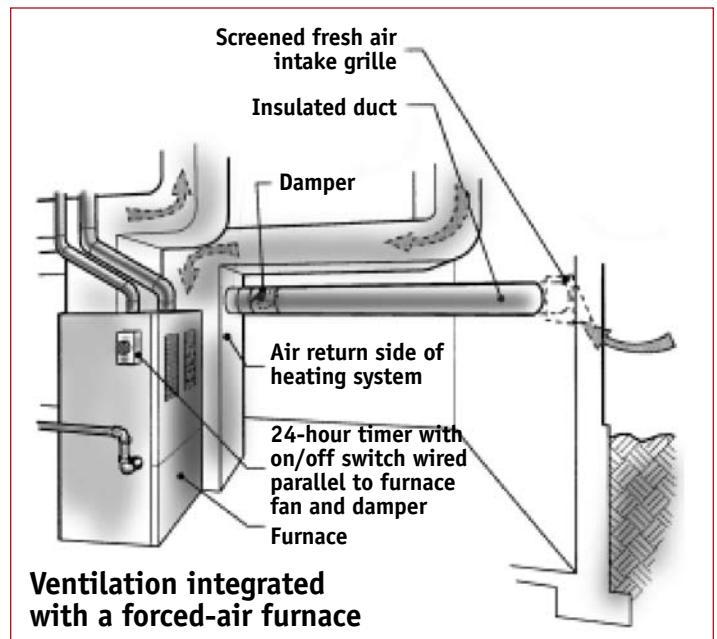
A new generation of high-quality bath fans is now available. They are quiet, use less energy and are rated for continuous operation. As well as keeping the moisture out of the bath, they can be run for much of the day to provide whole house ventilation. Timers or other automatic controls operate the fan eight hours or more each day to provide the desired ventilation level.

Ventilation integrated with a forced-air heating system

By adding a fresh air intake to the return air duct of a forced-air heating system, a forced-air furnace can be used to provide whole house ventilation. A timer controls the furnace fan motor, as well as an automatic damper attached to the intake duct. These systems use about twice as much energy as simple exhaust fans described above.

Heat recovery ventilation

Heat recovery ventilation systems can reduce the energy impacts of providing fresh outdoor air to a home. Models vary. Some can be integrated with a forced-air heating system. Others require an independent set of ductwork to distribute fresh air throughout the home. The simplest models are much like a window mount air conditioner. Heat recovery ventilators are most cost effective in cold climates, or when exceptionally high volumes of ventilation are required.



Ventilation integrated with a forced-air furnace

Major household pollutants

Moisture

Moisture is not typically viewed as an indoor air contaminant, but it does have an effect on indoor air quality. It can influence the emission rate of some other pollutants, for example, formaldehyde. In addition, condensation on building surfaces can sponsor the growth of fungi and promote microbial contamination. Dust mites grow most readily in moist environments. To reduce indoor moisture, make sure bath, kitchens or other sources of moisture are well vented to the outdoors. If your home has a crawl space, make sure the ground is covered with a black, 6-mil plastic sheet.

Radon

Radon is a radioactive gas continuously being created by the radioactive decay of radium, a naturally occurring metallic element that exists in all soils in varying concentrations. Radon sources can include soil, ground water and earth- or rock-based building materials. Radon lasts just a few days before it decays into other radioactive elements which are solid particles. These radon “progeny” can be breathed into the lungs, where they are likely to attach to the lung lining and decay again, exposing the lungs to radiation. Radon is associated with lung cancer. The Environmental Protection Agency estimates that radon causes about 14,000 lung cancer deaths each year. You can easily measure radon concentrations in the home and effectively reduce them using radon proof construction methods. Radon is not found in all geographic locations. Check with your local health department to see if radon is a problem in your area.

Formaldehyde

Formaldehyde is a very reactive chemical used in many household products, including particleboard, hardwood plywood, furniture, drapes, carpet pads and urea-formaldehyde foam insulation. Formaldehyde outgases from these and other materials for many years, though the amount of outgassing decreases over time. In gaseous form, it is very pungent and an irritant to eyes, nasal passages, lungs and skin. Formaldehyde is currently classified as a potential carcinogen. Control strategies include source removal, source reduction and ventilation.

Particulates

Particulates are particles (both solids and liquids) suspended in indoor air in varying sizes and of various composition. Both organic and inorganic materials are found in the air, including pollens, spores, microbes, asbestos fibers, insect debris, food remnants and pet dander. Those particles small enough to be inhaled are known as respirable suspended particulates and are of particular importance. Some are harmful in themselves. Others can carry harmful substances, such as radon progeny, into the lungs. Measurement is relatively difficult. You can control particulates through source control, specialized filtration and air cleaning.

Combustion products

Combustion products can enter the indoor air from unvented or improperly vented combustion appliances, such as unvented kerosene heaters, gas ranges, furnaces, water heaters, woodstoves and even cigarettes. The major products of concern are carbon monoxide, nitrogen oxides and RSP. Carbon monoxide is an odorless, colorless gas that impairs the blood's ability to carry oxygen. Carbon monoxide is lethal at higher concentrations. Nitrogen dioxide is a colorless gas with a pungent odor that can damage the lungs and cause lung disease. To control these pollutants, you must properly install, use and maintain vented appliances. Unvented combustion appliances are major pollutant sources. You should use them with caution only in well-ventilated areas.

Organic compounds

Hundreds of different organic compounds are found in household products, and the full range of potential health effects is very large. Health effects range from eye, nose, throat and skin irritation to an increased risk of cancer. Some products may cause headaches, dizziness or nausea. Pesticides, aerosol sprays, carpets, synthetic plastics, adhesives and cleaning agents are a few examples of organic compounds. To control potential problems, learn more about the chemical composition of products substitute less hazardous products and use and store these products as instructed. Limit their effect on indoor air quality by ventilation.

What is an unsafe indoor air quality level?

Air is never absolutely pure, so the question boils down to what is considered a “normal” or acceptable concentration of a pollutant. This is a crucial question, but very difficult to answer precisely.

Government standards have been set in the United States and many other countries for both outdoor and workplace exposure levels to some toxic pollutants. But there are no

regulatory standards for indoor air pollutant levels in U.S. residences. The number of potential pollutants is enormous. Low levels of pollutants, when combined, can cause problems. Each individual has different sensitivities to certain pollutants. What is an allergen or irritant for some will leave others seemingly unaffected. Individual sensitivities may need to be considered to assure a healthy indoor environment. ⚡

Limit indoor air pollution sources

Many indoor air pollutants are generated inside the home through human activities. Many modern building materials and home furnishings emit them. Particleboard furniture, cabinets and flooring may be pollutant sources. If you smoke or if you use products such as oven cleaners, disinfectants, carpet shampoos, insecticides, paints and furniture strippers, you are contributing to indoor air pollution. Other sources can include woodstoves and unvented combustion appliances.

The single most important factor in indoor air quality is the intensity of the pollutant source. The greater the “source strength,” the greater the potential for unhealthy air in the home. The source strength depends on both the quantity of a pollutant present and the rate emitted into the indoor air.

The first priority in controlling a pollutant is to remove the source or reduce its strength. The best solution would be to replace a polluting source with an alternative non-polluting product. For example, replace an unvented combustion space heater with an electric or vented heater. In some cases an alternative product may not be available and you could

store the polluting source (such as paint thinners) elsewhere, perhaps in a detached garage. If you can't remove the source, you may be able to reduce its strength. For example, sometimes formaldehyde-emitting materials can be sealed to reduce the rate of emission.

Source reduction techniques are generally the most effective and reliable, and they can often decrease pollutant concentrations by a factor of three to 10 or more. ⚡

New products reduce indoor air quality hazards

In response to concerns about indoor air quality, a growing number of businesses produce products with fewer contaminants. If you are constructing a new home or remodeling an existing home, the best reviews are available online from Environmental Building News at www.ebuild.com/. Low emission products include nontoxic paint, formaldehyde-free particleboard, less-toxic carpet and more.

Additional resources:

Books

Consumer Guide to Home Energy Savings, 8th Edition; Alex Wilson, Jennifer Thorne, and John Morrill; American Council for an Energy-Efficient Economy; Berkeley, Calif.; 2003, \$8.95
Order at www.aceee.org.

Web sites

American Lung Association
www.lungusa.org

Environmental Building News
www.ebuild.com

U.S. Environmental Protection Agency
Indoor Air Quality Division
www.epa.gov/iaq

Radon Resistant New Construction
National Safety Council
www.nsc.org/ehc/radon/construc.htm



Energy Services Web site
www.wapa.gov/es

Western's Power Line:
1-800-POWERLN
(1-800-769-3756)

This fact sheet is published by Western Area Power Administration for its power customers. Contact us at: Western Area Power Administration P.O.B. 281213, Lakewood, CO 80228-8213; telephone 720-962-7419.

The mention of any service, product or technology does not constitute an endorsement of same and Western, the Department of Energy or the United States Government cannot be held responsible or liable for use thereof.