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Deep Dive on Gas Stoves and Range Hood Ventilation

What Types of Ventilation Exist?

Building **ventilation** generally falls under three categories: (1) natural ventilation, which relies on natural air flow through the building;[1] (2) whole-home mechanical ventilation, which utilizes a ventilation system to uniformly push air in and/or out of the whole building; and (3) localized source ventilation, another form of mechanical ventilation that is typically found in kitchens and bathrooms to remove pollutants at or near the source of emissions.

This resource focuses on range hoods that specifically provide source ventilation for gas stoves. While **whole-home mechanical ventilation** is important to maintain air quality in the home, range hoods are **generally more effective** at reducing cooking pollutants.[2]

Why Is it Important to Ventilate While Cooking on Gas Stoves?

The process of cooking food releases air pollutants. Cooking on gas stoves **emits additional health-harming pollutants** such as nitrogen dioxide (NO_2), carbon monoxide (CO), and formaldehyde that are uniquely tied to gas combustion.[3] As such, it is important to ventilate while cooking, especially when using a gas stove, to prevent the buildup of pollutants indoors.

What Are CE and CFM?

There are two commonly used metrics for kitchen ventilation: capture efficiency (CE) and airflow rates measured in cubic feet per minute (CFM).

- CE represents the **percentage of pollutants captured or removed** by the ventilation system.[4] For example, a CE of 100 percent means all pollutants are captured and exhausted outside, while a CE of 0 percent means no pollutants are captured and are instead free to mix indoors. A range hood's CE depends on several factors: airflow rate and size of the room; the design, shape, depth, and distance of the hood; whether the front or back burners are being used; and the amount of cooking.

- The CFM rating is a measure of airflow rates in cubic feet per minute and is the most-commonly used metric for measuring ventilation. According to a ***Reducing Outdoor Contaminants in Indoor Spaces (ROCIS)* report**, the ideal airflow rate for a range hood is between 200 and 350 CFM in a typical home.[5]

Because CE is affected by airflow rates and additional factors, CE can change for any given CFM. This is illustrated by how **different CFMs can produce the same CE depending on burner location.**[6] While CE is a more nuanced assessment of ventilation performance, there is currently no standardized method of testing CE, meaning CFM is more commonly used.

What Are the Facts on Range Hood Efficacy, Operation, and Use?

- **Pollutant removal:** Two major pollutants related to cooking with gas stoves are NO_2 and $PM_{2.5}$. It generally takes **higher ventilation rates (CFM) and longer ventilation times** to remove NO_2 from indoor air.[7] A **2020 study** found that a minimum CE of 70 percent was needed to keep a majority of California multifamily homes from exceeding the averaged outdoor **hourly NO_2 standard** of 100 ppm.[8] Cooking with back burners can improve range hood CE. For example, the **CE of back burners is usually higher** for nitrogen oxides than the CE of front burners.[9] According to the same study, $PM_{2.5}$ requires at least 60 percent CE to keep a majority of California multifamily homes from exceeding the World Health Organization's **daily $PM_{2.5}$ standard.**[10]

- **Ratings and real-world efficacy:** While the CFM rating of range hoods can provide a sense of how well they will capture pollutants, the rating itself is often not enough to assess real-world efficacy. One study testing range hood airflow found that two-thirds of the sample **performed significantly worse than advertised** (CFM was 70 percent or lower than the product description claimed).[11]

- **Housing type/building characteristics:** In **a study simulating cooking pollution and kitchen ventilation**, results demonstrate that the real-world efficacy of range hoods is heavily influenced by many factors other than advertised CE and CFM.[12] For example, smaller dwelling units were more prone to high concentration of pollutants and require range hoods capable of achieving a higher CE. Multifamily homes and single-family attached homes were also more likely to exceed NO_2 and $PM_{2.5}$ standards even with appropriate range hoods, compared with single-family detached homes.

- **Backdrafting:** High ventilation airflow (above 300–400 CFM) can cause an imbalance of indoor and outdoor air pressure when the air exhausted outdoors is not being replaced indoors. When indoor air pressure is lower than that of outdoor air (also called negative pressure), backdrafting can occur and prevent effective ventilation to the outdoors.[13] Backdrafting means that air is pulled into the home (backdrafted) from outdoors and adjoining spaces, which can result in combustion appliance pollution, like CO, accumulating in the home. One method of addressing this is to provide **makeup airflow** to replace air that is exhausted.[14]

- **Ventilation adherence:** Survey data in the United States estimates that only about **10–25 percent of households use their range hoods** during cooking events, although actual use is often less than self-reported use.[15] Many factors contribute to this low adherence rate and can greatly impact indoor air quality. Research in California found that there was an increased risk of indoor buildup of **NO_2**, **$PM_{2.5}$**, **CO**, and **formaldehyde** when range hoods were not used during gas-stove cooking.[16] **Range hood use is generally higher in single-family homes than in low-income apartments** in California.[17] It is hypothesized that education may affect this difference as range hood use was significantly higher in homes with higher education.

- **Noise:** Noise also plays a large role in range hood adherence, as **noisy fans are a major deterrent** for range hood use. [18] However, increasing the CFM of a range hood will often increase noise levels. It is important that range hoods are both able to produce substantial airflow and remain quiet enough for everyday use. A range hood should have a maximum **noise rating of 3 sones** when operated at 200 CFM or higher. [19]

- **Recirculating range hoods:** Unlike venting range hoods that directly exhaust pollutants outdoors, recirculating (or "ductless") range hoods aim to filter intake air before returning it back into the kitchen. These range hoods typically have a grease filter and a **charcoal filter that requires frequent replacement.** [20] Recirculating range hoods **can reduce energy consumption in certain settings** but they are **generally considered ineffective** in the reduction of cooking pollutants. [21] However, **recirculating range hoods are generally cheaper** than their ducted counterparts and are oftentimes the default. [22]

- **Product availability and cost:** The availability of range hood products that are effective and accessible is an important consideration in ventilation adherence. The **price of range hoods tends to increase with its efficacy**, meaning that range hoods with higher airflow (CFM) ratings tend to cost more. [23] Households with gas stoves may require range hoods at a higher price point in order to effectively remove indoor air pollutants.

What Are the In-Home Strategies to Improve Ventilation?

- **Increase household range hood use:** Educating households on the importance of ventilation while cooking, especially when using gas stoves, is imperative. One study found that a major reason why range hoods are not routinely used is because **residents could not detect cooking pollutants** in the air. [24] Ensuring that people understand pollutants are present even without detectable smoke can increase range hood use.

- **Ensure correct range hood use:** Appropriate range hood use increases its efficacy in reducing air pollutants. Research suggests that range hoods should be used for the **entirety of the cooking/baking session.** [25]

- **Choose an effective range hood:** Choosing the best range hood for a kitchen will depend on a variety of factors such as building characteristics, cooking practices, and noise preferences. Smaller homes, such as multifamily and single-family attached units, will require range hoods with higher CFM ratings. Kitchens with gas stoves may also require a range hood with a higher CFM rating for hard-to-remove gas-related pollutants. The list of **Home Ventilating Institute certified products** can be used as a guide for selecting an appropriate range hood based on CFM, noise, and energy usage. [26]

- **Increase natural ventilation:** Homes without range hoods can **increase natural ventilation** by opening doors and windows. [27] The efficacy of natural ventilation for reducing pollutants depends on many factors: wind; outdoor air quality; the size, shape, and operability of windows and doors; and the orientation of the building. Creating cross-ventilation by opening doors and windows concurrently is more effective.

- **Electrify the kitchen:** Transitioning from gas stoves to electric stoves is the **best intervention to reduce pollutant concentrations.** [28] However, in cases where electrifying the stove is not a possibility, opting for electric alternatives such as portable electric stoves, toasters, and electric kettles can help.

What Are the Policy Strategies to Improve Ventilation?

- **Test the efficacy of range hoods:** Range hood efficacy testing requirements can be **folded into building codes and product-testing procedures** to ensure installed range hoods perform as expected. [29] Building codes can require the testing of range hood efficacy after installation to compare measured with reported performance. Range hoods should also be required to undergo third-party testing to ensure accuracy of reported performance standards. However, additional costs associated with efficacy testing must also not increase range hood costs to prohibitive levels.

- **Make range hoods quieter:** Range hood sound requirements can be **enforced and potentially made more stringent** to address the issue of noise as a major deterrent for range hood use. [30] Common standards for vent hoods require a maximum sound rating of 3 sones when operated at 100 CFM. However, ROCIS suggests a maximum of 3 sones when operated at 200 CFM or more, and Energy Star suggests a maximum sound rating of 2 sones.

- **Require more powerful range hoods for gas stoves:** Differentiated range hood requirements can better protect homes with gas stoves that are more at risk of impacted air quality. These policies require that homes with gas stoves, which produce NO_2 and other harmful pollutants in addition to $PM_{2.5}$, have **range hoods with higher CFM** than homes with electric stoves. [31] In Washington State, building code requires that **single-family homes** and **multifamily buildings** have 250 CFM for gas stoves and 160 CFM for electric stoves. [32] California building code set the ventilation requirements for **single and multifamily homes** based on dwelling size for both gas and electric stoves. [33]

- **Eliminate the need to manually turn on range hoods:** **Automatic ventilation** is a potential solution to poor operation and low use of range hoods. [34] Automatic ventilation systems will turn the hood on when temperature sensors indicate a cooking activity or when pollutant sensors detect high pollutant concentrations. However, this technology requires more product availability and research on its energy impacts before it can be scaled.

- **Support electrification policies:** While ventilation will always be crucial, the **electrification of stoves** will fundamentally remove harmful air pollutants associated with gas combustion. [35] Transitioning to electric stoves also improves compatibility with lower CFM/CE range hoods, reducing much of the burden placed on households to find and use a high-performing and potentially costly range hood capable of mitigating gas stove pollution.

While whole-home mechanical ventilation is important to maintain air quality in the home, range hoods are generally more effective at reducing cooking pollutants.

Endnotes

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Endnotes continued

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