

The Health Impact of Combustion in Homes

Two thirds of U.S. households burn fuel in their homes. These households burn methane (commonly referred to as “natural gas”), wood, propane, heating oil or other fuel to heat their homes and water, dry their clothes and cook their food. Burning fuel produces emissions that are harmful to human health and the environment. Some types of appliances, including cook stoves, release their emissions directly into the home, where they are inhaled by residents. Other appliances, such as furnaces and water heaters, when installed and operated as designed, vent most combustion by-products to the outside, where they contribute to air pollution and climate change.



According to EPA, indoor levels of pollutants may be two to five times — and sometimes more than 100 times — higher than outdoor levels. Since most people spend about 90 percent of their time indoors, policies and practices that reduce the emission of combustion pollutants in homes are an important step forward in protecting public health.

What’s Burning? Residential Fuel Use in the U.S.

Of the approximately 118.2 million housing units in the United States, nearly all have access to and use electricity. Two-thirds of homes also use one or more sources of fuel: roughly 60% of residences use gas, 15% of homes use other fossil fuels including propane, fuel oil and kerosene, and 9% of homes use wood.

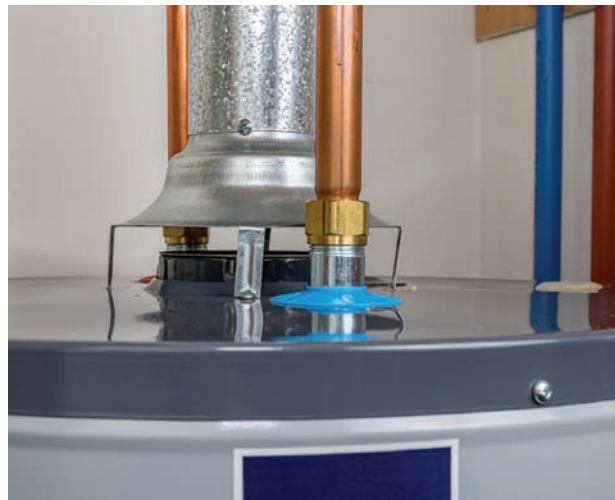
Gas is used most widely for powering furnaces and hot water heaters, in approximately 60 million homes. Some 40 million homes use gas stoves or cooktops for food preparation.

Propane, or bottled gas, is the next most frequently used residential fuel type, and an important source of energy for heating and cooking in rural parts of the country that do not have natural gas service. Overall, propane is used indoors in 6% of households, including 20% of mobile homes. Household use of fuel oil has been declining for decades, but about 5 million homes, mainly in the Northeast, still use it primarily for heating.

Wood is used less frequently. Approximately 5 million homes use a woodstove for a primary or secondary heat source. Woodstoves are enclosed and vented to the outdoors as opposed to fireplaces that can be directly open to the indoor living space. Fireplaces are more common in higher-income, single family homes, and are likely being used more as a choice than as a necessity.

Emissions and Indoor Air Quality

Residential appliances used for heating and cooking are never 100% efficient, meaning they do not extract all the energy from the source material. Unburned compounds are released as emissions, or air pollutants. The make-up and amount of emissions vary with fuel type and are influenced by the type and age of the appliance, its maintenance status and its pattern of use. If the appliance is vented to the outside, as are furnaces, water heaters and most gas clothes dryers, most emissions go up the flue and impact the outside air. Gas stoves and unvented gas fireplaces, in contrast, release emissions directly into the home environment, sometimes resulting in high indoor concentrations of pollutants that can threaten resident health.



Gas kitchen appliances can emit substantial amounts of CO and NO_x and modest amounts of PM and PAHs. The level of particle emissions can be highly variable, depending in part on what type of food is being cooked, and the cooking technique used. The impact on indoor air quality can extend well beyond the kitchen, particularly when exhaust fans are not used or are not vented to the outdoors.

Appliances using propane and kerosene emit pollutants at higher rates than those using natural gas, and they may or may not exhaust to the living area.



Residential wood combustion can greatly increase indoor levels of CO, NO_x and air toxics. Wood stoves and fireplaces also release prodigious amounts of deadly particulate matter. Emissions vary with type of wood burned, along with the age and condition of the appliance. Pelletized fuels generally emit at lower levels than cord wood, although the type of pellet makes a difference. Newer, closed-door wood stoves release fewer emissions into the home environment than open fireplaces.

Combustion pollutants and their health effects

- Carbon monoxide (CO), a dangerous gas that when inhaled can interfere with the ability of blood to carry oxygen from the lungs to the rest of the body
- Nitrogen oxides (NOx), a respiratory irritant that causes airway inflammation, coughing, wheezing and increased asthma attacks
- Particulate matter (PM), a mixture of microscopic solids and liquids that affects multiple body systems and can increase the risk of premature death
- Air toxics, including as ammonia, formaldehyde, polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs) that can cause cancer, birth defects and other serious health harms

Health Effects of Combustion Pollutants

A large body of research on outdoor air over the last 50 years has firmly established that exposure to air pollution is harmful to health. Particle pollution, ozone, nitrogen oxides, carbon monoxide and air toxics contribute to premature mortality and increased risk of illness in children and adults, including heart disease and stroke, asthma, COPD, lung cancer, type 2 diabetes, premature birth and respiratory infection.

The strongest body of evidence for the health impact of burning natural gas in homes is for nitrogen oxides, including nitrogen dioxide (NO₂). Studies have shown that exposure to NO₂ from cooking with gas can make children sick, especially those with asthma and allergies. It worsens asthma symptoms and wheeze and may also increase lower respiratory tract infections and reduce lung function.

Ventilation matters, as does the duration of use and the condition of the appliance. Children living in homes where gas stoves are used for heating without ventilation are significantly more likely to develop pneumonia and coughing than those living in homes where the stove is used only for cooking, and a vent fan is used.



A health equity issue

- Children, other susceptible populations such as people living with asthma or cardiopulmonary diseases, pregnant people and older individuals, people of color and people in low wealth or rural communities are the most vulnerable to detrimental health effects from exposure to pollutants from residential combustion.
- Under-resourced and underserved communities often have little control over the fuel options available to them, or the condition and healthfulness of the available housing. Living spaces may be small, crowded, and poorly ventilated. Appliances may be old and not functioning properly. Resource limitations may prevent both homeowners and renters from fixing indoor air problems, including selecting cleaner sources of energy for heating and cooking.

Indoor exposure to air pollutants from wood combustion is linked with increased lower respiratory infections in children, and may be associated with upper respiratory infections, wheeze and cough. The particulate matter in woodsmoke has a detrimental effect on children's immune system, leaving them more susceptible to infections.

Much of the research on the health impact of residential wood burning has looked at “community wood smoke” – the smoke from indoor wood stoves that spreads throughout a neighborhood. High levels of community wood smoke, especially in the winter-time, are notorious in many communities for causing irritation of the eyes, nose and throat, and respiratory effects in children, including hospital admissions.



When Indoor Pollution Gets Outdoors

Venting combustion appliances to the outside may reduce residents' exposure to unhealthy emissions in their homes. But those emissions do not disappear -- they are released into the community where they contribute to local and regional outdoor pollution and help drive climate change. Residential and commercial emissions made up 13% of total U.S. global warming emissions in 2020, mostly from burning natural gas and heating oil.

More research is needed to know exactly what indoor air is doing to the outdoor environment but known impacts of the types of pollutants emitted demonstrate a need to reduce these emissions beyond expelling them to the outside.

What Needs to Be Done

To protect individuals and communities from the health impacts of pollution from indoor combustion, the American Lung Association recommends a three-pronged approach: personal protection, source reduction and additional research.

If you rely on combustion appliances for heating, hot water and/or cooking, there are some immediate steps you can take to reduce your risk from exposure to harmful pollutants:

- Make sure your gas appliances are in proper working order.
- Install carbon monoxide monitors.
- Use ventilation, either a range hood that vents to the outside or an open window or both.
- For homes that rely on wood burning for heat or cooking, an air cleaning device that uses HEPA filtration can provide some protection from the soot and smoke.



Individuals, schools and businesses can take steps to reduce the emission of combustion pollutants to protect public health:

- Individuals can reduce or eliminate the use of unnecessary wood burning and replace gas appliances with electric as circumstances allow.
- Homeowners can take advantage of incentives programs available from utilities and governments to purchase safer and cleaner heating systems, water heaters, clothes dryers, and stoves.
- Public and private entities, including schools, employers and building owners and managers, should assess the impact of combustion pollutants on indoor air quality in their facilities and take steps to reduce or eliminate them.

Federal, state and local government entities can take steps to reduce building emissions, improve air quality and advance energy efficiency and climate goals:

- Increase appliance efficiency and safety standards, including setting zero-emission appliance standards.

- Establish building codes and building performance standards for ventilation, energy efficiency and reduced direct emissions.
- Expand incentive programs for the purchase and installation of cleaner more efficient appliances, with a focus on equity.
- Eliminate industry subsidies for expansion of gas lines into new communities.
- Transition to healthy, all-electric construction in new buildings and major renovations.

Development and implementation of effective policies and practices to reduce the health harms from combustion pollutants indoors would greatly benefit from more research on all aspects of the issue to:

- Better quantify the number and use of combustion appliances in the U.S.
- Measure the impact of all types of combustion pollutants on the indoor environment in all types of residences.
- Study the health effects of combustion pollutants in “real world settings” in the U.S., with an emphasis on sensitive populations.

The problem of preemption

- In response to municipal action, 20 states have passed “preemption laws” to prohibit local jurisdictions from acting to protect the public from the health impact of residential combustion.
- When states stop local governments from setting more health-protective standards, they take away the ability to do what is in the best interest of the community.
- The American Lung Association opposes all forms of preemption of state and local public health authority.

For more detailed discussion and references for the primary sources cited in this brief see the *Literature Review on the Impacts of Residential Combustion* at [Lung.org/residential-combustion](https://www.lung.org/residential-combustion).
