November 29, 2022

Dear Eugene City Council Members:

My name is David Dodge and I live in Bend, OR. I am a Principal Scientist at Gradient, an environmental and risk sciences consulting firm. I am board-certified in both toxicology and industrial hygiene, and commonly apply these disciplines to human health risk assessment.

On behalf of NW Natural, I am writing to respond to certain speakers' comments during the November 21 City Council Public Hearing on agenda item 4: "An Ordinance Prohibiting Fossil Fuel Infrastructure in New Low-Rise Residential Buildings." My response addresses unsupported and out of context statements regarding purported adverse effects from use of gas appliances in homes on indoor air quality and human health. These comments fail to consider important factors in evaluating scientific evidence relevant to this topic, including measurement, modeling, and epidemiology studies.

First, the mere presence of a chemical in indoor air, whether attributable to gas cooking or not, is not informative as to whether it can pose health risks. Some of the speakers named specific air pollutants (*e.g.*, nitrogen dioxide [NO_2], particulate matter [PM]) emitted to indoor air when using gas appliances, and the purported health effects these pollutants are capable of causing. In order to understand the potential for a chemical to pose health risks, we must have information on dose (*i.e.*, the amount of a chemical that actually gets into the body). For all chemicals, a sufficient dose is necessary in order for it to cause adverse health effects. For a chemical in air, dose depends on how much of the chemical is in the air where a person breathes, and how often and for how long that person breathes it. Standards exist for many chemicals so we can judge whether a chemical measured at a certain concentration over a certain time period is harmless or has the potential to cause health effects.

Second, it is important to understand the methods and assumptions used in studies that have measured or modeled (*i.e.*, predicted) indoor air concentrations of chemicals in homes with gas and/or electric stoves so that they are not misinterpreted. For example, some studies have measured chemicals in unburned natural gas before it is actually used for cooking.[1,2] These studies are not informative as to actual exposures because the measurements do not represent what people actually breathe. It is also important to view the results in appropriate context. For example, certain speakers noted that some studies have reported higher indoor air concentrations of NO_2 when using gas applicances compared to electric appliances.[3,4] Often, however, the NO_2 concentrations when using gas appliances do not exceed national standards for NO_2 in ambient air under most scenarios, and thus are not significant from a health perspective. For example, Belanger *et al.* (2013) measured a mean indoor NO_2 level over 1 month of 10.6 parts per billion (ppb) in all homes, and 15.6 ppb from homes with gas stoves. By comparison, the US EPA primary National Ambient Air Quality Standard (NAAQS) for NO_2 is 53 ppb as an annual average concentration. NAAQS are intended to be protective of public health, including sensitive populations such as asthmatics, children, and the elderly.

[1] Michanowicz, DR, *et al.* 2022. "Home is where the pipeline ends: Characterization of volatile organic compounds present in natural gas at the point of the residential end user." *Environ. Sci. Technol.* 56(14):10258-10268.
[2] Lebel, ED, *et al*. 2022. "Composition, emissions, and air quality impacts of hazardous air pollutants in unburned natural gas from residential stoves in California." *Environ. Sci. Technol.* 56(22):15828-15838.
[3] Mullen, NA; Li, J; Russell, ML; Spears, M; Less, BD; Singer, BC. 2016. "Results of the California Healthy Homes Indoor Air Quality Study of 2011-2013: Impact of natural gas appliances on air pollutant concentrations." *Indoor Air* 26(2):231-245.
[4] Belanger, K; Holford, TR; Gent, JF; Hill, ME; Kezik, JM; Leaderer, BP. 2013. "Household levels of nitrogen dioxide and pediatric asthma severity." *Epidemiology* 24(2):320-330.

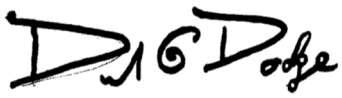
Third, some speakers recited a finding from an epidemiology study that there is a 42% increase in asthma in children living in homes with gas appliances. This finding is inconsistent with other parts of the study, as well as other epidemiology studies. Epidemiology studies look at health outcomes in populations having a particular exposure at issue and compare them to populations that do not have the exposure. The reliability of epidemiology studies depends on their design, which can vary in quality. Several epidemiology studies have looked at health outcomes in populations using gas appliances in comparison to populations using other fuel sources. These studies have yielded inconsistent results.[5] The referenced 42% increase in asthma in children living in homes with gas appliances comes from an epidemiology study by Lin *et al*. (2013).[6] These authors evaluated associations for the four combinations between gas cooking and indoor NO_2 and the outcomes asthma and wheeze. They reported small, but statistically significant, associations between gas cooking and asthma and between indoor NO_2 and wheeze, but not between gas cooking and wheeze or between indoor NO_2 and asthma. The speakers only mentioned one of these findings, and not the inconsistent, negative findings. Moreover, this study relied on data from several older studies, which may not be representative of modern indoor air concentrations because of technological advances that have resulted in reduced emissions from gas appliances.[7]

Notably, none of the speakers mentioned a much larger study, Wong *et al*. (2013),[8] with a number of study design strengths that "reported no association between gas cooking and lifetime asthma or current asthma in children when compared to children who lived in households that used electric stoves for cooking." This larger study included one of the authors of the Lin *et al*. (2013) study.

Finally, proponents of the ordinance did not address the beneficial role of kitchen ventilation (*i.e*., range hood, exhaust fan) in mitigating indoor air emissions associated with cooking activities, no matter the fuel type. Several studies have demonstrated reductions in indoor air levels of NO_2, PM, and other chemicals associated with cooking when kitchen ventilation is used.[9,10,11,12,13]

In summary, in considering the use of gas appliances, information and scientific evidence needs to be evaluated and interpreted carefully.

Sincerely,



David G. Dodge, MS, DABT, CIH

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[5] Zhu, Y; Connolly, R; Lin, Y; Mathews, T; Wang, Z. April 2020. "Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California." Report to Sierra Club National (Oakland, CA). 68p.

[6] Lin, W; Brunekreef, B; Gehring, U. 2013. "Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children." *Int. J. Epidemiol.* 42(6):1724-1737.

[7] Zhu *supra* note 5.

[8] Wong, GW, *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)." *Lancet Respir. Med.* 1(5):386-394. .

[9] Lawrence Berkeley National Laboratory, *et al*. March 30, 2020. "Simulations of Short-Term Exposure to NO_2 and $PM_{2.5}$ to Inform Capture Efficiency Standards (Final)." Report to California Energy Commission; US Dept. of Energy (US DOE). 27p. .

[10] Dobbin, NA; Sun, L; Wallace, L; Kulka, R; You, H; Shin, T; Aubin, D; St-Jean, M; Singer, BC. 2018. "The benefit of kitchen exhaust fan use after cooking - An experimental assessment." *Building Environ.* 135:286-296. .

[11] Mullen *supra* note 3.

[12] Singer, BC; Pass, RZ; Delp, WW; Lorenzetti, DM; Mallalena, RL. 2017. "Pollutant concentrations and emission rates from natural gas cooking burners without and with range hood exhaust in nine California homes." *Building Environ.* 122:215-229.

[13] Logue, JM; Klepeis, NE; Lobscheid, AB; Singer, BC. 2014. "Pollutant exposures from natural gas cooking burners: A simulation-based assessment for Southern California." *Environ. Health Perspect.* 122(1):43-50.