

# FACT SHEET

## Combustion Emissions from Residential Gas Ranges

There are over 42 million natural gas and propane household gas ranges, ovens, and cooktops (referred to, here, collectively as “ranges”) in the U. S. Even with the excellent safety record of these appliances, combustion emissions and their unvented operation have received negative publicity through public media stories.

### ***Has there been any federal regulatory action on residential cooking appliances related to combustion safety and consumer health?***

The U. S. Consumer Product Safety Commission (CPSC) and Environmental Protection Agency (EPA) do not present gas ranges as a major contributor to negative air quality... or health hazard in their technical or public information literature, guidance, or requirements. CPSC has authority to regulate gas ranges for safety concerns including emissions (carbon monoxide (CO), for example) through the Consumer Product Safety Act.<sup>1</sup> CPSC is a long-term participant in the development of the American National Standards for gas ranges, ANSI Z21.1, *Household Cooking Appliances* and has, itself, tested natural gas-fired ranges for CO emissions, finding no health or safety issues associated with normal operation of these appliances.<sup>2</sup> EPA does not have direct regulatory authority over these appliances but regularly reviews (every five years, with the latest review from 2016) research on gas-fired cooking and exposure to combustion emissions as part of its health “criteria” document process for outdoor air quality standards, which comprise the National Ambient Air Quality Standards (NAAQS) authorized by the Clean Air Act and Amendments.<sup>3</sup> Even so, EPA’s non-regulatory IAQ program, states among its listed concerns no substantial issues associated directly because an appliance is gas-fired.

### ***Can emissions from the cooking process impact IAQ?***

The cooking process itself has the potential to create a large amount of emissions that is independent of the source of heat, whether it is an electric or gas cooking appliance. Anyone who has burnt a meal or inhaled the smell of baking bread have experienced some of the cooking process emissions that can temporarily impact indoor air quality (IAQ). Beyond these obvious cooking process emissions, the overwhelming consensus regarding IAQ and residential cooking is chiefly associated with emissions from the cooking of fats and oils. These emissions can include particulates, vapors, particle-associated organic compounds. (Technically these include polycyclic aromatic hydrocarbons (PAH) as well as heterocyclic amines, and toxic gases such as formaldehyde, acetaldehyde, acrylamide, and acrolein.<sup>4</sup>) Controlling these emissions to reduce their impact on IAQ is recommended.

Residential range hoods that exhaust to the outdoors are not an

installation code requirement. Range hoods that recirculate air through a filter are also allowed. It is a good idea to run the range hood every time you utilize an electric or gas cooking appliance to eliminate or reduce the normal byproducts of cooking. Wherever possible a range hood that exhausts to the outdoors should be installed. Recirculating range hood filters should be cleaned regularly, and filters changed as recommended by the manufacturer.

Other steps for the continued safe use of any cooking appliance that can reduce cooking process emissions are to keep the cook top and oven surfaces clean, monitor the cooking process, modulate cooking temperature to reduce the chance of burning food, and to utilize the appropriate pot or pan size.

### ***What are the combustion emission concerns being raised with gas cooking appliances?***

Carbon monoxide (CO) and nitrogen oxide (NO<sub>2</sub>) emissions from gas cooking appliances have been cited as indoor air pollutants.

#### ***CO:***

***What is the safety record for combustion emissions for gas ranges?*** When discussing gas consumer safety, CO is the primary combustion product of concern. The recent focus in the media on CO from gas ranges has been encouraged by the availability and aggressive marketing of low-cost CO detectors (now referred to as “alarms”). The media message sometimes delivered to consumers is that all levels of CO exposure are harmful, without providing information on the prevalence of CO in the environment and without public health-based interpretations on exposures that are hazardous to health. Thus, some consumers may be convinced that CO exposure, at any level and for any duration, is harmful to health. Public health information does not support this view. According to data from CPSC, there were three (3) CO deaths, on average, per year from 2004 to 2014 associated with natural gas and propane ranges and ovens. Figure 1 compares CPSC’s average yearly data of CO deaths from 2004 to 2014 for different appliances.<sup>5</sup>

<sup>1</sup> 15 U.S.C. §§ 2051–2089, Public Law 92-573; 86 Stat. 1207, Oct. 27, 1972.

<sup>2</sup> Reuther, J.J., “Critique of ANSI Z21.1 Standard for CO Emissions from Gas-fired Ovens and Ranges,” Gas Research Institute, June 1996.

<sup>3</sup> 42 U.S.C. ch. 85, subch. I § 7401 et seq.

<sup>4</sup> Abdullahi, L., Delgado S., Juana M., Harrison, R., “Emissions and Indoor

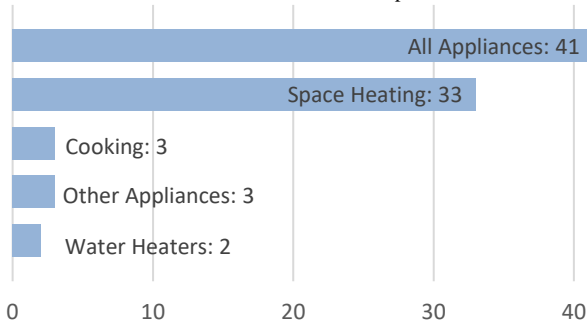
Concentrations of Particulate Matter and Its Specific Chemical Components from Cooking: A Review,” *Atmospheric Environment*, vol. 41, pp. 260-294, June 2013.

<sup>5</sup> Hnatov, M., “Non-Fire Carbon Monoxide Deaths Associated with the Use of Consumer Products, 2014 Annual Estimates,” U. S. Consumer Product Safety Commission, January 2014, Cleared for Public November 2017

# FACT SHEET

## Combustion Emissions from Residential Gas Ranges

Figure 1: 2004 to 2014 Average Yearly Deaths (Non-Fire, Accidental) For Selected Consumer Products Natural Gas and Propane



CO fatalities due to all types of gas appliances have been declining since 1946. This downward trend holds true for gas ranges as well as for gas appliances as a group. Media accounts have begun emphasizing non-fatal CO poisonings as a major source of concern for public health and safety, suggesting that fatalities data alone do not represent the frequency of CO problems. However, published estimates on CO injuries are much less reliable due to the estimation approaches used and may even overstate the frequency of CO injuries. For example, hospital admissions data reported as CO poisonings can often include cases in which poisoning symptoms were not observed and where diagnoses suggest no injurious levels of exposure.

**Haven't there been reports of research about ranges producing unsafe levels of CO?** Media reports have summarized a study concentration measured in the oven flue, on average. A more conducted by Portland State University suggesting that one-half of 60 gas ovens studied produced hazardous levels of CO<sup>6</sup>. This research has been reviewed and a summary of one such review is available.<sup>7</sup> Among the criticisms of the study are that the study was conducted under unrealistic operating conditions, public health standards were misapplied in judging the ovens unsafe, pre-study CO levels were not included in the data, and inappropriate statistical methods were used in summarizing results. Other studies of range emissions studies are anticipated. Given the potential impact of these studies, the gas industry needs to apply technical scrutiny to these studies and not simply accept what, in the past, has been shown to be unsubstantiated conclusions about range safety and health.

**Do gas ranges meet safety standards for CO emissions?** All certified gas appliances must meet emission limits set by the Z21/83 standards committee using its American National Standards Institute (ANSI) approved standards procedures. Studies show that gas ranges produce considerably less than the allowable maximum in the standard. An analysis by Battelle Memorial Institute under sponsorship by GRI has shown that the

CO limit is very conservative in protecting public health in terms of exposure levels that can result from oven use<sup>8</sup>. The CO emission limit in the Z21 standard is based on exposure due to misuse of the oven as a space heater.

**Emissions of up to 800 ppm CO allowed by the standard seems very high. What do you mean by air-free emissions?** The 800-ppm air-free limit refers to an adjusted sample measurement used in the certification process and not to the air people would breath. Measured CO concentrations are adjusted to remove the contribution of dilution air in combustion products. This is done in the certification process to provide a common basis for measurement. The correction is based on the theoretical concentration of CO<sub>2</sub> (12%) in pure, stoichiometric combustion products. In a kitchen environment, combustion products become diluted very quickly. Thus, the air-free concentration is often 200 to 300 times the room air concentration<sup>2</sup>.

**Can you make air-free measurements for ranges and ovens in the field?** While one can attempt to make air-free measurements in the field, health and safety interpretations of such measurements are problematic. The standard of 800 ppm air-free is based on specific assumptions about room volume, air exchange with the rest of the occupancy, and safe level of exposure. These assumptions are discussed in the Battelle study<sup>7</sup>. However, these assumptions may or may not apply in a specific dwelling. In addition, measurement in the oven flue and especially for the range top burners is not very repeatable. Air-free measurements range from 2 to 10 times the as measured value. However, as a rough estimate, air-free CO measurements are about 3 times the concentration measured in the oven flue, on average. A more direct means of evaluating the safety of ranges and ovens would be to measure room concentrations of CO following a period of operation of the appliance that captures the use (or potential misuse) pattern for the appliance industry standards or uniform governmental requirements.

**On what basis, should gas customer service personnel evaluate CO emissions from gas ranges?** Virtually all gas companies already have policies and procedures for evaluating acceptable CO emissions levels from residential gas equipment. No industry standards or uniform governmental requirements currently exist for evaluating acceptability of range emissions. Likewise, no industry standards or governmental requirements exist for unacceptable residential indoor exposures to CO. Public health standards such as the National Ambient Air Quality Standard (NAAQS) for CO, administered by the U. S. Environmental Protection Agency (EPA), cannot be directly applied to exposures indoors for several reasons:

- First, the CO standard is specifically applicable to outdoor

<sup>6</sup> Tsongas, G and Hager, W., "Field Monitoring of Elevated Carbon Monoxide Production from Residential Gas Ovens," ASHRAE IAQ, Nov. 1994

<sup>7</sup> U. S. Environmental Protection Agency, "Review of the National Ambient Air Quality Standards for Carbon Monoxide, Assessment of Scientific and Technical

Information: OAQPS Staff Paper," EPA-452/R-92-004, Aug. 1992 Quality Standards for Carbon Monoxide, Assessment of Scientific and Technical Information: OAQPS Staff Paper," EPA-452/R-92-004, Aug. 1992.

<sup>8</sup> U. S. Environmental Protection Agency, "Review of the National Ambient Air

# FACT SHEET

## Combustion Emissions from Residential Gas Ranges

air under the Clean Air Act, and EPA does not recognize its use for indoor air quality.<sup>9</sup>

- Second, EPA under the law must consider specific types of sensitive populations and lifestyle considerations that may or may not be appropriate for the general population and indoor occupancies.
- Third, the CO standard, when properly enforced, requires monitoring throughout the year to identify potential violations of its time weighted average one hour and eight-hour exposure levels, making it impractical for most customer service evaluations.

However, gas companies in setting or revising their own policies and procedures on CO from ranges may wish to review the information available from EPA supporting the NAAQS. The EPA CO standard process generates information that is useful in reviewing and updating policies and procedures dealing with CO. The five-year revision cycle to the NAAQS requires a comprehensive EPA review of health studies and data. This review is the most exhaustive and complete public agency review of health information conducted in the U. S. This review and the EPA staff evaluation of the standard itself are summarized in a staff paper by the EPA Office of Air Quality Planning and Standards (OAQPS), which is available to the public<sup>10</sup>. In addition, EPA publishes guidance for health professionals on indoor air pollution in cooperation with the CPSC and national medical associations which can be useful to the gas industry<sup>11</sup>.

### NO<sub>2</sub>:

**What does the research say about NO<sub>2</sub> associated with gas ranges?** Several key studies are available to address this question.

- A study on over 300 houses in California found that NO<sub>2</sub> levels in homes were driven primarily by outside air concentrations of NO<sub>2</sub>, *not* by the presence or use of gas appliances<sup>12</sup>.
- A University of New Mexico study of respiratory illness and NO<sub>2</sub> found no relationship between gas appliances and illness in children<sup>13</sup>.

- Such studies, while sponsored in part by the gas industry, are peer reviewed research findings upon which the gas industry and public health officials can rely and have been accepted and used by EPA.<sup>14, 15</sup>

A landmark publication by the National Institute of Medicine, entitled *Clearing the Air: Asthma and Indoor Air Exposures*, acknowledged that “most epidemiologic studies reviewed [concerning health concerns and gas ranges] have assessed NO<sub>2</sub> exposure based on the presence or absence of gas appliances in the home, rather than based on NO<sub>2</sub> measurements.”<sup>16</sup> Furthermore, the evaluation classifies NO<sub>2</sub> as a chemical agent for which “inadequate or insufficient evidence to determine whether an association [with development of asthma] exists.”<sup>16</sup>

**What is the Significance of Reported Health Issues Associated with NO<sub>2</sub> and Gas Ranges?** Several popular magazines and other publications have reported the findings of a study in the British journal, *The Lancet*, which found a relationship between asthma like symptoms in British housewives and gas ranges<sup>17</sup>. This study, while being published in a widely known health sciences publication, has several fundamental shortcomings.

- First, NO<sub>2</sub> was never measured in the study. Instead, the presence of gas ranges was used as a surrogate for assuming exposure of the occupants to NO<sub>2</sub>.
- Second, intervening considerations were not controlled in the study. For example, smokers and non-smokers were not accounted for in the results.
- Third, NO<sub>2</sub> in the outside air, a major contributor to indoor concentrations, was not measured.

Per researchers, these shortcomings have been common in similar studies of NO<sub>2</sub> indoors and symptomatic effects. Such studies on NO<sub>2</sub> have been submitted to the EPA process for setting an ambient NO<sub>2</sub> standard in the past and have been rejected for consideration by EPA. The results of EPA’s evaluation also have been published.<sup>18</sup> The gas industry needs to remain vigilant about such studies and their acceptance in the popular press. It should be recognized that the gas industry has sponsored a significant contribution of research used by EPA in its NAAQS process for

<sup>9</sup> <https://www.epa.gov/co-pollution/setting-and-reviewing-standards-control-carbon-monoxide-co-pollution-outdoor-air#standards>

<sup>10</sup> U. S. Environmental Protection Agency, “Review of the National Ambient Air Quality Standards for Carbon Monoxide, Assessment of Scientific and Technical Information: OAQPS Staff Paper,” EPA-452/R-92-004, Aug. 1992.

<sup>11</sup> American Lung Association, Environmental Protection Agency, Consumer Products Safety Commission, American Medical Association, “Indoor Air Pollution: An Introduction to Health Professionals,” (undated).

<sup>12</sup> Wilson, A. L., Colome, S. D., and Tian, Y., “California Residential Indoor Air Quality Study, Vol. I: Methodology and Descriptive Statistics,” Gas Research Institute, May 1993.

<sup>13</sup> Samet, J. M., Lambert, W. E., Skipper, B. J., Cushing, A. H., Young, S. A., McLaren, L. C., Schwab, M., and Spengler, J. D., “Nitrogen Dioxide and Respiratory Illness in Children, Part I: Health Outcomes; Part II: Assessment of

Exposure to Nitrogen Dioxide,” HEI Research Report No. 58, Health Effects Institute, June 1993.

<sup>14</sup> [https://cfpub.epa.gov/si/si\\_public\\_record\\_report.cfm?Lab=NCER&dirEntryId=54368](https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NCER&dirEntryId=54368)

<sup>15</sup> [https://cfpub.epa.gov/ols/catalog/advanced\\_brief\\_record.cfm?&FIELD1=AUTHOR&INPUT1=Tuan%20AND%20Yi.&TYPE1=ALL&LOGIC1=AND&COLL=&SORT\\_TYPE=MTIC&item\\_count=1](https://cfpub.epa.gov/ols/catalog/advanced_brief_record.cfm?&FIELD1=AUTHOR&INPUT1=Tuan%20AND%20Yi.&TYPE1=ALL&LOGIC1=AND&COLL=&SORT_TYPE=MTIC&item_count=1)

<sup>16</sup> National Institute of Medicine, *Clearing the Air: Asthma and Indoor Air Exposures*, National Academy Press, 2000, P225.

<sup>17</sup> Brauer, M. and Kennedy, S. M., “Gas Stoves and Respiratory Health,” *The Lancet*, Vol. 347: 412. (1996).

<sup>18</sup> <https://www.epa.gov/no2-pollution/setting-and-reviewing-standards-control-no2-pollution>

# FACT SHEET

## Combustion Emissions from Residential Gas Ranges

---

both CO and NO<sub>2</sub>.

**What are the public health standards for NO<sub>2</sub>?** As in the case of CO, no national standards exist for indoor residential exposure to NO<sub>2</sub>. Furthermore, the NAAQS for NO<sub>2</sub> administered by EPA includes no short-term exposure standard. Under this standard, exposure is limited to an annual average not to exceed 53 part per billion (ppb).

### **What does the future hold for gas ranges and concerns over emissions from these appliances?**

It can be assumed that concerns over emissions from gas ranges will continue to be raised and debated. The limited credible NO<sub>2</sub> research and reports are from the 1990s when most cooking appliances had constant burning or standing pilots. U. S. Department of Energy minimum efficiency standards for gas-fired cooking appliances have eliminated standing pilots, virtually nullifying the speculation of risks from this combustion source. In addition, home cooking patterns have changed, reducing the amount of home cooking performed.<sup>19</sup> These changes underline a need for additional research to quantify emissions under current home cooking appliances and patterns. Caution should also be exercised when citing previously published reports and findings that do not necessarily apply today.

AGA has found that some media reports quote researchers outside of the public health community. Many of these researchers may not be as objective about the science or transparent in their research methods as federal agencies such as the EPA, which have a statutory responsibility for objective and transparent research. The media using quotes from non-public health researchers has been a long-standing issue and is likely to continue.

The gas utility industry continues to work to develop information and provide education for consumers, employees, and regulators about the safety of gas cooking appliances and ways to reduce cooking process emissions from impacting IAQ.

---

<sup>19</sup> Smith, L.P., Wen, S., Popkin, B.M., "Trends in US home food preparation and consumption: analysis of national nutrition surveys and time use studies from

1965-1966 to 2007-2008," National Center for Biotechnology, Nutrition Journal, Vol. 12: 45, April 2013.