

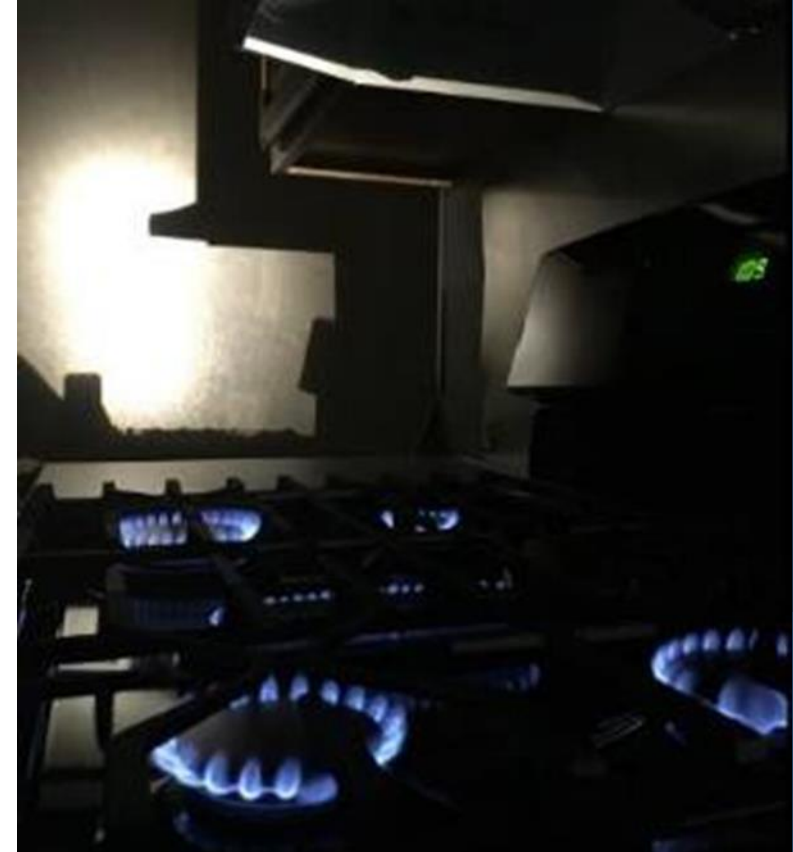


Gas Appliance Cooking: Discussion on the Studies and Research Conducted

Advocacy through Education

NGA 2023 Spring Operations Conference

Robert D. Wilson, Vice President, Special Projects
Northeast Gas Association
bwilson@northeastgas.org



Agenda

- ✓ **Overview of the Issues**
- ✓ **Resources for Residential Cooking and Indoor Air Quality**
- ✓ **Indoor Air Quality Q&A**

Acknowledgement:

NGA would like to thank GTI Energy. specifically, Frank Johnson PhD, R&D Manager, Residential and Commercial Foodservice & the Residential Cooking IAQ Project Team for sharing what is presented today.

fjohnson@gti.energy



Residential Cooking IAQ – The Issue

- **Claims against Cooking with Natural Gas**
 - Causes asthma in children
 - Causes asthma in women
 - Causes allergies in children
 - Lowers IQ or causes learning disabilities in children
 - Makes COVID symptoms worse
 - Releases harmful greenhouse gases
 - Larger carbon footprint than electric
 - Causes cancer
 - Wastes more energy than electric
 - Releases harmful PM (particulate matter) that kills 354 persons/year in California



Residential Cooking IAQ – The Issue

Growing Concerns of the Safety of Cooking with Natural Gas



FACTSHEET

Gas stoves and asthma in children

indoor pollution

healthy home

triggers

DONATE

DONATE

THE CONVERSATION

Academic rigor, journalistic fair

Search analysis, research, academics...

COVID-19 Arts + Culture Economy + Business Education Environment + Energy Ethics + Religion Health Politics + Society Science + Technology



Gas cooking is associated with worsening asthma in kids. But proper ventilation helps

Mr. Gillis is a former New York Times opinion writer. Mr. Nilles is a

study says

As Grapple With Climate Change, Gas Stoves Fight To Stay In Business

Washington Post
How electric stoves are poised to dethrone the mighty gas range

Gas stoves cause indoor air pollution, health risks

clearco2.org



Childhood asthma; worse covid outcomes

air,

Residential Cooking IAQ – The Issue

Natural Gas Bans

Berkeley first city in California to ban natural gas in new buildings



Berkeley is leading the way again with a new law to ban natural gas infrastructure in new construction. Photo: Emilie Raguso

No more natural gas in new San Francisco buildings starting next year

J.K. Dineen | Nov 12, 2020 | Updated: Nov 12, 2020 9:34 a.m.



CNBC

MARKETS BUSINESS INVESTING TECH POLITICS CNBC TV WATCHLIST CRAMER PRO

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MAKE IT

CLIMATE

New York City is banning natural gas hookups for new buildings to fight climate change

PUBLISHED WED, DEC 15 2021-3:45 PM EST | UPDATED WED, DEC 15 2021-5:39 PM EST

Emma Newburger
@EMMA_NEWBURGER

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Residential Cooking IAQ – The Issue

Good Morning America: Nov 2, 2021



Residential Cooking IAQ – The Issue

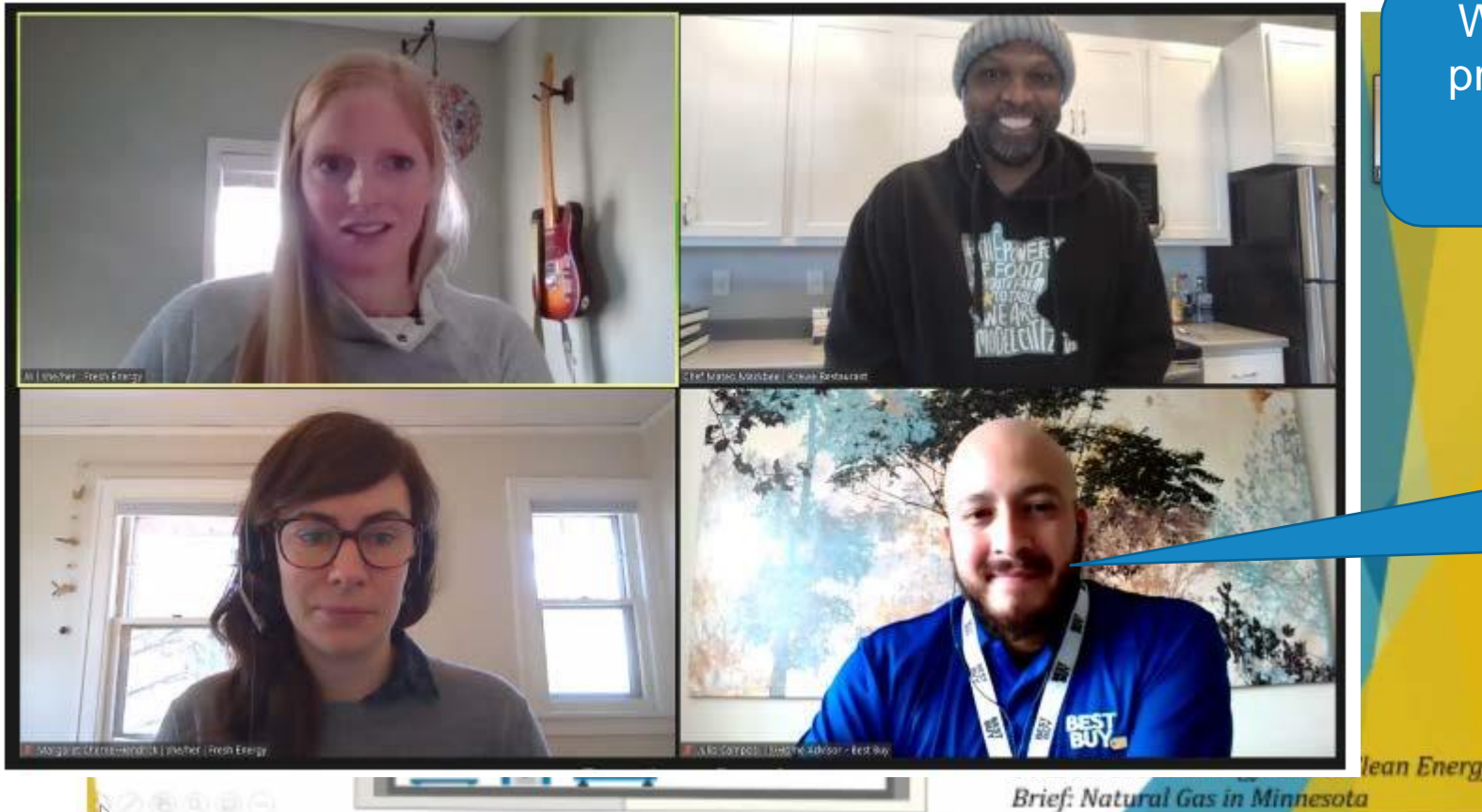
NPR segment *“We need to talk about your gas stove, your health and climate change”*

- Tests conducted by a professor of environmental epidemiologist from Drexel University in his own home and using a rented NO₂ monitor
- States that NO₂ levels exceeded World Health Organization guidelines of 106 ppm
 - Instantaneous readings and not time averaged as is conventionally done for IAQ measurements



Residential Cooking IAQ – The Issue

- Webinar: Clean Cooking with Induction by Fresh Energy of Minnesota



What roles does proper ventilation play in clean cooking?



“Ventilation is the most important element of cooking. Most use it wrong or not at all”

Residential Cooking IAQ – The Issue

- **What we have learned so far:** Literature review Conclusions
 - National Publications
 - Focus on natural gas health (asthma) and climate change (greenhouse gas)
 - Very negative toward natural gas
 - “Scientific” Publications
 - Questionable conclusions on NOx-asthma and greenhouse gases
 - Causality vs. Coincidence
 - Review articles consolidate implied results into single conclusion against natural gas
- “Need for further research”
 - Importance of cooking ventilation system

Residential Cooking IAQ – The Response

- Updated list of resources concerning residential cooking with natural gas
 - Includes three white papers by GTI Energy
 - Available by request

> 50 requests responded to

Below is updated list of downloadable information maintained by Frank Johnson (fjohnson@gti.energy) of GTI on IAQ and residential cooking.

[Articles against natural gas](#)

[Response articles or whitepapers](#)

[Other information](#)

Consumer Awareness blog by Sean [Lintow](#) of SLS Construction & Building Solutions LLC
[Monday Musing: Don't believe the Hype](#)

AGA resources to address the role and value of natural gas to consumers, the economy, and the environment, including information related to concerns about natural gas cooking and indoor air quality.

[Natural Gas: Critical Energy for American Communities](#)

[The Value of Natural Gas](#)

[Combustion Emissions from Natural Gas Ranges](#)

[Indoor Air Quality and Residential Gas Ranges Q&A](#)

[Implications Of Policy Driven Residential Electrification](#)

[AGA Evaluation of Report Health Effects from Gas Stove Pollution](#)

[AGA Fact Sheet: Combustion Emissions from Residential Gas Ranges](#)

NFPA Home Cooking Fires Report

[NFPA Home Cooking Fires - Marty Ahrens](#)

Resources for Residential Cooking and Indoor Air Quality

Recent reports and information presented by some universities, media outlets and other research organizations have raised questions about using natural gas or propane as the primary energy source for residential cooking in terms of safety and environmental issues with a focus on indoor air quality (IAQ). Many of these sources conclude that more research is needed to draw definitive conclusions for the claims being made. However, results from many of these sources are being used to make negative claims against using natural gas or propane as the primary energy source for cooking.

Below is updated list of downloadable maintained by Frank Johnson (fjohnson@gti.energy) of GTI Energy on IAQ and residential cooking. The information includes research articles, responses to research, media information and special reports. The information is organized by the main study responses, topic areas or general information.

Sierra Club/UCLA Study

One of the main studies quoted in the media is a study completed at UCLA and can be found at the following link:

Sierra Club/UCLA Study

[Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California](#)

A comprehensive review of the UCLA study was completed by Daniel Tormey and can be found at the following links:

[California Restaurant Association News](#)

[Full Review by Daniel Tormey of Sierra Club/UCLA Study](#) Comments from the reviewer include:

- Indoor air modeling results are incorrectly compared to NAAQS and CAAQS
 - Had the UCLA Report made the correct comparisons, it would have concluded that there are no adverse health impacts from indoor use of natural gas appliances.
- Cites several references that conclude that indoor air quality is more a function of what is being cooked, rather than the fuel used for cooking.
- Does not consider consequences of electrification (cost and disproportionate adverse impacts to disadvantaged communities, availability, hazards)
- Results depend upon a sequential series of assumptions, some of which are unsupported by the literature.
- Numerous statements throughout the UCLA Report are not supported by the data provided or the references cited. Because the UCLA Report is built on data in the published literature, this problem indicates a flawed foundation for the findings.

Stanford Study

The second most quoted study was completed at Stanford University and is referred to as the Standford Study that can be found at the following link:

Stanford Article

[Methane and NOx Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes](#)

A review of the Stanford Study was completed by Energy In Depth and available at the following link: [Energy In Depth Review of Stanford Study](#)
Comments from the reviewer included:

- The author's health claims are unsupported by their findings and methods

Resources for Residential Cooking and Indoor Air Quality

- Compared NO₂ emissions readings over the course of a few minutes to the NAAQS 1-hr outdoor air standard
- The researchers create an unrealistic kitchen environment to achieve their results
 - Kitchens sealed with plastic, prevents natural air flow
- The researchers have made false claims about natural gas in homes
 - Claims of small leaks in homes that are too small to smell (unlikely with odorants)
 - Encourage homeowners to tighten fittings themselves
- The study is affiliated with “Keep it in the Ground” groups
 - PSEHE, Tony Ingraffea, his research is “a form of advocacy”
 - Receives funds from anti-fracking Park Foundation
- The natural gas industry has actively invested in reducing emissions

Harvard Study

An article was published by the Harvard T.H. Chan School of Public Health and can be found at the following link:

[Home is Where the Pipeline Ends: Characterization of Volatile Organic Compounds Present in Natural Gas at the Point of the Residential End User](#)

A response to Harvard T.H. Chan School of Public Health Article was published by AGA and includes the following information:

“While combustion emissions from gas ranges, ovens, and cooktops can contribute to some degree to emissions of recognized pollutants, there are no documented risks to respiratory health from natural gas stoves from the regulatory and advisory agencies and organizations responsible for protecting residential consumer health and safety. The Federal Interagency Committee on Indoor Air Quality (CIAQ), which is comprised of two dozen federal agencies led by the U.S. Environmental Protection Agency (EPA), routinely addresses indoor air quality issues of public importance. The CIAQ has not identified natural gas cooking emissions as an important issue concerning asthma or respiratory illness. Furthermore, the U.S. Consumer Product Safety Commission and EPA do not present gas ranges as a significant contributor to adverse air quality or health hazard in their technical or public information literature, guidance, or requirements.”

AGA pointed out two specific issues with the study:

- *All the natural gas samples measured in the study reported odorant (TBM) thresholds that meet federal regulations.*
- *The authors admit that the concentrations of VOCs in the natural gas sampled "are likely lower compared to other source types" such as household chemical products, cleaning agents, etc.*

AMA Resolution 439

The American Medical Association (AMA) House of Delegates introduced Resolution 439. The purpose of the resolution is to inform physicians, health care providers and the public that cooking with a gas stove increases household air pollution and the risk of childhood asthma. The resolution is located at the following link:

[AMA House of Delegates - Resolution 439](#)

AGA requested and received a review of the resolution from Gradient and issued a letter to the AMA (see following links).

[Review of Resolution 439 by Gradient](#)

[Letter to AMA from AGA](#) The conclusion of the review states,
“AMA should understand the strengths and limitations of the documents upon which Resolution 439 is based in order to make a more informed decision. Neither the AMA Resolution itself, nor the document introducing it, provide a well-balanced review of research findings, acknowledge the conflicting evidence, or address key issues affecting the interpretation of these studies, including study quality, study limitations, and the inconsistency of study findings. As discussed in this letter, due to significant limitations, the available studies do not provide a reliable scientific basis for AMA to make causal inferences regarding the relationship between the use of gas-fired residential cooking appliances and childhood asthma.”

Benzene and IAQ Article

Another article from the same research team as the earlier Stanford article, published an article on the impacts of IAQ from natural gas emissions in homes and specifically the concerns of Benzene. The article is located at the following link: [Composition, Emissions, and Air Quality Impacts of Hazardous Air Pollutants in Unburned Natural Gas from Residential Stoves in California](#)

AGA issued a review of the article at the following link: [AGA Response to Benzene Article](#) The review states,

“The authors appear to have used an extreme, beyond "worst case" scenario to model potential exceedances of benzene in atypical circumstances. Furthermore, if these scenarios did occur, the odorants in the natural gas would alert the building occupants before the elevated benzene levels were encountered (based on the authors' own numbers in a prior study). Further investigation of the underlying methods, assumptions, and results is required to develop a full and fair exposition of the pertinent facts.”

Other Research Articles on Cooking and IAQ

The following is a list of other research projects associated with IAQ and cooking. A summary of the results is included with a link to the articles:

Wong et. Al, 2013, Cooking fuels and prevalence of asthma: a global analysis of phase three of the International Study of Asthma and Allergies in Childhood (ISAAC)

- Link: [ISAAC - The international study of asthma and allergies in childhood](#)
- Investigated the association between types of cooking fuels and symptoms of asthma using logistic regression
- Adjustments made for sex, region of the world, language, gross national income, maternal education, parental smoking and six other subject-specific covariates
- Data collected between 1999 and 2004
 - 198,398 children aged 6-7 years from 29 countries
 - 314,309 children aged 13-14 years from 47 countries
- Detected no evidence of an association between the use of gas as a cooking fuel and either asthma symptoms or asthma diagnosis for both age groups

Resources for Residential Cooking and Indoor Air Quality

Jarvis D, Chinn S, Sterne J, Luczynska C, Burney P. The association of respiratory symptoms and lung function with the use of gas for cooking. European Community Respiratory Health Survey.

- Link: [Article at National Library of Medicine](#)
- European community respirator health survey
- Over 100,000 respondents
- Conclusion: No relation between the use of gas for cooking and obstructive respiratory symptoms

Johnson F, Swierczyna R, Sutherland B, Pixler J. Cooking Emissions for Natural Gas, Propane and Electric Range Tops. UTD Special Report.

- Link: [Cooking Emissions for NG, Propane and Electric Range Tops](#)
- Cooking emissions for food only comparison study for natural gas, propane and electric range tops
- Results showed that natural gas and propane do not generate more particulate matter (PM) emissions from food than electric for residential range tops
- Concluded: Cooking emissions as a function of the fuel source are not well understood and require additional testing and evaluations with other range designs and food types to make definitive conclusions

Other Response Articles or Whitepapers

AGA response to Atlantic article, "Kill Your Gas Stove" [Link to AGA Response to Atlantic Article](#)

AGA response to Weather Channel video

[Link to AGA Response to Weather Channel GTI UTD Special Report Review of Claims Against Residential Cooking with Natural Gas](#)

Other information

RMI Report Health Effects from Gas Stove Pollution

[Gas Stoves: Health and Air Quality Impacts and Solutions](#)

California Cities Banning Natural Gas Article from KFI 640 AM

[California Cities Banning Natural Gas Have Cooked up a Controversy](#)

Consumer Awareness blog by Sean Lintow of SLS Construction & Building Solutions LLC [Monday Musing: Don't believe the Hype](#)

AGA resources to address the role and value of natural gas to consumers, the economy, and the environment, including information related to concerns about natural gas cooking and indoor air quality.

[Natural Gas: Critical Energy for American Communities](#) [The Value of Natural Gas](#)

[Combustion Emissions from Natural Gas Ranges](#) [Indoor Air Quality and Residential Gas Ranges Q&A](#)

[Implications Of Policy Driven Residential Electrification](#)

[AGA Evaluation of Report Health Effects from Gas Stove Pollution](#) [AGA Fact Sheet: Combustion Emissions from Residential Gas Ranges](#)

Resources for Residential Cooking and Indoor Air Quality

NFPA Home Cooking Fires Report
[NFPA Home Cooking Fires - Marty Ahrens](#)

California Energy Commission Report
[Ventilation and Air Quality in New California Homes with Gas Appliances and Mechanical Ventilation](#)

ASHRAE Position Document on Unvented Combustion Devices and Indoor Air Quality

IAQ Q&A

- Question: **With all the sources coming out about the harmful effects of cooking with natural gas, it must be dangerous?**
- Answer:
 - Only 2 Main Sources Used as Source of Most Articles
 - UCLA Study
 - Stanford Study



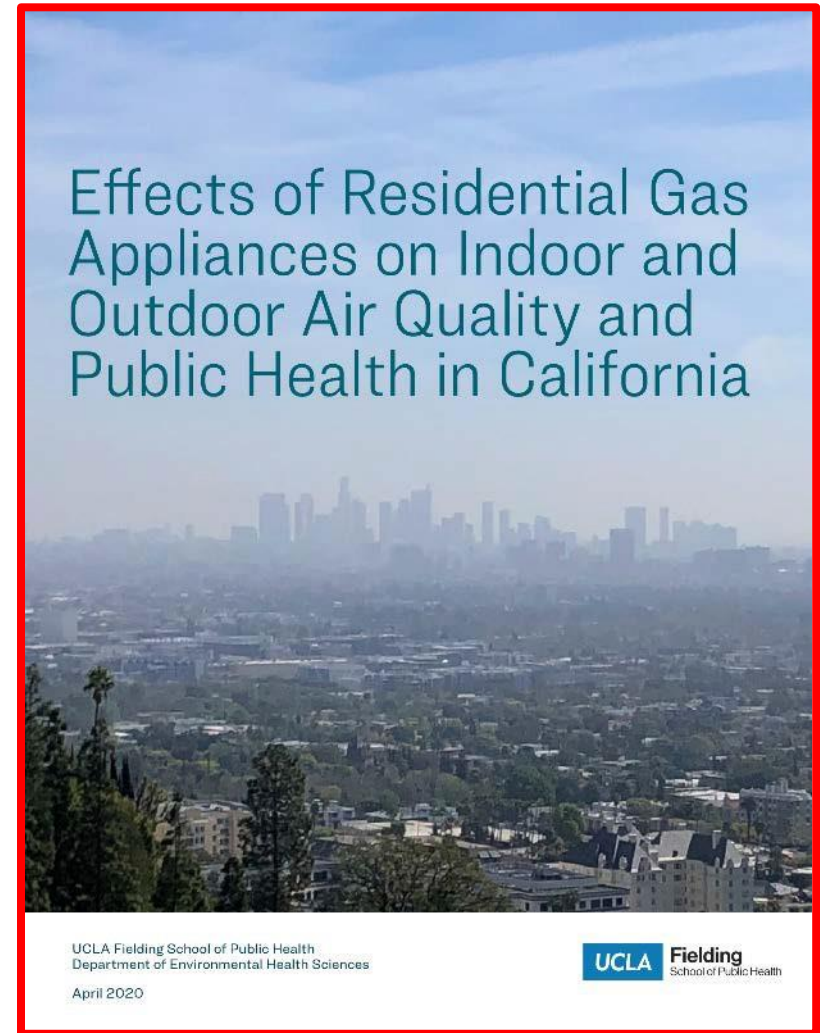
ENVIRONMENTAL
Science & Technology

pubs.acs.org/est

Article

Methane and NO_x Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes

Eric D. Lebel,* Colin J. Finnegan, Zutao Ouyang, and Robert B. Jackson



Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California

UCLA Fielding School of Public Health
Department of Environmental Health Sciences
April 2020

UCLA Fielding School of Public Health

IAQ Q&A

- Question: **What Does the UCLA Study Say?**
- Answer: Critical comments about using natural gas for residential cooking in terms of particulate matter (PM) and NOx
 - Example: Releases harmful PM (particulate matter) that kills 354 persons/year in California
- Question: **Are there issues with the claims in the UCLA Study?**
- Answer: Yes



Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California

UCLA Fielding School of Public Health
Department of Environmental Health Sciences

April 2020

UCLA Fielding
School of Public Health

IAQ Q&A

Review by Daniel Tormey and Steve Huntley of Catalyst Environmental Solutions of the UCLA Study:

- Indoor air modeling results are incorrectly compared to NAAQS and CAAQS
 - Had the UCLA Report made the correct comparisons, it would have concluded that there are no adverse health impacts from indoor use of natural gas appliances.
- Cites several references that conclude that indoor air quality is more a function of what is being cooked, rather than the fuel used for cooking.
- Results depend upon a sequential series of assumptions, some of which are unsupported by the literature.
- Numerous statements throughout the UCLA Report are not supported by the data provided or the references cited. Because the UCLA Report is built on data in the published literature, this problem indicates a flawed foundation for the findings.

By Aling Chen

Report: Push to ban gas appliances in California based on faulty science

Cole Lauterbach, The Center Square

October 21, 2021 · 3 min read



IAQ Q&A

- Question: **What Does the Stanford Study Say?**
- Answer: Critical comments about using natural gas for residential cooking in terms of methane leaks and NO_x

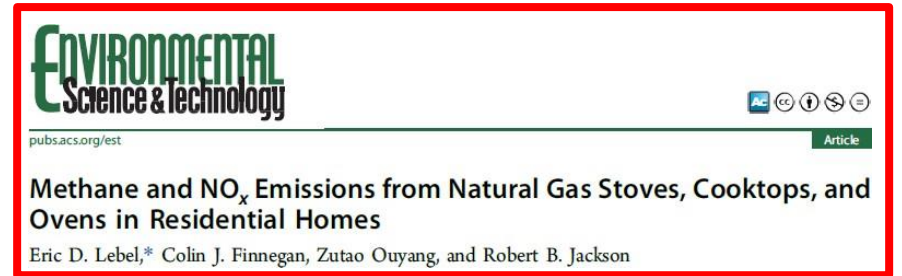


- Question: **Are there issues with the claims in the Stanford Study?**
- Answer: Yes

IAQ Q&A

A review of the Stanford Study by *Menyae Christopher of Energy In-Depth, Five Facts on PSEHE's (Oakland based research consortium Physicians, Scientists and Engineers for Healthy Energy) New Questionable Indoor Air Quality Study gives the following summary:*

- The author's health claims are unsupported by their findings and methods
 - Compared NO₂ emissions readings over the course of a few minutes to the NAAQS 1-hr outdoor air standard
- The researchers create an unrealistic kitchen environment to achieve their results
 - Kitchens sealed with plastic, prevents natural air flow
- The researchers have made false claims about natural gas in homes
 - Claims of small leaks in homes that are too small to smell (unlikely with odorants)
 - Encourage homeowners to tighten fittings themselves
- The study is affiliated with "Keep it in the Ground" groups
 - PSEHE, Tony Ingraffea, his research is "a form of advocacy"



IAQ Q&A

- Question: **Does cooking with natural gas cause asthma?**
- Answer: Undetermined, more data is needed

Jarvis et al, 1998, The association of respiratory symptoms and lung function with the use of gas for cooking. European Community Respiratory Health Survey

- European community respirator health survey
- Over 100,000 respondents
- Conclusion: No relation between the use of gas for cooking and obstructive respiratory symptoms

IAQ Q&A

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Wong et. Al, 2013, Cooking fuels and prevalence of asthma: a global analysis of phase three of the International Study of Asthma and Allergies in Childhood (ISAAC)

- Investigated the association between types of cooking fuels and symptoms of asthma using logistic regression
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 - 314,309 children aged 13-14 years from 47 countries
- Detected no evidence of an association between the use of gas as a cooking fuel and either asthma symptoms or asthma diagnosis for both age groups

IAQ Q&A

- Question: **Who is RMI and what information are they presenting?**
- Answer:
 - Rocky Mountain Institute
 - Generate and distribute information and graphics from UCLA and Stanford studies



The screenshot shows the RMI website header with navigation links: Our Work, Research & Analysis, Stories, News & Events, Impact, About, Join, and a search icon. A teal 'Donate' button is on the right. Below the header is a large image of a person pouring yellow batter into a pan. Below the image is the breadcrumb trail: BUILDINGS >> BUILDING ELECTRIFICATION >> INDOOR AIR POLLUTION: THE LINK BETWEEN CLIMATE AND HEALTH. The main content area features a 'Shares' button, the article title 'Indoor Air Pollution: the Link between Climate and Health', the date 'May 5, 2020', and the author 'By Brady Seals'. On the right, a 'RECENT POSTS' section lists three articles: 'Transforming Trucking in India', 'Let RMI Be Your Guide to the Global Energy Transformation', and 'Gender-Inclusive Strategies Are Key to Advancing the Energy Transition'.

IAQ Q&A

EXHIBIT 1

Differentiating Pollutants from Cooking Food vs. Gas Fuel

Many factors contribute to which pollutants are generated from the stove and the food being cooked.

Pollutants Generated from Cooking Food (regardless of stove type)	Pollutants Associated With Gas Stoves
<p>Particulate Matter (PM₁₀) Small particles with a diameter less than 10 micrometers. Commonly measured in cooking activities like frying or broiling with the highest emissions levels found during the oven self-cleaning cycle.¹⁷</p>	<p>Particulate Matter (PM_{2.5}) Unlike electric stoves, gas stoves emit PM_{2.5} in the absence of cooking food (i.e., from the flames). Although cooking food emits PM_{2.5}, tests show PM_{2.5} emissions from gas stoves can be two times higher than from electric stoves.¹⁸</p>
<p>Particulate Matter (PM_{2.5}) Small particles with a diameter less than 2.5 micrometers. PM_{2.5} can penetrate deep into the lungs and even enter the bloodstream.¹⁹ Stove tests show emissions are dependent on a number of factors such as the type of food cooked, cooking temperature, type of oil used, and type of fuel/stove used.²⁰</p>	<p>Nitrogen Oxides (NO_x) When nitrogen and oxygen react to each other, especially at high temperatures, they produce several toxic gases. NO₂ and NO are the principal gases associated with combustion sources (collectively known as NO_x).^{21,22}</p> <p><small>*A 2001 laboratory study showed no rise in NO_x when using an electric stove.²³ *A study published in 2016 showed that after subtracting outdoor contribution, all-electric homes had NO_x levels close to zero.²⁴</small></p>
<p>Ultrafine Particles (UFP) These tiny particles are less than 100 nanometers (nm) in diameter and are hazardous to health. Cooking is the main source of UFP in homes, particularly those with gas stoves.²⁵ Gas stoves and electric coil resistance stoves emit high quantities of UFP, particularly smaller than 10 nm in diameter.²⁶</p>	<p>Nitrogen Dioxide (NO₂) Nitric Oxide is oxidized in the air to form NO₂. More data exists on NO₂ than NO. NO₂ is regulated by the EPA and thus is the component most studied and considered by the EPA in terms of health effects.²⁷</p>

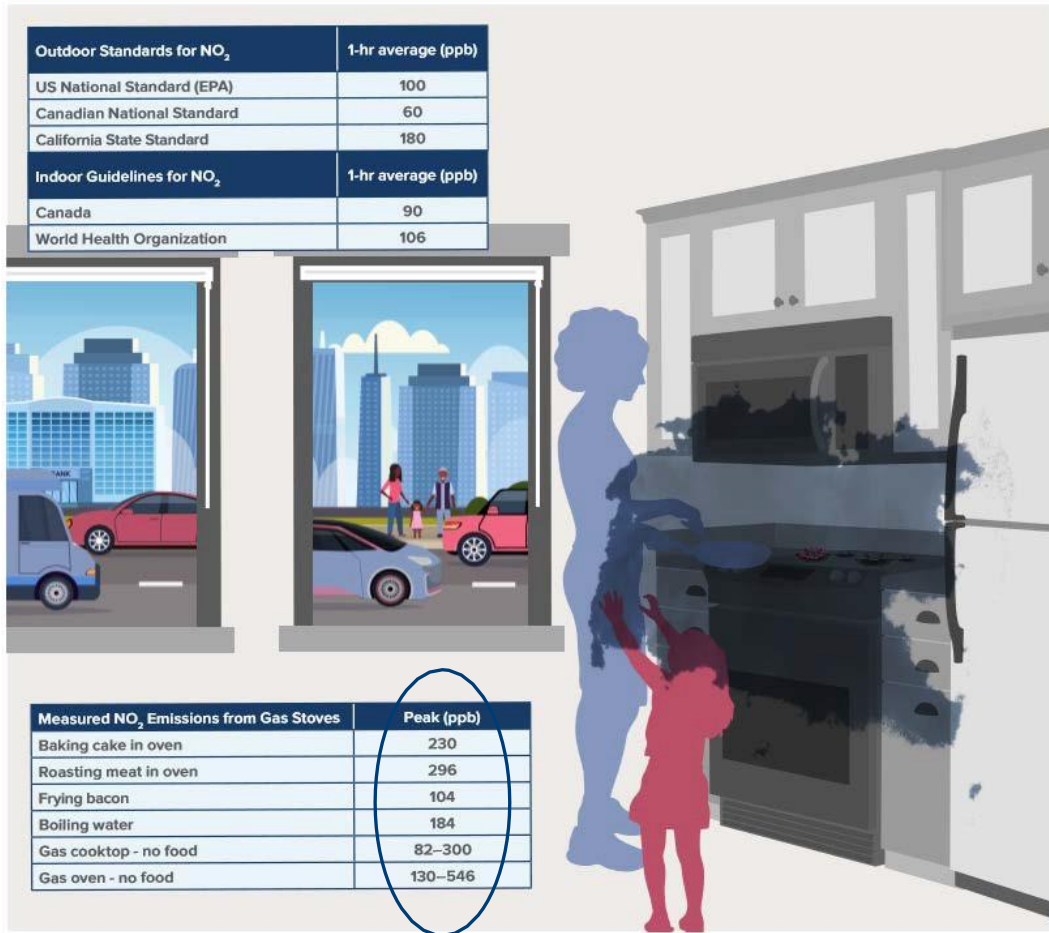
18. Tianchao Hu, Brett C Singer, Jennifer M Logue, *Compilation of Published PM_{2.5} Emission Rates for Cooking, Candles and Incense for Use in Modeling Exposures in Residences*, Ernest Orlando Lawrence Berkeley National Laboratory, 2012, p. 11, <https://www.osti.gov/servlets/purl/1172959>.

Some studies compared different types of stoves to see if stove fuel type influenced particle emission rates. Zhang et al performed repeated cooking experiments frying chicken on gas and electric types of ranges. The results showed that emissions from the use of the gas stove were a factor of 2 higher than an electric stove for the same cooking method. Buonanno et al. found that gas stoves generate more particles than electric when grilling. This result reflects the fact that indoor combustion, i.e. gas stove flames, is an important sources of particulate matter in the absence of cooking emissions. Gas stoves are also an important source of pollutants such as CO and NO_x and can result in acute exposures at harmful concentrations.

IAQ Q&A

EXHIBIT 3

Gas Stoves Can Emit Elevated Indoor Nitrogen Dioxide (NO₂) Levels Often Exceeding Indoor Guidelines and Outdoor Standards⁶⁹



Brett C. Singer et al, *Pollutant Concentrations and Emission Rates from Scripted Natural Gas Cooking Burner Use in Nine Northern Californian Homes*, Lawrence Berkeley National Laboratory, 2016, p.

observed in those homes. Four of the nine homes had kitchen levels exceed the national ambient air quality standard threshold of 100 ppb NO₂ over 1h, and two others had 1h NO₂ concentrations of at least half this value. Three of the nine homes had bedroom NO₂ levels exceed 50 ppb. This suggests significant exposures may occur for anyone at home when natural gas burners are used for even a single, substantial cooking event.

5 Recommendations

Based on the findings of this field study and the related, prior work referenced herein, the authors offer the following policy recommendations.

Efforts should be made to increase awareness (a) that natural gas cooking burners are a source of air pollutant emissions into homes, and (b) that these pollutants can be controlled with an appropriately-sized venting range hood or other kitchen exhaust ventilation. Since cooking with electric burners also produces pollutants, kitchen exhaust ventilation should be available in all homes, and operated as a precaution whenever cooking occurs. Since the performance of most hoods is much better when cooking is done on the back cooktop burners, this practice should be encouraged to improve safety. Gas utilities could play a valuable role in publicizing these messages.

Building standards should require that range hoods have airflows of at least 95 L/s and cover front burners or preferably demonstrate performance through a standard test. Such a test is currently under development by ASTM.

IAQ Q&A

- Question: **What Does the Harvard Study Say?**
- Answer: Critical of use of natural gas in homes because of volatile organic compounds (VOC) and methane leaks from natural gas

- Question: **Are there issues with the claims in the Harvard Study?**
- Answer: Yes

Home is Where the Pipeline Ends: Characterization of Volatile Organic Compounds Present in Natural Gas at the Point of the Residential End User

Drew R. Michanowicz*, Archana Dayalu, Curtis L. Nordgaard, Jonathan J. Buonocore, Molly W. Fairchild, Robert Ackley, Jessica E. Schiff, Abbie Liu, Nathan G. Phillips, Audrey Schulman, Zeyneb Magavi, and John D. Spengler

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IAQ Q&A

Response to Harvard T.H. Chan School of Public Health Article by the AGA

“While combustion emissions from gas ranges, ovens, and cooktops can contribute to some degree to emissions of recognized pollutants, there are no documented risks to respiratory health from natural gas stoves from the regulatory and advisory agencies and organizations responsible for protecting residential consumer health and safety. The Federal Interagency Committee on Indoor Air Quality (CIAQ), which is comprised of two dozen federal agencies led by the U.S. Environmental Protection Agency (EPA), routinely addresses indoor air quality issues of public importance. The CIAQ has not identified natural gas cooking emissions as an important issue concerning asthma or respiratory illness. Furthermore, the U.S. Consumer Product Safety Commission and EPA do not present gas ranges as a significant contributor to adverse air quality or health hazard in their technical or public information literature, guidance, or requirements.”

AGA pointed out two specific issues with the study:

- All the natural gas samples measured in the study reported odorant (TBM) thresholds that meet federal regulations.
- The authors admit that the concentrations of VOCs in the natural gas sampled "are likely lower compared to other source types" such as household chemical products, cleaning agents, etc.

IAQ Q&A

- Question: **Should I switch to cooking with electric because the American Medical Association (AMA) proposed a resolution against cooking with natural gas?**
- Answer: Not necessarily and yes they did

AMERICAN MEDICAL ASSOCIATION HOUSE OF DELEGATES

Resolution: 439
(A-22)

Introduced by: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

Subject: Informing Physicians, Health Care Providers, and the Public That Cooking with a Gas Stove Increases Household Air Pollution and the Risk of Childhood Asthma

Referred to: Reference Committee D

1 Whereas, In the United States, more than 11.5 million people with asthma, including nearly 3
2 million children, report having had one or more asthma attacks in 2015¹; and
3
4 Whereas, Household air pollution is a major health problem. Worldwide, it is responsible for
5 more than three million deaths a year,² and indoor air pollution is strongly linked to asthma;³
6 and
7
8 Whereas, Household and outdoor air pollution are social determinants of health and associated
9 with an increased risk of asthma;^{4,5} and air pollution contributes to health disparities in asthma;⁶
10 and
11
12 Whereas, According to the United States Environmental Protection Agency (EPA), a growing
13 body of scientific evidence indicates that, even in large cities, indoor air can be more polluted
14 than the outdoor air;⁷ and
15
16 Whereas, Burning natural gas creates nitrogen dioxide (NO₂), particulate matter (PM_{2.5}), carbon
17 monoxide (CO), and other byproducts that contribute to air pollution;⁸ and
18
19 Whereas, Nitrogen dioxide levels are significantly higher in homes with gas stoves than homes
20 with electric stoves;^{9,10} and

⁸ Environmental Protection Agency . Natural gas combustion. www3.epa.gov/ttn/chief/ap42/ch01/final/c01s04.pdf. Accessed February 14, 2019.

⁹ Belanger K, Gent JF, Triche EW, Bracken MB, Leaderer BP. Association of indoor nitrogen dioxide exposure with respiratory symptoms in children with asthma. *Am J Respir Crit Care Med*. 2006;173(3):297–303. doi:10.1164/rccm.200408-1123OC.

¹⁰ Mullen NA, Li J, Russell ML, Spears M, Less BD, Singer BC. Results of the California Health Homes Indoor Air Quality Study of 2011–2013: impact of natural gas appliances on air pollutant concentrations. *Indoor Air*. 2016;26: 231–245. <https://doi.org/10.1111/ina.12190>.

IAQ Q&A

A review by of the AMA Resolution by **Gradient**

- **Review of Resolution 439 by Gradient ([link](#))**

*“Resolution 439 presumes a causal relationship between the use of gas-fired residential cooking appliances and childhood asthma. The document that introduced this resolution cites a very limited number of studies that are not representative of the broader body of scientific literature. As discussed more below, scientific studies addressing gas-fired residential cooking appliances and childhood asthma have significant limitations, including poor study quality, inadequate control of potential confounders, and potential sources of bias. As a result, these studies do not provide reliable basis for causal inferences. **We also note that the AMA resolution downplays the important role of ventilation for mitigating gas combustion-related and cooking-related air emissions.**”*

- **Letter to AMA from AGA ([link](#))**



IAQ Q&A

- Question: **Cooking with natural gas generates more cooking emissions than electric?**
- Answer: **No with a twist**

EXHIBIT 1

Differentiating Pollutants from Cooking Food vs. Gas Fuel

Many factors contribute to which pollutants are generated from the stove and the food being cooked.

Pollutants Generated from Cooking Food (regardless of stove type)	Pollutants Associated With Gas Stoves
<p>Particulate Matter (PM₁₀) Small particles with a diameter less than 10 micrometers. Commonly measured in cooking activities like frying or broiling with the highest emissions levels found during the oven self-cleaning cycle.¹⁷</p>	<p>Particulate Matter (PM_{2.5}) Unlike electric stoves, gas stoves emit PM_{2.5} in the absence of cooking food (i.e., from the flames). Although cooking food emits PM_{2.5}, tests show PM_{2.5} emissions from gas stoves can be two times higher than from electric stoves.¹⁸</p>
<p>Particulate Matter (PM_{2.5}) Small particles with a diameter less than 2.5 micrometers. PM_{2.5} can penetrate deep into the lungs and even enter the bloodstream.¹⁹ Stove tests show emissions are dependent on a number of factors such as the type of food cooked, cooking temperature, type of oil used, and type of fuel/stove used.²⁰</p>	<p>Nitrogen Oxides (NO_x) When nitrogen and oxygen react to each other, especially at high temperatures, they produce several toxic gases. NO₂ and NO are the principal gases associated with combustion sources (collectively known as NO_x).^{21,22}</p> <p>*A 2001 laboratory study showed no rise in NO_x when using an electric stove.²³ *A study published in 2016 showed that after subtracting outdoor contribution, all-electric homes had NO_x levels close to zero.²⁴</p>
<p>Ultrafine Particles (UFP) These tiny particles are less than 100 nanometers (nm) in diameter and are hazardous to health. Cooking is the main source of UFP in homes, particularly those with gas stoves.²⁵ Gas stoves and electric coil resistance stoves emit high quantities of UFP, particularly smaller than 10 nm in diameter.²⁶</p>	<p>Nitrogen Dioxide (NO₂) Nitric Oxide is oxidized in the air to form NO₂. More data exists on NO₂ than NO. NO₂ is regulated by the EPA and thus is the component most studied and considered by the EPA in terms of health effects.²⁷</p>



VS



Residential Cooking IAQ – The Research

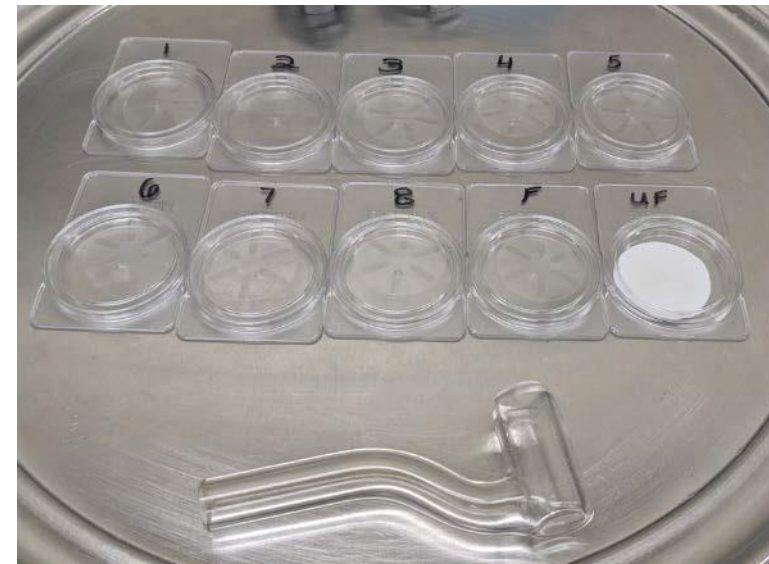
- **Cooking Emissions testing of residential ranges**
 - Measure and compare cooking emissions with natural gas and electric residential ranges
 - Cooking emissions = only emissions generated from food



Residential Cooking IAQ – The Research

Cooking Emissions Tests: Setup

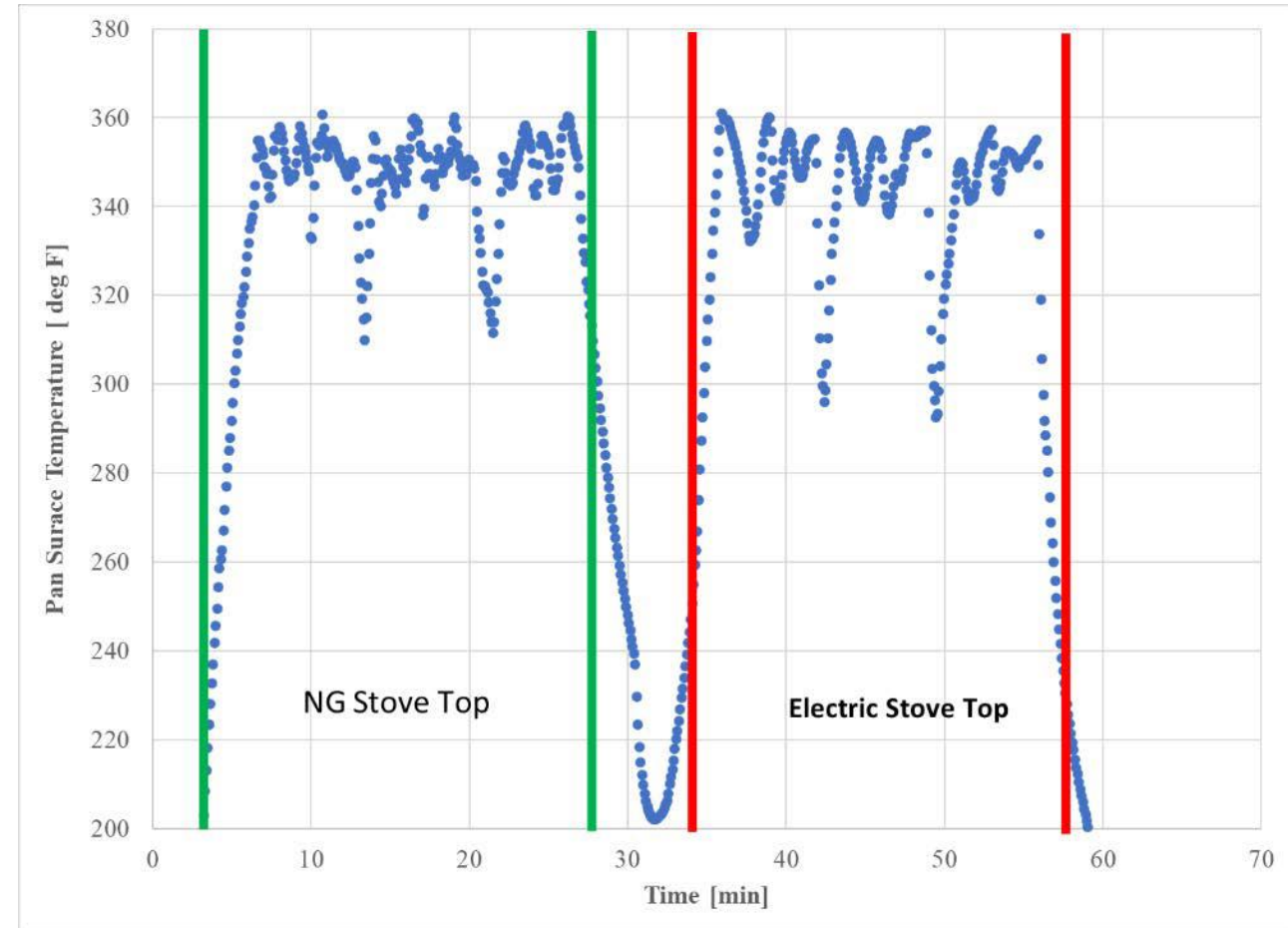
- Based on ASTM F1521-12
 - 80/20 hamburgers
 - Thermocouple welded to pan surface
 - 350 °F
- Particulate capture method from Gerstler et al (1998) University of Minnesota
 - ASHRAE RP-745



Residential Cooking IAQ – The Research

Cooking Emissions Tests: Results

- Measured weight gain per volume (mg/m^3)
 - Electric: 15.2 to 26.4 mg/m^3
 - Natural Gas: 7.1 to 8.2 mg/m^3
 - Propane: 4.7 to 5.9 mg/m^3
- Other factors
 - Consistency of product
 - Age of product
 - Temperature Control (Standard Deviation)
 - Natural gas: 5.8 °F
 - Electric: 9.7 °F



Residential Cooking IAQ – The Research

Cooking Emissions Tests: Conclusions

- Cooking emissions as a function of the fuel source are not well understood and require additional testing and evaluations with other range designs and food types to make definitive conclusions
- Ventilation is the best solution for improving indoor air quality
 - Turn it on
 - Better capture efficiency
- More research is needed

Residential Cooking IAQ Special Report:
Cooking Emissions for Natural Gas, Propane
and Electric Range Tops



By: Frank Johnson, PhD – GTI Energy

Summary

Recent reports and information presented by some universities, media outlets and other research organizations have raised questions about using natural gas or propane as the primary energy source for residential cooking in terms of safety and environmental issues. Many of these sources conclude that more research is needed to draw definitive conclusions for the claims being made. GTI Energy tested one claim that electric ranges have lower cooking emissions than natural gas¹. For this study, cooking emissions is defined as only the emissions from the food during the cooking process and not the combustion emissions from the heat source. Based on the range top cook test developed by GTI Energy, and the tests conducted with natural gas, propane and electric range tops; a conclusion that one energy source generates more cooking emissions than the others cannot be made despite GTI Energy's results showing electric ranges emitted more cooking emission than natural gas or propane. Results showed cooking emissions were more a function of the cooking vessel and food product cooked than energy source. The results varied with different boxes of same food product and with the age of the food. The temperature control and temperature distribution of the pan's cooking surface was also shown to affect the cooking emissions generated. In the tests conducted by GTI Energy, the temperature varied more for the electric range and was more difficult to control than natural gas or propane.

Results showed that cooking emissions as a function of the fuel source are not well understood and require additional testing and evaluations with other range designs and food types to make definitive conclusions.

Cooking Emission Collection System and Test Design

The cook tests were conducted in the Residential Kitchen Ventilation test lab at GTI Energy using a gas range and an electric range. The gas range was chosen based on its typical design and popularity and the electric range was chosen based on it being the closest equivalent to the gas model in terms of cost and cooking compatibility.

A test plan was developed based on an updated standard being developed by Frontier Energy for ASTM F26 (<https://www.astm.org/COMMITTEE/F26.htm>). ASTM F1521-12 defines the pan, cooking procedures and food product to use during the testing, including 80% lean / 20% fat ¼ pound hamburgers. The biggest issue with measuring cooking emissions was developing a method to collect

IAQ Q&A

- Question: **Will the addition of hydrogen to the natural gas system improve IAQ?**
- Answer:
 - No for cooking emissions
 - Maybe for combustion emissions
 - NO_x emissions being studied
 - New burner technology
 - Improved efficiency
 - Improved emissions
 - Insufficient data



IAQ Q&A

- Question: **Does cooking with natural gas release cancer causing Benzene into my home?**
- Answer: Undetermined

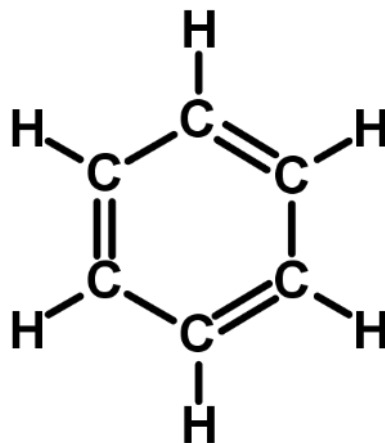


pubs.acs.org/est

Article

Composition, Emissions, and Air Quality Impacts of Hazardous Air Pollutants in Unburned Natural Gas from Residential Stoves in California

Eric D. Lebel,* Drew R. Michanowicz, Kelsey R. Bilsback, Lee Ann L. Hill, Jackson S. W. Goldman, Jeremy K. Domen, Jessie M. Jaeger, Angélica Ruiz, and Seth B. C. Shonkoff



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Study: Cancer-causing gas leaking from CA stoves, pipes

By DREW COSTLEY October 20, 2022



IAQ Q&A

Composition, Emissions, and Air Quality Impacts of Hazardous Air Pollutants in Unburned Natural Gas from Residential Stoves in California

Eric D. Lebel,* Drew R. Michanowicz, Kelsey R. Bilsback, Lee Ann L. Hill, Jackson S. W. Goldman, Jeremy K. Domen, Jessie M. Jaeger, Angélica Ruiz, and Seth B. C. Shonkoff

- Claims in article
 - Benzene is an understudied source of human health risks
 - Estimated emissions of 4,200 kg/yr in California
 - Natural Gas leakage from stoves lead to Benzene emissions above 0.94 ppbv
 - Greater than CA Office of Environmental Health Hazard Assessment 8-h Exposure Level
- Response by AGA
 - *“The authors appear to have used an extreme, beyond “worst case” scenario to model potential exceedances of benzene in atypical circumstances. Furthermore, if these scenarios did occur, the odorants in the natural gas would alert the building occupants before the elevated benzene levels were encountered (based on the authors' own numbers in a prior study). Further investigation of the underlying methods, assumptions, and results is required to develop a full and fair exposition of the pertinent facts.”*
<https://www.aga.org/globalassets/american-gas-association-review-and-comments-lebel-et.-al-october-2022-10.26.22.pdf>

IAQ Q&A

- Question: Is it safe to cook with Natural Gas?
- Answer: Yes



- There are potential IAQ issues with cooking both gas and electric due to the generation of cooking emissions (moisture, heat, particulates, VOCs)
- The consensus best solution to improve IAQ is to use proper ventilation
 - Always turn on the hood
 - Keep the filter clean
 - Captures cooking emissions and combustion emissions

Get Engaged !!

GTI Energy: Residential Cooking IAQ

Project Team:

- Frank Johnson, PhD
- Rich Swierczyna
- Brian Sutherland
- Jacob Pixler



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GTI ENERGY : Utility Customers

solutions that transform





Questions?

Discussion