METHANE GAS:
HEALTH, SAFETY, ECONOMIC, AND CLIMATE IMPACTS

A case for equitable electrification

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A note from the authors

Since we originally published this report in August 2021, the call for equitable electrification has only become louder. As of November 2022, nearly 31 million people now live in one of 82 jurisdictions with policies requiring or encouraging the switch from fossil fuels to healthy all-electric homes and buildings.[1] The tide is turning towards electrification because it is the safest way to power our buildings, for both our climate and our health.

Yet even as science and research all point to the growing benefits of electrification, the gas industry continues to pollute the policy making process with misinformation, delaying necessary action at all levels of government. From Southern Oregon to Northern Washington, the spread of misinformation by gas utilities about the safety of gas and methane has soared. Companies like NW Natural, servicing Oregon and Southwest Washington, have even reached new lows by marketing propaganda to elementary school children, through coloring books, word searches, and puzzles about "clean burning natural gas."[2] With this steady rise of marketing and misinformation, we believe it is of utmost importance that policy makers (and the general public) are able to:

1) identify false expressions of environmental care (greenwashing) as a cover for polluting and dangerous activities;
2) know where to find accurate data about the many health and safety impacts of the gas industry;
3) avoid undue influence by fossil fuel interests; and
4) make sound policy decisions for the health and safety of our communities in the just transition to a clean energy economy.

We offer an updated version of this report as a local, Pacific Northwest-specific resource to equip elected officials and policy makers, community and business leaders, journalists, and the broader public, so we can all be equipped with the research-backed knowledge we need to safeguard our climate and the health and safety of our communities.

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"Cutting methane is the strongest lever we have to slow climate change over the next 25 years… We need international cooperation to urgently reduce methane emissions as much as possible this decade.""

– Inger Anderson, UN Environment Programme (UNEP) director[3]

Following COP26 in Glasgow, Scotland in November 2021, 122 countries around the world signed onto the Global Methane Pledge, committing to collectively reduce methane emissions by at least 30% below 2020 levels by 2030.[4] These countries noted that reducing methane emissions is the "the single most effective strategy" for keeping global temperatures below 1.5 degrees Celsius.[4] While this pledge represents the first national or international policy commitment on methane for many of the countries involved, an October 2022 report from Global Energy Monitor shows that many of those very countries continue to switch power plants from coal to methane gas, which could make meeting the goals of the pledge impossible.[5] Thus, local and state-level policies to limit the expansion of gas and methane are crucial to stave off the worst impacts of the climate crisis.

In the Pacific Northwest, the gas industry continues to act in direct conflict with our region's climate goals. Even as the industry claims to be working towards carbon neutrality and sustainability, it actively undermines climate action at all levels of government, expanding fossil fuel infrastructure and lobbying against climate policy. For years, gas utilities like NW Natural, Avista, and Cascade Natural Gas have promoted methane gas as a clean, safe energy alternative. From images of happy people at home, nestled by their gas fireplaces to using the name "natural," these companies want everyone to believe they are environmentally conscious corporations you can trust. In attempts to grow their customer bases and stave off increased regulation of their dangerous product, gas companies have ramped up their greenwashing efforts, promoting methane gas as a fuel that is helping cities and states reach their carbon emissions reduction targets. This could not be further from the truth.

This compendium of research and reports can help to dispel confusion resulting from strategic misinformation campaigns designed by fossil fuel interests for elected officials and the public. The science and peer-reviewed research on health, safety, feasibility, economics, and climate are not on the side of the methane gas industry, as demonstrated by the following facts:

- Electrification is the lowest-cost method to decarbonize buildings, increase efficiency, and protect families and communities from the hazards presented by gas. [6,7]
- The Northwest's gas supply comes primarily from hydraulic fracturing, or "fracking," a dangerous extraction method that poses immense health and safety risks to communities living near fracking wells, the climate, and drinking water for millions of people.[8,9]
- Methane is a potent greenhouse gas, with up to 120 times the global warming potential of carbon dioxide.[10]
- Biomethane, commonly referred to as "renewable natural gas" (RNG), is still methane and is not a solution to mitigating the climate crisis, nor the health impacts associated with burning gas.
- Burning methane indoors generates byproducts known to be harmful to human health, including nitrogen oxides, carbon monoxide, and particulate matter. These pollutants have been shown to cause or exacerbate respiratory conditions, including asthma, in children, the elderly, those with underlying health conditions, low-income, and Black, Indigenous, People of Color (BIPOC) communities.[11]
- The dangerous health and safety impacts of gas—from extraction to compromised indoor air quality from gas stoves—fall disproportionately on low-income and BIPOC communities.[9,11]
- Nearly every month in the US there are massive and often fatal accidents involving gas explosions. An October 2016 gas explosion in Northwest Portland injured eight people and caused $17.2 million in property damages.[12]

Given these facts, governments have a strong policy rationale for restricting new gas infrastructure and legislating a rapid and just transition toward electric and other non-combustion technologies in new and existing buildings. Resources must be allocated to electrifying homes of low-income households who cannot afford the up-front cost of replacing gas appliances, and information must be shared on how to mitigate the health impacts of indoor air pollution from gas stoves while the transition occurs. Allowing disinformation to delay or prevent evidence-based decision-making will result in enormous costs to human health, higher utility bills, stranded assets, and further destabilize our climate.

As communities across the Pacific Northwest know all too well, continuing "business as usual" instead of working towards meaningful climate action has dire consequences. It's time to make important policy choices, including dramatically refocusing our infrastructure resource allocations. Research supports the rapid electrification of Pacific Northwest buildings as an affordable way to help meet Oregon's carbon reduction goals and keep our communities healthy and safe.

The signed organizations contributed to and/or support the findings in this report to ensure that elected officials, community and business leaders, journalists, and the broader public are equipped with knowledge to safeguard our communities and our climate and the health and safety of our communities. Members of the signed organizations stand together to promote building electrification and counter recent misleading claims by gas companies seeking to prolong and expand the use of methane gas.

Rapid Electrification of Residential & Commercial Buildings is the Clear Path Forward

Numerous recent studies examining alternative strategies for meeting our climate goals all reach the same conclusion: utilizing clean electricity rather than fossil gas for heating is the most effective and lowest cost pathway to decarbonize our built environment.

The following is a list of twelve studies, which compare a range of building decarbonization technologies, including the use of renewable natural gas (RNG) and other "low carbon" products within the gas distribution system. In every case, the electrification scenarios were found to be a lowest cost and most effective way to reduce greenhouse gas emissions in buildings. Note: two studies were released in 2022 that focus specifically on the Pacific Northwest.

Synapse Energy Economics, Inc. (June 2022), Toward Net Zero Emissions from Oregon Buildings[13]
This study analyzes two different rapid electrification pathways for Oregon's commercial and residential buildings and compares these to the direct use of gas. Both pathways take an aggressive approach to reaching 100 percent market share for efficient electrical equipment – the point at which customers no longer purchase fossil-fuel based heating systems and appliances. Scenario 1 achieves that target in 2030, Scenario 2 in 2025. For each scenario, researchers modelled peak winter electric load growth, overall electricity and gas system costs changes, and residential customer bill impact for Portland and Bend, comparing efficient electric appliance heating to both gas appliance heating and electric resistance appliance heating.

The study found that 1) the electric load growth required for full high efficiency electrification is very modest, 2) net energy system costs go down, and 3) in both Portland and Bend, energy bills for all electric residential customers with heat pumps would be lower than homes with either gas or electric resistance heating systems.

> "The total building peak load is projected to increase at an average annual growth rate of 0.6 percent in Scenario 1 and 0.5 percent in Scenario 2. The primary reason for these relatively low load growth rates is that our analysis projects declining peak loads for the residential (RES) sector, driven by switching from electric resistance heating systems to heat pump systems."
>
> "In both scenarios, our analysis shows that building electrification lowers overall energy system costs for households and businesses in Oregon."
>
> "The Alternative Case with efficient electrification measures has the lowest annual bill in both Portland and Bend." [compared to gas heating and electric resistance heating][13]

RMI (April 2022), Economic and Energy Analysis of Building Electrification in Eugene[14]
This analysis compares construction costs, 15-year operating costs, and 15-year greenhouse gas emissions for all-electric new construction homes, to mixed fuel homes that use natural gas for heating and cooking, using data specific to the city of Eugene, OR.

> "Economic and emissions analysis shows that all-electric construction in the city of Eugene would both lower greenhouse gas emissions and reduce building construction and operation costs."
>
> "According to RMI's analysis, an all-electric home in Eugene saves $1,600 in upfront construction costs, primarily due to the cost savings from eliminating the need for gas infrastructure."

"The all-electric home also has a $3,500 net present cost savings over a 15-year period. The increase in life-cycle cost savings is primarily due to utility bill savings of the all-electric home, equal to $208 per year."

"Using the statewide model from Cambium, the emissions reduction for an all-electric home was found to be 50%. Using the EWEB's [Eugene Water and Electricity Board] 2021 published emissions intensity, the emissions reduction for an all-electric home was 74%."

"Given that Oregon has committed to 100% carbon-free electricity by 2040 for its retail electricity, buildings will most likely see an increase in these carbon-free sources into the future, and all-electric buildings will result in even greater emissions reductions."[14]

American Council for an Energy Efficient Economy (ACEEE) (July 2022), Analysis of Electric and Gas Decarbonization Options for Homes and Apartments[15]

Researchers analyzed approximately 5,000 homes across the United States, examining a variety of decarbonization options for space and water heating including electric heat pumps, gas-fired heat pumps and lower carbon alternative fuels such as biogas and synthetic gas.

"For water heating, electric heat pump water heaters (HPWHs) have the lowest life-cycle costs in every home analyzed."

"For homes (detached and attached) with one to four units, electric heat pumps generally minimize average life-cycle equipment and energy costs for heating and cooling in places with fewer than 6,000 heating degree days (HDDs), such as south of Detroit." [Similar to the Pacific Northwest.]

"Looking at results by region, electric heat pumps are more likely to minimize life-cycle costs for homes in the South and along the Pacific and least likely in the Midwest, with other regions in between."[15]

UC Davis Western Cooling Efficiency Center (April 2021), Greenhouse Gas Emission Forecasts for Electrification of Space Heating in Residential Homes in the United States[16]

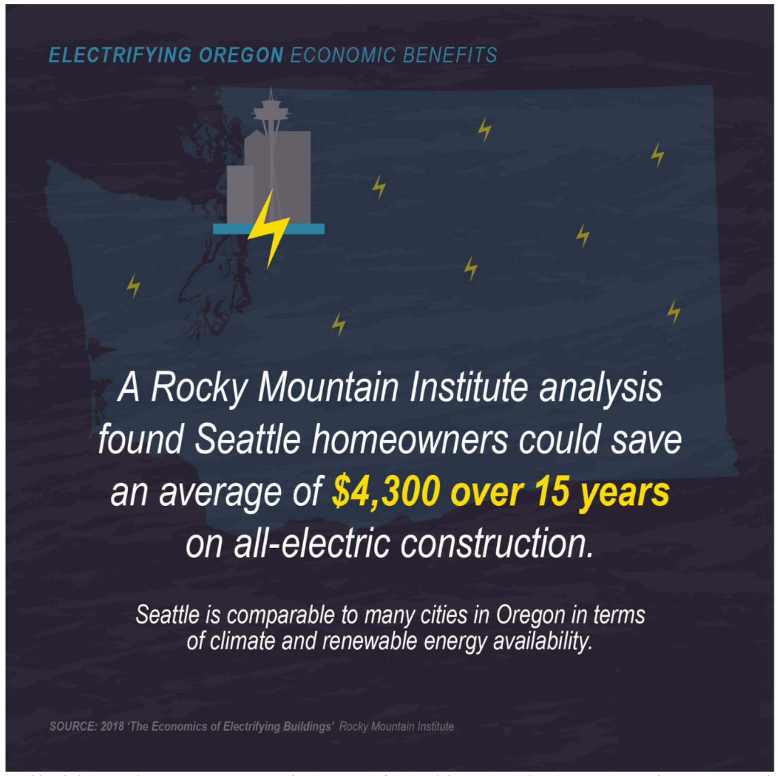
This study modeled the 15-year greenhouse gas emissions & lifecycle impacts resulting from replacing a natural gas furnace with an electric heat pump in single-family homes in various climatic regions across the US. It utilized the most sophisticated projections available for long-run marginal emissions rates for electricity in each region and included emissions from methane leakage in gas distributions systems, methane combustion in the home and estimates for refrigerant leakage.

Results: In the Pacific region over a 15-year period, heat pumps for residential space heating were found to reduce global warming emissions by 70% to 85% compared to high efficiency gas furnaces.

Note: This study was completed before Oregon HB2021 was passed which mandates aggressively moving to 100% clean electricity by 2040.[109] The effects of this law would significantly reduce the carbon emissions from electric heat pumps and thus make this comparison even more favorable to electric heat pumps.[16]

Rocky Mountain Institute (RMI) (October 2020), All-Electric New Homes: A Win for the Climate and the Economy[6]

RMI compared construction costs for new all-electric versus mixed fuel (fossil gas plus electric) single-family homes in seven cities. It also modeled lifetime greenhouse gas emissions for each scenario.



> "The new all-electric, single-family home has a lower net present cost than the new mixed-fuel home in every city we studied: Austin, TX; Boston, MA; Columbus, OH; Denver, CO; Minneapolis, MN; New York City, NY; and Seattle, WA."

> "The all-electric home results in substantial carbon emissions savings over the mixed-fuel home in all cities. The greatest savings are found in Seattle (93%) and New York City (81%). Minneapolis, Columbus, Boston, and Austin all save more than 50% over the lifetime of the equipment compared with the mixed-fuel home."[6]

Sierra Club (April 2020), New Analysis: Heat Pumps Slow Climate Change in Every Corner of the Country[17]

In this study, the Sierra Club conducted a detailed analysis of the current and future electricity grid and assessed the impact of converting homes heated by gas to electricity in every state.

> "Our analysis demonstrates that, while states with more ambitious clean energy deployment benefit the most, advanced electric appliances like heat pumps installed today will reduce greenhouse gas emissions in every state over the next 10 years of the appliance's life."

> "In fact, for the average house, installing electric heat pumps in place of a gas furnace and gas water heater will reduce heating emissions more than 45 percent over the next 10 years."[17]

Evolved Energy Research (December 2020), Washington State Energy Strategy Decarbonization Modeling Final Report[18]

This research updated the Northwest Deep Decarbonization Pathways model with current cost and technology information. It examined multiple scenarios to achieve Washington State's 100% clean electricity grid target as well as its 2030, 2040 and 2050 greenhouse gas emissions reductions targets including both electrification of buildings and continued use of methane gas and decarbonized gas for heating.

> "Electrification of buildings lowers costs over retaining gas use – long-term benefits of avoiding the need for clean gas: 0.2% of GDP savings annually in Electrification case vs. Gas in Buildings case by 2050."[18]

American Council for an Energy Efficient Economy (ACEEE) (October 2020), Electrifying Space Heating in Existing Commercial Buildings: Opportunities and Challenges[19]

ACEEE explored the greenhouse gas emission reduction opportunities and the expected payback periods for converting space heating and central boiler/chiller systems from fossil gas to electric heat pumps in commercial buildings across the United States.

> "The electrification opportunities we examined could reduce total commercial-sector site energy use in the portion of the commercial building stock we analyzed by about 37% and greenhouse gas emissions by about 44%."
>
> "Buildings with the best paybacks are more likely to be located in the southern United States and the Pacific region…"[19]

California Energy Commission, Energy Research and Development Division (April 2020), Final Project Report: The Challenge of Retail Gas in California's Low-Carbon Future

This study evaluated scenarios that achieved an 80 percent reduction in California's greenhouse gas emissions by 2050 from 1990 levels, focusing on the implications of achieving these climate goals for gas customers and the gas system.[7]

> "In all the long-term GHG reduction scenarios evaluated here, electrification of buildings, and particularly the use of electric heat pumps for space and water heating, leads to lower energy bills for customers over the long term than the use of renewable natural gas. Likewise, building electrification lowers the total societal cost of meeting California's long-term climate goals."
>
> "Building electrification is found to improve outdoor air quality and public health outcomes…"[7]

Energy and Environmental Economics (E3) (April 2019), Residential Building Electrification in California[20]

This study evaluated the consumer economics, greenhouse gas savings and grid-impacts of electrification in residential low-rise buildings across six representative home types in six climate zones in California. Consumer economics were evaluated in three ways, by comparing: 1) upfront installed capital costs, 2) energy bills, and 3) lifecycle savings between gas-fired and electric technologies.

> "Electrification is found to reduce total greenhouse gas emissions in single family homes by ~30% - 60% in 2020, relative to a natural gas-fueled home. As the carbon intensity of the grid decreases over time, these savings are estimated to increase to ~80% - 90% by 2050, including the impacts of upstream methane leakage and refrigerant gas leakage from air conditioners and heat pumps."
>
> "All-electric new construction is expected to be lower cost than gas-fueled new construction homes in homes that have air conditioning, resulting in lifecycle savings of $130 - $540/year. These findings are based on commonly available technology, without incentives or intervening policies."
>
> "87% of the simulated single family retrofit homes (all of which are assumed to have air conditioning) see lifecycle savings from switching from a gas furnace and air conditioner to an electric heat pump HVAC system".[20]

UCLA Luskin Center for Innovation (November 2019), California Building Decarbonization Workforce Needs and Recommendations[21]

This study estimated the potential employment impacts of electrifying buildings to achieve California's climate goals.

"In total, building electrification in California could support an average of 64,200 - 104,100 [additional] jobs annually, after accounting for losses in the gas industry."[21]

Synapse Energy Economics Inc. (October 2018), Decarbonization of Heating Energy Use in California Buildings[22]

This report focused on electrification as one of the major pathways for building decarbonization in California.

> "Renewable gas produced from decay of wastes in sources like landfills or digesters, and other bio-energy and synthetic options for zero- or low-emission combustible fuels, are important parts of a cost-effective solution to California's climate challenges. Their contribution comes in part through the need to capture methane from biogenic sources such as dairies and landfills. However, their limited availability and high cost limit them to be a piece of the solution, not a wholesale alternative to large-scale electrification of the building sector."
>
> "Residents that choose electric space heating, water heating, or all-electric homes will substantially reduce the GHG emissions from their energy use, and that reduction will increase over time as California's electric grid decarbonizes."[22]

Energy and Environmental Economics (E3) (November 2018), Pacific Northwest Pathways to 2050: Achieving an 80% reduction in economy-wide greenhouse gases by 2050[23]

This older study was funded by NW Natural and is often erroneously cited by NW Natural as evidence to support the feasibility of direct use of gas to heat buildings as Oregon and Washington move toward economy wide decarbonization. Because analysis was completed before HB 2021 mandated 100% clean energy in Oregon, this study significantly under-estimates the carbon reduction impact of electrification.

The study compares 4 scenarios to meet space heating needs in buildings – two with either conventional or cold climate electric heat pumps, and two with either conventional gas furnaces or gas heat pumps. The study utilizes very aggressive assumptions about the rapid and widespread adoption of (as yet unavailable) gas-fired heat pump technologies, and the widespread availability of low cost, low carbon alternative fuels. These assumptions have been routinely criticized by third party stakeholders in Oregon Integrated Resource Plan and Public Utility Commission dockets.

Regarding electric heat pumps the study "does not assume installations of higher efficiency systems on the upper-end of the heat pump market, nor does it assume any technology innovation" despite using the precise opposite assumptions for gas devices. These assumptions artificially improve the apparent energy efficiency and cost effectiveness of the gas technologies relative to the electric technologies.

Even with assumptions that unjustifiably favor natural gas, the study still concludes that direct use of gas for heating buildings will mean that the building sector will fail to meet its decarbonization targets. Oregon must rely on other sectors to overcompensate if it is to achieve economy-wide emissions reduction targets.

> "In both of the Direct Gas Use scenarios, industry electrification is the primary mitigation measure to offset the additional emissions from the building sector. Industry electrification is an emerging opportunity for decarbonization, but more research is needed to understand the cost of industrial fuel switching."
>
> "Since these scenarios use a relatively high share of the region's 2050 GHG emissions budget in the buildings sector, more mitigation efforts in other sectors of the economy are required, each of which face their own set of implementation challenges."[23]

The implication of this study is that if we continue to use gas for heating buildings instead of using available and cost effective electric heat pump technologies, we will have to invent and rapidly deploy new technologies in gas-fired heat pumps, low-carbon alternative fuels and industry electrification – technologies which do not exist commercially today.

Cumulatively, these reports leave no doubt that electrification is the most cost-effective solution for building decarbonization across the US -- and specifically Oregon and Washington. Continued use of gas to heat residential and commercial buildings is inconsistent with regional decarbonization targets. Further expansion of methane gas infrastructure is also inconsistent with these targets. In fact, it is essential to scale back existing gas infrastructure in a way that supports our region's most vulnerable neighbors.

The transition towards efficient electric heating for our buildings must be just and equitable, leaving no one behind. Without a careful strategy, consumption will decrease, prices will rise, and systems maintenance costs will be born by an ever-shrinking customer base.[24] Low-income households—who are least able to afford increased rates—must not be left to shoulder these higher costs or be unintentionally harmed by efficiency upgrades mandated for existing buildings. To ensure that the wide array of electrification benefits extend to all residents, a just transition must safeguard housing stability and anti-displacement, and elevate the voices and needs of people with low incomes, BIPOC communities, and renters.[25]

Methane Gas – Trying to Stay Relevant in a Decarbonizing World

The Northwest's Gas Supply Comes Primarily from Fracking

The majority of the Northwest's methane gas supply comes from the extraction process of hydraulic fracturing, or "fracking," explaining why some people in our region use the more accurate term "fracked gas" instead of "natural gas."[8] Fracked gas is a fossil fuel with tremendous health, safety, climate, and economic impacts. The process of fracking has led to earthquakes and puts drinking water at risk for rural communities. Fracking causes economic losses and human suffering through toxic contamination of air, land and water; human-caused and natural disasters; displacement of economic activities such as fishing, recreation, and tourism; desecration of culturally and historically significant sites; loss of habitat and despoliation of the environment; and dramatic increases to greenhouse gas emissions in our energy supply. All of these deleterious effects are associated directly or indirectly with increased sickness and death in affected communities.[9] These impacts disproportionately affect Black, Indigenous, People of Color, rural, and low-income communities, as documented by the Concerned Health Professionals of New York and Physicians for Social Responsibility:

> "Studies consistently show that Black, Indigenous, Hispanic, rural, and impoverished white communities bear the brunt of exposures to toxic waste and fossil fuel-derived air pollution. These patterns extend to fracking and its infrastructure. In multiple regions where fracking is practiced, well pads and associated infrastructure are disproportionately sited in non-white, indigenous, or low-income communities. A 2019 analysis of socio-demographic characteristics of people living close to drilling and fracking operations in the states of Colorado, Oklahoma, Pennsylvania, and Texas found strong evidence that minorities, especially African Americans, disproportionately live near fracking wells."[9]

According to reports from Oregon, Washington, and industry observers (described below), fracked gas will remain the dominant source of methane gas in our system for the foreseeable future. Alternatives such as hydrogen and "Renewable Natural Gas," or RNG, are not currently economically feasible. Hydrogen is sometimes produced using fracked gas. RNG refers to methane captured at landfills, large animal farms, and other dispersed waste-generating facilities. RNG will likely comprise only a small portion of our region's overall gas supply, possibly one-fifth in a best-case scenario.[26] Recent Energy Information Administration data indicate that roughly two-thirds of the Northwest region's gas comes from fracking, and the proportion is likely to increase over time as fracking wells replace conventionally produced gas in the market.[8] Accordingly, most of the gas we use in Oregon and Southwest Washington will continue to be sourced from fracking until we transition away from the use of gas entirely.

When state and local governing bodies incentivize gas infrastructure expansion or offer special treatment to this form of polluting fossil energy, they are investing or "locking in" a carbon-based energy system that delays inevitable and essential renewable energy upgrades.[27] Projects that lock in gas infrastructure are also locking in all the water and air pollution created by the fracked gas production and transmission process. Research from the Green Energy Institute shows that locking in fracked gas poses a tremendous risk to decarbonization efforts.[28] Ultimately, quitting fracked gas and methane will be essential to a clean energy transition.

Gas System Leaks Make Fracked Gas Carbon Impacts Similar to Coal

Until recently, the carbon emissions from producing and burning methane gas have been considered to be lower than emissions from burning coal. More and more, researchers are revealing the true extent of methane leaks from production, transmission, distribution, gas meters, and even the final stage of use in homes and buildings. Leakage is much higher than previously thought and higher than the U.S. Environmental Protection Agency has reported.

Since unburned methane has a dramatically higher impact on global warming than burned methane, even a small increase in unburned methane due to pipeline distribution leakage significantly increases the carbon intensity of fracked gas. The Gas Index,[29] a 2020 report includes data from multiple studies measuring gas system leakage in 71 cities and leakage data from major production sites within the US. While the EPA estimates system leakage to be less than 2%, the study concluded that leakage rates for commercial and residential applications are more than twice that estimate.[29] Leakage from the residential and commercial gas system in Portland, Oregon was found to be nearly three times higher than the EPA estimated, and far higher than the national average, despite NW Natural's claim to have "one of the tightest, lowest emitting systems in the nation."[29,30]

Scientists estimate that a gas system that leaks unburned methane at rates higher than 2.7% will have the same global warming impact as burning coal.[31] The Gas Index reports that national leakage rates for residential and commercial gas systems average over 4%. In Portland, OR the leakage rate is reported at over 5.5%. These leakage rates mean that burning fossil gas to heat homes and buildings in Oregon is as bad as or potentially worse than burning coal.[29]

"Renewable Natural Gas" and Hydrogen are not Viable Replacements for Gas in Buildings

Background on "Renewable Natural Gas" and Hydrogen

Renewable natural gas (RNG) and renewable "green" hydrogen are often held up by the methane gas industry as green fuels that will one day replace the gas used in homes, buildings and transportation across the United States. While most experts agree that green hydrogen and RNG have a significant role in achieving full decarbonization — particularly in hard-to-decarbonize sectors — the use of hydrogen and RNG in homes and buildings is not one of those applications. Exaggerating the potential of these fuels is a political strategy employed by the gas industry to allow for the continued expansion of gas infrastructure, muddying the water on electrification and greenwashing the industry's anti-environmental lobbying efforts.

Renewable Natural Gas Cannot Meet Energy Demand and is not Cost-effective

The gas industry is actively developing RNG projects using agricultural and other forms of waste, but the potential of this technology is extremely limited. A 2018 Oregon Department of Energy Renewable Natural Gas Inventory report to the Oregon Legislature found that in the best-case scenario, RNG could only replace about one fifth of the state's current gas demand and even that amount is largely dependent on technology that is not currently operational in the United States.[26] Studies conducted in Washington [32] and California [33] have come to similar conclusions. Limited availability alone makes RNG infeasible as a replacement for current fracked gas consumption.

Despite Oregon Department of Energy's conclusion that RNG is not a viable replacement for methane gas, the 2018 report[26] is often cited by NW Natural. This study found that, *theoretically*, RNG has the potential to generate 22.1% of Oregon's 2018 natural gas use via anaerobic digestion (4.6%) and thermal gasification (17.5%). However, to achieve this output, significant logistical, economic, and technological barriers would need to be overcome. Barriers for generating methane through anaerobic digestion at manure lagoons, landfills, or sewage treatment plants, etc. include the distance of agricultural operations from pipe infrastructure, high costs, and a lack of guaranteed supply. In addition, incentives to utilize some of these sources could lead to perverse outcomes, such as favoring soil-depleting industrial agriculture or causing food waste to be sent to landfills instead compost facilities. The process of "thermal gasification" entails using energy to turn agriculture and commercial forest harvest residues into methane but, currently, there are no commercial thermal gasification plants in the United States. The report states, "Once technical obstacles are overcome, thermal gasification could produce about 17.5% of annual natural gas use." In other words, the vast majority (nearly 80%) of the potential for RNG in Oregon relies on technology that, according to the Oregon DOE, is not commercially available and would require significant research efforts to "bring down the cost of conversion."[26]

NW Natural has misrepresented the top-line findings of this report by asserting that RNG has the real potential to replace all current residential gas consumption (which makes up a little less than 20% of all methane used in Oregon). Even an industry-influenced study by ICF found that, nationally, RNG could meet at most 16% of current gas demand.[34] Furthermore, most experts agree that our limited RNG resources should not be wasted on residential use, which can be easily and cost-effectively electrified.[35]

Limited quantities of RNG should instead be reserved for hard-to-electrify sectors, such as marine, aviation, and industry. An RMI report emphasized that allocating RNG to homes and buildings would be a grievous misuse of a resource that could be critical in decarbonizing heavy industry.[36] Wise allocation of RNG is essential if the Pacific Northwest is to achieve economy-wide emissions reductions in line with a trajectory to limit warming to 1.5°C or even 2°C.

Even if the fundamental issue of RNG availability were solved, renewable natural gas is very expensive to produce. As Sightline Institute reported in March 2021:

> "Today, a million BTUs (MMBTU) of natural gas costs $3.67. According to a 2019 study prepared for the American Gas Foundation, about 44 percent of prospective RNG projects can be developed at a cost of $7 to $20 per MMBTU, with a median cost among those of approximately $18. The remaining 56 percent of potential projects exceed $20 per MMBTU. Many of the lowest-cost RNG projects (those developed from waste streams that are large, centrally contained, and conveniently located near existing pipelines) have for the most part already been developed. What remains are the costlier projects: smaller facilities farther away from pipelines, and biomass that is dispersed and therefore costly to gather and process".[37]

Green Hydrogen is Incompatible with Existing Gas Pipelines

Contrary to what the gas industry states, green hydrogen is also not the answer. Producing hydrogen is expensive and energy intensive.[38] While green hydrogen does have some potential applications in a clean energy future, it cannot be transported through most existing gas lines in meaningful quantities. According to a report from the National Renewable Energy Laboratory, hydrogen can only be added to natural gas at concentrations of 5-15% before it becomes incompatible with existing gas infrastructure, weakening pipeline integrity.[39] According to the US Department of Energy's Hydrogen Program Plan, additional research and development is needed to address issues such as mixing requirements, materials issues, NOx emissions, and other combustion-related phenomena.[40]

While burning hydrogen does not produce greenhouse gas emissions, the combustion of green hydrogen in buildings emits nitrogen oxides (NOx),[38] exacerbating many of the indoor air quality threats currently posed by gas use in buildings, as discussed in the following section. These emissions also pollute air and water, negatively impacting human health.[41,42] Pollution concerns specifically connected to green hydrogen were reported by the Union of Concerned Scientists in December 2020,

> "When hydrogen is combusted (as opposed to being used in a fuel cell), it can generate significant NOx emissions, commensurate with that of natural gas combustion—or worse. While hydrogen can be carbon-free, an oft-overlooked fact is that unless dedicated NOx-mitigation research is advanced and combustion improvements made, hydrogen combustion may not be pollution free, unacceptably risking a further perpetuation of pollution harms."[38]

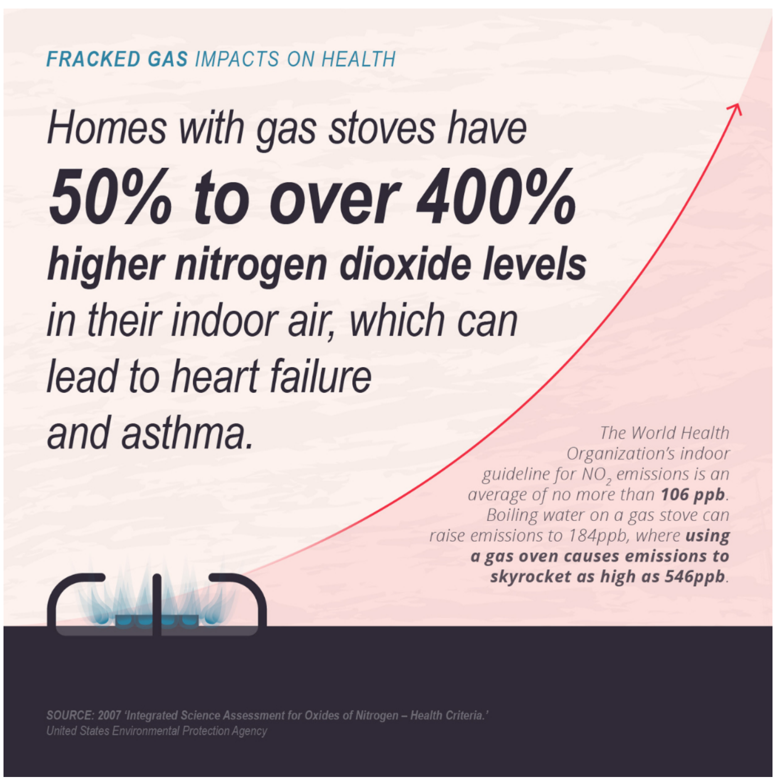
For these reasons, mixing hydrogen into existing methane distribution lines is not a practical, cost-effective, or safe solution to building decarbonization.

Methane Significantly Impacts Health and Indoor Air Quality

Methane Appliances Cause Hazardous Indoor Air Quality, Impacting Public Health

"Natural" gas appliances cause hazardous indoor air quality. It is a long-established fact that the combustion of fossil fuels, including gas, emits pollutants such as nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matter (PM 2.5), and formaldehyde. Studies published in 2022 found that gas stoves emit methane, even when they are off, and that methane contains at least 21 hazardous air pollutants, designated as such by the EPA.[43, 44]

Two comprehensive reviews, one conducted jointly by Physicians for Social Responsibility, the Rocky Mountain Institute, Mothers Out Front, and the Sierra Club and the other by researchers at the UCLA Fielding School of Public Health analyzed peer reviewed studies concluding that the pollutants emitted by gas burning stoves and ovens in residential homes are, in fact, harmful to health, especially the health of children, the elderly, those with underlying health conditions and vulnerable minority and low income communities.[11, 45]



"Natural" gas stoves generate a number of harmful air pollutants, including nitrogen dioxide (NO_2). Nitrogen dioxide has been consistently identified in scientific literature as harmful to health. The Environmental Protection Agency (EPA), in 2016, changed short-term NO_2 exposure from "likely causal" to "causal" of asthma attacks, and long-term NO_2 exposure to "likely causal" of the development of asthma.[46] Numerous studies show that gas stoves are associated with increased risk of asthma in children and the EPA found that older adults had more emergency department visits and hospitalizations for asthma with short-term NO_2 exposure and higher rates of total mortality with long term exposure to NO_2.[43,47]

In 2022, the American Medical Association adopted Resolution 439, "Informing physicians, health care providers, and the public that cooking with a gas stove increases household air pollution and the risk of childhood asthma."[48] The Washington State Medical Association (2021)[49], the Pennsylvania Medical Society (2022)[50], and the Massachusetts Medical Society (2019)[51] adopted similar resolutions promoting electric appliances as a solution that benefits both health and climate.

The U.S. House Committee on Oversight and Reform published the following in a press release on Aug 1, 2022: "Rep. Raja Krishnamoorthi, Chairman of the Subcommittee on Economic and Consumer Policy, sent a letter to the

Consumer Product Safety Commission (CPSC) requesting documents and information about CPSC's failure to establish safety standards or provide warnings to consumers on the significant health risks posed by air pollutants emitted from gas stoves despite having knowledge of potential risks as early as 1986."[52]

Numerous Scientific Studies Confirm the Negative Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health

Both the World Health Organization and the Canadian government have established indoor air pollution guidelines. Despite the fact that most Americans spend at least 90% of their time indoors, the United States has not set similar guidelines or standards.[11] Research on indoor air pollution shows that concentrations of many pollutants in homes and buildings are often higher than outdoor air pollutants.[11, 53] Cooking food itself produces certain air pollutants, especially particulate matter. However, combustion of gas from stoves and ovens produces additional NO_x and carbon monoxide, pollutants not emitted from electric stoves. The EPA has estimated that average nitrogen dioxide (NO_2) levels are approximately 50% to over 400% higher in homes with gas rather than electric cookstoves,[54] especially where individuals live in smaller homes and cook for longer periods of time. In many instances, the short- and long-term NO_2 levels in homes with gas stoves exceed outdoor EPA air quality limits, which, in turn are higher and less stringent than the indoor air quality guidelines issued by the World Health Organization and Health Canada (as stated above, there are no indoor guidelines issued by the US EPA).[52] In addition, poorly maintained gas stoves are more likely to emit elevated levels of carbon monoxide.[11] In other words – cooking with gas can lead to levels of indoor air pollution, which, if outdoors, would exceed legal limits.

Electric stoves do not emit nitrogen dioxide (NO_2), an established marker for gas combustion,[55] and gas stoves are an important source of personal NO_2 exposure.[56] Children are more susceptible to air pollution because of their developing lungs and immune systems and their higher breathing rates.[57] Cooking with gas has been shown to reduce lung function up to 3.4% in children,[58] and NO_2 exposure in children is correlated with poor lung function.[56] Moreover, the evidence for NO_2 exposure and adverse health effects in children is the most consistent for children living in homes with gas stoves.[56]

The connection between indoor NO_2 and pediatric respiratory illness is not new. A 2013 meta-analysis by Lin et al., published in the *International Journal of Epidemiology*, analyzed data from 41 studies.[59] The goal of this meta-analysis was to update a 1992, 11-study meta-analysis by Hasselblad et al. which concluded that children exposed to a long-term increase of 15 ppb NO_2 indoors suffer a 20% increase in respiratory illness risk.[60] This early quantitative analysis became a benchmark study for the relationship between indoor NO_2 and respiratory illness in children, and an important reference for the outdoor NO_2 Air Quality Guideline value established by the World Health Organization (WHO) in 1997 and confirmed in 2005. Lin et al.'s findings supported those of the earlier study:

> "Our meta-analyses suggest that children living in a home with gas cooking have a 42% increased risk of having current asthma, a 24% increased risk of lifetime asthma and an overall 32% increased risk of having current and lifetime asthma; per 15 ppb increase in indoor NO_2 level, children have a 15% increased risk of having current wheeze. In summary, this meta-analysis provides quantitative evidence that gas cooking increases the risk of asthma in children, and indoor NO_2 increases the risk of current wheeze in children."[59]

In a prospective study of young children (ages 2-6) with an asthma diagnosis, Hansel and associates observed a dose-dependent increase in asthma symptoms at indoor concentrations of NO_2 well below outdoor health standards.[61] A 20 ppb increase in NO_2 levels was associated with statistically significant increases in asthma symptoms after adjusting for confounding factors and assuring that the effects of indoor NO_2 were independent of outdoor NO_2 levels.[61]

In a prospective study of over a thousand asthmatic children (ages 5-10), Belanger and associates also found a dose-response relationship above a six ppb threshold: every five-fold increase in NO_2 levels was associated with a dose-dependent increase in risk of higher asthma severity score (odds ratio = 1.37 [95% confidence interval = 1.01–1.89]), wheeze (1.49 [1.09–2.03]), night symptoms (1.52 [1.16–2.00]), and rescue medication use (1.78 [1.33–2.38]).[62] The authors concluded that "Asthmatic children exposed to NO_2 indoors, at levels well below the U.S. Environmental Protection Agency outdoor standard (53 ppb), are at risk for increased asthma morbidity."[62] Risks are not confined to children in cities, but also occur at NO_2 concentrations common in suburban homes.[58]

A 2022 study by Downen et al. examined the feasibility of using in-home NO_2 sensors to observe correlations between use of gas appliances in the home, elevated acute NO_2 levels, and indicators of asthma exacerbation and severity from hospital records. Subjects were separated into "gas stove" and "no gas stove" groups.[63] Homes with gas appliances had an increased frequency of elevated hourly NO_2 and the frequency of acute elevated NO_2 exposure correlated with hospital admissions due to asthma. While the strength of the study is limited due to a small sample size (n=30), the results agree with other research indicating that current recommendations/guidelines for indoor NO_2 levels may not be adequate protection for children with asthma.[63]

A January 2022 Stanford study by Lebel et al, published in *Environmental Science & Technology,* found that, in addition to NO_2, PM2.5, CO, and formaldehyde, our indoor air is also polluted by methane and its contaminants.[43] Researchers found that stoves emit 0.9-1.3% of the gas they use as unburned methane. More than three-quarters of the methane emissions occurred when the stoves were turned off. This was true whether the stove was new or old.[43]

A study from the Harvard T.H. Chan School of Public Health, published in June 2022, found that gas used in homes throughout the greater Boston area contains at least 21 different hazardous air pollutants that may impact air quality and health, wherever natural gas, i.e. methane, is leaked.[44] Researchers collected over 200 unburned natural gas samples from 69 unique kitchen stoves and building pipelines across Greater Boston between December 2019 and May 2021. They found that natural gas piped into Massachusetts' homes contains varying levels of at least 21 different hazardous air pollutants, as defined by the EPA, including benzene, toluene, ethylbenzene, xylene, and hexane. Concentrations of hazardous air pollutants in natural gas varied depending on location and time of year, with the highest concentrations found in the winter. Based on odorant concentrations, small leaks can be undetectable by smell.[44] As an example of the health risks of one of these 21 hazardous air pollutants, benzene is recognized by the EPA as a known human carcinogen and the World Health Organization states that "no safe level of exposure can be recommended."[64]

Reducing ambient NO_2 has been shown to decrease asthma rates. Garcia, E. et al. in a longitudinal study over 20 years (1993-2014) of more than 4000 children, using data from the Southern California Children's Health Study, found that improving pollution controls on cars decreased childhood asthma rates in tandem with lowered levels of ambient NO_2. "Each 4.3–parts-per-billion decrease in nitrogen dioxide was associated with a reduction of 0.83 cases per 100 person-years in asthma incidence."[65]

Ongoing research seeks to demonstrate that reducing NO_2 levels in indoor air decreases asthma rates and improves the overall health of residents. Two groups are conducting separate studies removing gas stoves from homes and replacing them with electric stoves. A community group in New York City, WE ACT for Environmental Justice, is currently leading a pilot study replacing gas stoves with induction stoves and measuring health benefits.[66] The California Energy Commission is also funding a $4 million randomized control trial looking at the impact of gas stove interventions on children with asthma.[67]

NW Natural's Claim that Gas Cooking is Safe Relies on Outdated and Irrelevant Reports

In its communications with policy makers,[68] NW Natural dismisses the UCLA report entitled "The Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health"[45] because they said "it collected no new information."[68] However, a literature review is not only a commonly-accepted scientific publication, it is recognized as an extremely valuable resource. This particular report reviewed data from more than 300 publications and government reports as well as conducting its own analyses to draw its conclusions.[45]

NW Natural quoted a line from the UCLA study out of context, implying that the authors' statement about "data paucity" somehow made their conclusions invalid. However, with regard to data limitations, the authors stated, "particularly for conducting future quantitative analyses with regard to equity, the development of additional, publicly available databases to include more detailed and higher spatial resolution data would be a significant asset."[45] In other words, the authors were challenging entities to collect higher quality data to enable further analyses of equity factors related to gas appliances and air quality.

NW Natural also stated that the UCLA study "focused primarily on misuse of equipment or improper ventilation, issues not generally relevant in today's homes. Current Oregon mechanical code requires vent hoods that exhaust to the outdoors for all cooktops, ranges and stoves – electric or gas."[68] In truth, misuse of equipment and improper ventilation is a minor part of the UCLA report; it provides data from California confirming the health impacts of elevated pollutants from gas appliances (CO, NO_2 and NO_x), and the disproportionate impact on vulnerable populations. It also uses an equity lens to qualitatively assess the vulnerability of specific populations' exposure to indoor air pollution from gas appliance usage.[45]

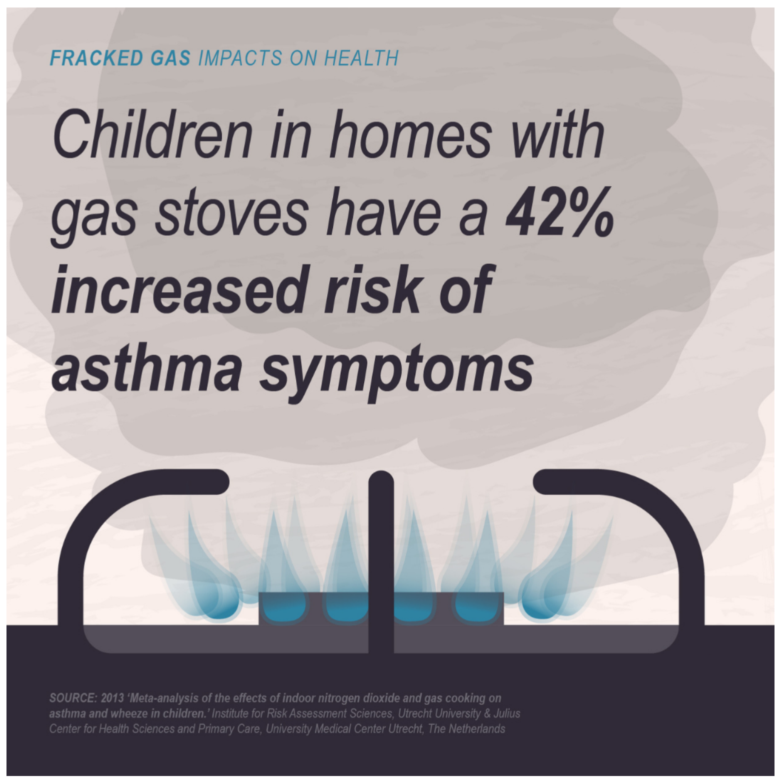
Furthermore, while it is true that Oregon's current mechanical code requires vent hoods for all cooktops, ranges and stoves, this doesn't mean that homes in Oregon are properly ventilated. 54% of homes in Oregon were built before 1978 and may or may not comply with code.[69] A study of 1,000 California homes describes real-world hood configurations that impact efficacy. Only 17% of homes cooking with natural gas had hoods that covered all burners.[70] Not all range hoods are equally effective, as performance varies with installation location and duct route, and many are not as effective as advertised.[71] In addition, the UCLA study notes that fewer than 35-54% of households actually use their range hoods while cooking.[45]

High quality range hoods are efficient at removing some of the toxic chemicals produced when cooking with a gas stove, but ventilation hoods may not effectively remove NO_2. Paulin et al. conducted a three-armed randomized trial to evaluate the efficacy of home interventions aimed at reducing indoor NO_2 concentrations in homes with unvented gas stoves.[72] The study looked at three techniques to reduce NO_2: replacing existing gas stoves with electric stoves, installation of ventilation hood over existing gas stoves, and placement of high-efficiency particulate air (HEPA) and carbon filters. They did home inspections and NO_2 monitoring at 1 week pre-intervention and at 1 week and 3 months post-intervention. They found that stove replacement resulted in a 51% and 42% decrease in median NO_2 concentration at the three month follow-up test in the kitchen and bedroom, respectively; air purifier placement resulted in an immediate decrease in median NO_2 concentration in the kitchen (27%) and bedroom (22%), However, at the 3 month follow up testing a significant reduction was seen only in the kitchen (20%). NO_2 concentrations in the kitchen and bedroom did not significantly change following ventilation hood installation. In summary, replacing the gas stove with an electric stove and using an air purifier with a HEPA and carbon filter are both effective home interventions for reducing NO_2 concentrations in the kitchen and bedroom, but installing ventilation hoods was not effective.[72]

Another study by The National Center for Healthy Housing showed that, even in homes with ASHRAE-compliant ventilation systems removal of NO_2 was inadequate. (ASHRAE is the American Society of Heating, Refrigerating and Air-Conditioning Engineers). Researchers conducted indoor air quality (IAQ) sampling for several air contaminants in homes with and without ASHRAE-compliant ventilation for four day blocks over an eight month period. Air contaminants included: particulate matter (PM2.5), carbon dioxide (CO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), and formaldehyde. Results show that ASHRAE-compliant ventilation reduced PM 2.5, CO_2, CO, and formaldehyde significantly but not NO_2.[73]

In a study of range hood performance by Singer et al. the flow rate, and the extent to which the exhaust device extends over the burners that are in use had a large effect on pollutant capture efficiency. "A flow rate of 95 liters per second (200 cubic feet per minute) was necessary, but not sufficient, to attain capture efficiency in excess of 75% for the front burners."[74] Even on medium or low fan settings, many devices, coupled with the ambient noise already present, raised sound levels above 60 dB, a level that would strongly compete with normal conversation. "Given these results, it is not surprising that people are reluctant to use their exhaust devices."[74]

NW Natural bases its claim that “gas does not cause hazardous indoor air quality” on a single 2013 study by Wong et al. which found no association between gas cook stoves and asthma in children.[75] However, this study is not a good model to examine the safety of cooking with methane. The study was actually designed to investigate whether cooking with open fires, burning wood, and other biomass products was associated with asthma in children. In addition, the study had methodological issues in that it was based on a self-reported global survey of household cooking fuels and asthma symptoms in which the respondents were children aged 13-14 and parents of children aged 6-7; data were combined from 31 countries with differences in geography, ambient temperatures, housing characteristics, ventilation and other factors; and participants may have inadvertently misclassified their cooking fuel (i.e. liquefied petroleum gas vs. methane).



NW Natural has stated that: “Neither the U.S. Consumer Product Safety Commission, the U.S. Environmental Protection Agency, nor the Federal Interagency Committee on Indoor [Air] Quality identify gas-fired cooking appliances as having a significant negative effect on indoor air quality.”[68] In support of this statement, they reference an undated EPA publication with latest reference from 1993 entitled “Indoor Air Pollution: An Introduction for Health Professionals.”[76] In contrast to NW Natural’s claims, this EPA publication actually identifies significant impacts of common gas stove pollutants such as nitrogen dioxide (NO_2), carbon monoxide (CO), and sulfur dioxide (SO_2) on respiratory health. For instance, the section on NO_2 states the following:

> “Recent studies indicate that low-level $N0_2$ exposure may cause increased bronchial reactivity in some asthmatics, decreased lung function in patients with chronic obstructive pulmonary disease, and an increased risk of respiratory infections, especially in young children.”[76]

While indoor air pollution research has come a long way in the nearly 30 years since that EPA report was published, the American Lung Association still lists the following range of harmful pulmonary effects caused by nitrogen dioxide emissions from indoor combustion:[77]

- Increased inflammation of the airways;
- Worsened cough and wheezing;
- Reduced lung function;
- Increased asthma attacks; and
- Greater likelihood of emergency department and hospital admissions.

The 1993 EPA publication also discussed the role of carbon monoxide as an asphyxiant (i.e. can cause death due to lack of oxygen):

> “The elderly, the fetus, and persons with cardiovascular and pulmonary diseases are particularly sensitive to elevated CO levels. Tissues with the highest oxygen needs -- myocardium, brain, and exercising muscle -- are the first affected. Studies involving controlled exposure have also shown that CO exposure shortens time to the onset of angina in exercising individuals with ischemic heart disease and decreases exercise tolerance in those with chronic obstructive pulmonary disease (COPD).”[76]

In a section entitled “Health problems caused by other combustion products (stoves, space heaters, furnaces, fireplaces),” the EPA report lists the following signs and symptoms:

- Dizziness or headache;
- Confusion;
- Nausea/emesis;
- Fatigue;
- Tachycardia;
- Eye and upper respiratory tract irritation;
- Wheezing/bronchial constriction;
- Persistent cough;
- Elevated blood carboxyhemoglobin levels; and
- Increased frequency of angina in persons with coronary heart disease.[76]

NW Natural’s statement that gas-fired cooking appliances “do not have a significant negative effect on indoor air quality”[68] is not supported by the publication they cite. As explained above, the EPA publication[76] actually confirms the harmful health effects of gas appliances.

These studies clearly link the ordinary use of gas stoves with harm to human health, especially children. NW Natural’s casual dismissal of scientific research shows a callous indifference to the well-being of its customers.

Exposure to Indoor Air Pollution from Burning Methane is an Issue of Health and Environmental Justice

Low income and communities of color, living in primarily urban areas, experience higher levels of outdoor air pollution in the U.S., demonstrated from monitoring data in a study by Miranda, et.al.[78] These communities are more likely to live in or near heavily industrialized areas or near major roadways.[78] The 70 million buildings in the U.S. that burn fossil fuels contribute to this air pollution, when gas appliances vent PM 2.5, carbon monoxide, nitrogen dioxide, and formaldehyde into outdoor air.[79] Three of these pollutants are EPA-established "criteria pollutants." It is well established that exposure to air pollution increases the risk of heart disease, stroke, respiratory disease and cancer and that there is a disproportionate effect on communities of color and low-income communities.

Oregonians experience these same effects as noted in the 2018 Climate Change and Health Report from the Oregon Health Authority: "communities more affected by air pollution are communities of color and low-income households, who already bear a disproportionate burden of disease in Oregon."[80] These communities include people with existing illnesses, people with disabilities, older adults, mothers, infants and children, indigenous peoples, immigrants, refugees, linguistically isolated, and communities of color. The connection between exposure to air pollution and the increased risk of heart disease, stroke, respiratory disease and cancer – four of the top five leading causes of death in Oregon – is well established, as is air pollution's disproportionate effect on communities of color and low-income communities.

According to a 2017 report jointly published by the NAACP and Clean Air Task Force: "More than 1 million African Americans live within a half mile of existing natural gas facilities and the number is growing every year. As a result, many African American communities face an elevated risk of cancer due to air toxics emissions from natural gas development: over 1 million African Americans live in counties that face a cancer risk above EPA's level of concern from toxics emitted by natural gas facilities."[81]

COVID-19 death rates have also been associated with fossil-fuel air pollutants, including PM 2.5, nitrogen dioxide, ozone, and formaldehyde.[82,83,84] These rates are 49% higher in places with a high Black population.[81]

Low-income and Black, Indigenous, and People of Color (BIPOC) communities already burdened with high levels of outdoor air pollution are at much greater risk of harm from indoor air pollution, including pollution emitted by gas stoves and ovens that burn methane. These individuals and families are more likely to be renters and live in high density, multiunit spaces where the effects of indoor sources of PM 2.5 and NO_2 were found to be greater.[85]

As a result of housing discrimination, low-income and BIPOC communities are more likely to live in smaller spaces and experience overcrowding. Renters have no control over their appliances, which are often older, poorly maintained and not adequately ventilated. These factors contribute to the potential for these communities living with increased concentrations of indoor pollutants. In addition, individuals have greater exposure to the products of gas combustion when they use gas ovens for home heating.[11] The National Center for Healthy Housing, in studying low-income homes with ASHRAE-compliant ventilation systems, found that although levels of PM 2.5, CO, CO_2 and formaldehyde were lowered when AHSRAE-compliant ventilation systems were used, there was no decrease in NO_2 levels. As a result, they recommended replacing gas stoves with electric stoves.[86]

Air pollution and asthma go hand-in-hand with environmental injustice. Asthma is the most common chronic illness in children and is an important health equity indicator. "Research has shown significant racial/ ethnic and income disparities in asthma rates, with populations of color and people in poverty experiencing consistently higher asthma prevalence rates and poor asthma outcomes compared with the general population. For this reason, asthma is a particularly important health equity indicator."[88]

In Multnomah County, there is a strong correlation between air pollution and asthma, with the highest rates in low-income and BIPOC communities.[87,88] The average rate of asthma is 11% in Oregon and 10% in Multnomah County but is much higher (>14%) among those who earn less than $20,000 per year or who are on the Oregon Health Plan.[89] Higher percentages of ethnic minorities live in census tracts with higher levels of air pollution and higher rates of asthma.[89] These health disparities may be further exacerbated by the exposure to pollutants, NO_2 and PM 2.5, from gas stoves.[89]

The impacts of methane gas are not just experienced locally, but through the entire gas extraction and transportation cycle. As of 2022, 79% of gas in the U.S. is produced by hydraulic fracturing.[90] Although there is no fracking in Oregon, frontline communities living adjacent to any part of the fracked gas extraction cycle experience exposure to contaminated air, water, and soils. Fracking is an environmental injustice with harms borne disproportionately by pregnant women, children, Indigenous people, communities of color, and low-income communities.[90] Our use of gas in Oregon continues to put all communities that are located adjacent to extraction, processing, and transportation sites at greater risk.

More than 17.6 million Americans live within one mile of a fracking site.[91] Communities living near these wells have been shown to have an increased incidence of cancers, asthma, respiratory diseases, skin rashes, heart problems, and mental health problems. Pregnant women residing near fracking operations across the nation show impairments to infant health, including birth defects, preterm birth, and low birth weight.[90]

> "As documented in more than 100 studies, toxic air pollution accompanies fracking. More than 200 airborne chemical contaminants have been detected near drilling and fracking operations, and air monitoring has confirmed strikingly high levels of toxic air pollutants in communities near these sites. Of these, 61 are classified as hazardous air pollutants with known health risks, including the potent carcinogens benzene and formaldehyde. Additional fracking-related air pollutants include diesel exhaust, fine particles, hydrogen sulfide gas, nitrogen oxides, and other chemical precursors of ground-level ozone (smog), which can damage respiratory, cardiovascular, and nervous systems."[90]

In addition, fracking is accelerating the climate crisis with the escape of methane from all parts of the extraction, processing and distribution system and the health and safety impacts caused by climate warming harms environmental justice communities disproportionately.[90]

Creating an equitable energy future depends on much more than switching fuels. The Emerald Cities Collaborative[92] and The Greenlining Institute[93] offer valuable resources that lay out key questions and steps to use when planning and implementing electrification. These tools help to grow energy democracy, center human rights, and ensure that low income and BIPOC people, neighborhoods, and communities are not further disenfranchised in terms of health, jobs, housing, energy costs, and political power.

Methane Gas is a Threat to Public Safety

Transporting Gas in Any Form is Dangerous

NW Natural states that, according to the US Department of Transportation, pipelines are the safest form of methane gas transportation.[68] NW Natural argues that methane gas is safe by attempting to redefine safety. Transporting gas via pipelines may be safer than transporting gas via vessel, rail, or truck, but pipelines still pose major risks to our communities. For example, in the last three years, the United States has averaged 76 "significant incidents" per year in gas distribution lines, which are defined to "include a fatality, or an injury requiring overnight, in-patient hospitalization, or $50,000 or more in total costs."[94]

Portland residents experienced one such incident in 2016, when an explosion in northwest Portland caused multiple injuries and approximately $17 million in damages.[12] This tally of "significant incidents" does not include leaks, leading to evacuations like the one experienced by northwest Portland business owners and residents in early 2021, when NW Natural discontinued service and cleared a multiple block area to manage a major natural gas leak.[95] NW Natural's own safety report identifies the following safety concerns and "highest ranking threats" to its distribution system: excavation damage; material, weld, or joint failure; and equipment failure.[96] Should NW Natural introduce hydrogen into pipelines as planned, it would further exacerbate existing safety concerns, due to the highly corrosive and flammable nature of this fuel.[97]

In addition, drawing attention away from real safety concerns related to transportation, NW Natural attempts similar misdirection when offering another example of safety — namely, that natural gas ranges caused fewer kitchen fires than electric ranges. Again, this narrow focus disregards not only the other types of fires associated with gas,[98] but also the myriad risks that methane presents during its lifecycle.

Other methane-related risks surround fracking[9], storage,[99] leaking/poisoning,[100] and combustion. In addition to the everyday impacts to indoor air quality, and the routine leakages and explosions discussed above, NW Natural stores and transports methane gas through areas where pipelines are at high risk of rupturing during the impending Cascadia subduction zone earthquake.[101] (See the 2021 joint study by the City of Portland's Bureau of Development Services and Multnomah County to quantify these risks in detail.)[102]

Finally, continued reliance on methane gas exacerbates the many safety concerns attending a planet destabilized by climate change, including safety issues related to increased fires, smoke, drought, heat waves, flooding, food insecurity, and more.[103] To summarize, NW Natural's narrow focus on the potential dangers of other means of transporting gas misleadingly side-steps pipeline safety issues and ignores the sweeping consequences of continued methane gas use and development.

Methane Gas and Extreme Weather and Fire Events

NW Natural has run advertisements implying that if customers have natural gas in their homes, they will be less affected by extreme weather.[104,105] In truth, most home heating systems and other gas appliances require electricity to ignite and, as such, may not function in the event of power outages. Outages also impact the function of essential ventilation systems, which, as discussed, are critical to mitigating the worst impacts of gas combustion on indoor air quality. Insufficient ventilation concentrates pollutants from gas appliances, exposing families to noxious fumes and associated health hazards.

Oregon's 2020 wildfire season increased awareness about gas stoves and indoor air quality. As the climate crisis progresses and our region experiences hazardous air quality from more frequent summer wildfires, gas stoves are a significant liability. On hazardous air quality days, the EPA guidance includes the following: "Avoid activities that create more fine particles indoors, including smoking cigarettes or using gas, propane or wood-burning stoves and furnaces."[106] On these hazardous air-quality days it is dangerous to open windows or run fans as recommended while cooking with gas. This means that the primary way to decrease the indoor air pollution of gas stoves is no longer available during periods of hazardous air quality.

The devastating Texas storms of 2021 led to massive grid failures, and despite what the fossil fuel industry would have us believe, renewable energy infrastructure did not lead to the outages. According to the Electric Reliability Council of Texas (ERCOT), which operates the state's power grid, "while some wind turbines did freeze, failures in natural gas, coal and nuclear energy systems were responsible for nearly twice as many outages as renewables."[107] Experts agree, the solution for extreme weather events (climate-driven or otherwise) is a more resilient grid and greater investments into emergency energy storage, decentralized renewable energy generation (i.e. rooftop solar) and housing retrofits to increase energy efficiency, insulation, and climate resilience, *not* more explosive gas infrastructure.

Expanding Gas Infrastructure is Inconsistent with Oregon's Climate Goals

Gas in buildings is one of the fastest growing sources of emissions in Oregon[108] and is directly at odds with Governor Brown's 2020 Executive Order,[109] the 100% Clean Energy for All standard passed in the Oregon State Legislature in June 2021,[110] and the best available science on mitigating the climate crisis. Decarbonizing the electricity grid, combined with aggressive building electrification and energy storage, is the primary path toward reducing emissions in Oregon's built environment.[111]

Oregon has the fastest timeline to eliminate greenhouse gas emissions from the electric sector in the United States, with the goal of reducing emissions 80% below baseline emission levels by 2030, 90% by 2035, and 100% by 2040.[110] As of 2015, Oregon's overall emissions were 42% above 1990 levels.[112] As described in Oregon Senate Bill 98's RNG plan,[113] continued pipeline expansion would not decarbonize Oregon's built environment. The bill set a goal of reaching 30% RNG in Oregon's methane gas pipelines by 2050. This implies that 70% would still be methane — the greenhouse gas that is up to 120 times more potent than CO_2.[10]

The Gas Industry is Misleading the Public with False Promises of Decarbonization while Opposing Climate Policy at All Levels of Government

NW Natural is currently conducting an advertising campaign, which can be viewed on television and on its "Less We Can" website.[114] It features images of people riding bikes, planting home gardens and recycling. It implies that customers can continue to use gas ranges and other gas appliances if they if they "use less and offset the rest."

The "Less We Can" campaign is an example of a gas industry greenwashing strategy claiming to be "saving" carbon emissions and minimizing the harmful effects of its product while NW Natural actually increases its annual carbon emissions as it adds more customers, incentivizes home builders to install gas appliances, and lobbies elected officials at the local, state and federal level to prevent laws and efficiency standards that reduce emissions.[115]

At the center of the "Less We Can" campaign is NW Natural's "voluntary carbon savings goal of 30% by 2035." NW Natural first made this pledge in 2016. A footnote in the NW Natural 2019 Environmental, Social and Governance Report clarifies that "this is an emissions savings goal equivalent to 30% of the carbon emissions from our sales customers' gas use and company operations from 2015."[30]

This 30% "savings goal" has been devised to sound impressive to the public and to imply emissions reductions, but to achieve that goal by 2035, NW Natural will only need to "save" approximately 1% of its emissions every year for the next 20 years even as their actual annual emissions continue to increase. As their emissions grow each year due to increased sales of fossil gas, these insignificant annual "savings" add up to an amount equivalent to 30% of the emissions they created in 2015.[30]

In effect, these relatively insignificant savings (1% per year) come from NW Natural's compliance with the state-mandated Energy Trust of Oregon (ETO) program and offsets that their customers pay for as an additional charge on their gas usage. Meanwhile NW Natural's annual gas sales and associated emissions have increased by over 10% since making this pledge.[116]

In its 2019 Environmental, Social and Governance Report, NW Natural claims that it is "on track to meet or exceed [its] voluntary carbon savings goal of 30% by 2035."[30] The report includes a chart showing annual "savings" achieved for the last 4 years. Roughly half of these "savings" are achieved through energy efficiency measures funded through ETO. The other half are achieved through biogas "Smart Energy" offsets funded by NW Natural customers who sign up for additional voluntary charges of 10.5 cents per therm. "More than 8% of our customers—about 58,000—are enrolled in the Smart Energy program. In 2019, they funded approximately 160,000 metric tons in emission reductions."[30]

While making these impressive sounding but meaningless commitments to pursue energy efficiency, the company is also actively fighting efforts to increase energy efficiency standards and other measures to reduce their emissions. In 2020, NW Natural CEO David Anderson was promoted to Chairman of the Board of Directors of the American Gas Association (AGA), the industry group that supports the methane gas industry.[117] In late 2020, the AGA successfully pressured the US Department of Energy to abandon a proposed efficiency standard for gas furnaces, which would have raised performance from 80% to 92% Annual Fuel Utilization Efficiency (AFUE).[118] The DOE estimated that this measure would have avoided 143 million metric tons of CO_2 emissions, thousands of tons of other air pollutants, and saved ratepayers $5.6 to $21.7 billion in gas utility bills.[119] Under David Anderson, the AGA and the gas industry shut down the DOE proposal, which would have made readily-available condensing gas furnaces the new standard and eliminated inefficient older, non-condensing furnaces, and they are still pursuing litigation to prevent the DOE from adopting higher efficiency standards.[120]

In March of 2022, NW Natural joined Avista and Cascade Natural Gas in filing a lawsuit to avoid reducing its greenhouse gas emissions under Oregon's new Climate Protection Program, which mandates that regulated gas utilities reduce annual carbon emissions in line with state decarbonization targets. As Oregon Citizens Utility Board notes:

> "Oregon's gas utilities have been widely marketing their support of environmental stewardship and decarbonization goals. In fact, all three recently released statements touting their commitment to a greener future. But if their suit is successful, these utilities will prevent landmark climate action and keep polluting our climate with methane emissions."[121]

It is clear that NW Natural and the greater methane gas industry are making misleading statements that appear to suggest they have "an important role to play in helping our region move toward a low-carbon, renewable energy future."[114] But in truth, the company is failing to do anything substantive to achieve that future, and is actively and systematically fighting government efforts to reduce carbon emissions. Despite what the fossil fuel industry would have us believe, methane gas has no role in helping Oregon or Washington meet its building decarbonization goals.

Concluding Call to Action

Methane gas is now the leading contributor to global greenhouse gas emissions increases,[122] and it's time for our region to create the conditions for a peak and sharp downward trend. Recently, the governors of Oregon, Washington and California joined with the British Columbia Premier in committing to bold climate action.[123] And, while the United States is beginning to deploy the Inflation Reduction Act, its biggest clean energy investment yet, it's up to states and local jurisdictions to share tools and lessons learned to pass essential policies that make way for clean, healthy, and efficient buildings for all.

This means that it is time to prioritize public health, energy justice, children and the well-being of both rural and urban members of low-income and BIPOC communities. There's no better time to stop subsidizing the expansion of the methane gas distribution system and instead subsidize heat pump programs for low-income households and renters.

Together, everyone in the Pacific Northwest has a role to play in leading the rapid electrification of residential and commercial, new and existing buildings: members of the public health community, economists, HVAC installers, chefs, electricians, elected officials, engineers, researchers, climate justice advocates, engineers, journalists, Career Technical Education Teachers, planners, bankers, building inspectors, real estate agents, renters and homeowners. Every home, school or business that goes electric is a win for our region.

It is essential that we show up and help all levels of government focus on the right outcomes and rapidly enact policies to ensure a just transition to a more healthy, equitable future, powered by clean and safe renewable energy.

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