



Health Professionals for a Healthy Climate

INEQUITABLE PUBLIC HEALTH HARMS OF LIQUIFIED NATURAL GAS' LIFECYCLE

PUBLIC HEALTH AND HEALTH EQUITY HARMS OF FRACKING AND DRILLING

Impacts to water quantity and public health:

Most of the methane gas¹ in the United States is obtained by unconventional drilling²- also called hydraulic fracking. In this process, operators drill down multiple bores turned horizontally to reach the methane gas trapped in shale rock. High volumes of pressurized fluid- water mixed with a stew of toxic chemicals, are sent into the shale layer to liberate methane gas. Each gas well uses millions of tons of water during its lifespan. Many fracking wells are already located in areas of water scarcity³. In the United States, nearly 1.5 trillion gallons of water have been used for fracking operations since 2011, according to a *New York Times* investigation in 2023⁴. As our population grows and many regions of the US face drought from climate change, this water scarcity will only worsen. During the review process, the DOE needs to consider that increasing LNG exports would result in heightened fracking activity, potentially redirecting water from domestic use to produce methane gas for overseas consumption.

Impacts to water quality and public health:

There are over a thousand chemicals in fracking fluid. A Yale team analyzed 240 of these chemicals and concluded that 157 of them- chemicals such as arsenic, benzene, cadmium, lead, formaldehyde, chlorine, and mercury- were associated with either developmental or reproductive toxicity⁵. In 2021, Physicians for Social Responsibility's (PSR) investigation found that PFAS⁶, aka forever chemicals, and their precursors have been used in fracking fluids in

¹ Natural gas is mainly composed of methane (CH₄). Thus, natural gas will be referred to as "methane gas" henceforth in this report. For the sake of convenience, the acronym LNG will be retained when discussing liquified methane gas.

² Energy Information Administration. (n.d.). *Where our natural gas comes from*. Retrieved from <https://www.eia.gov/energyexplained/natural-gas/where-our-natural-gas-comes-from.php>

³ Ceres. (Feb 2016). *Hydraulic fracturing & water stress: Water demand by the numbers*. Retrieved from <https://www.ceres.org/resources/reports/hydraulic-fracturing-water-stress-water-demand-numbers>

⁴ New York Times. (2023, September 25). *Fracking's impact on water resources: A visual exploration*. Retrieved from <https://www.nytimes.com/interactive/2023/09/25/climate/fracking-oil-gas-wells-water.html>

⁵ Elliott, E., Ettinger, A., Leaderer, B. *et al.* A systematic evaluation of chemicals in hydraulic-fracturing fluids and wastewater for reproductive and developmental toxicity. *J Expo Sci Environ Epidemiol* 27, 90–99 (2017). <https://doi.org/10.1038/jes.2015.81>

⁶ Horwitt, D. (2021, July). *Fracking with "Forever Chemicals"* Physicians for Social Responsibility. Retrieved from <https://psr.org/wp-content/uploads/2021/07/fracking-with-forever-chemicals.pdf>

thousands of wells across several states. Oil and gas companies have injected at least 43,000 pounds of PTFE/Teflon across 73 Texas counties over the past decade per another PSR report⁷. The oil and gas industry is the only one allowed by the Environmental Protection Agency (EPA) to inject these known hazardous materials directly underground, potentially contaminating groundwater, as the EPA does not regulate fracking fluid injection (under the Safe Drinking Water Act) due to the “Halliburton loophole.”⁸

During fracking and drilling operations, what comes up is not just oil and gas, but also wastewater. This so-called “produced water” typically has a high concentration of technically enhanced naturally occurring radioactive materials (TENORM) like uranium, as well as other contaminants such as fracking fluid chemicals, heavy metals like arsenic, lead, nickel, and barium, polyaromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs) all of which can be very harmful to groundwater, surface water, soil, and human health.⁹

This radioactive wastewater is disposed of in several ways. One is to flush it down any of the more than 187,000¹⁰ disposal wells nationwide that accept oil and gas waste. These wells may then connect to groundwater aquifers. In 2016,¹¹ a public health research team showed that disposal wells for fracking wastewater were more than twice as common in areas where residents are 80 percent people of color compared to majority-white communities. Wells were also more commonly sited in high-poverty regions. When workers carry this wastewater in tanker trucks over great distances, they’re exposed to levels of radiation capable of impacting their health¹². Radioactive wastewater is also used as de-icing material in rural communities, disproportionately increasing their exposure.

Public health and health equity harms of air pollution:

More than 17.6 million US residents¹³ live within one mile of at least one active oil and gas well. A study of over 15 million Medicare beneficiaries showed that living downwind from

⁷ Horwitt, D., & Gottlieb, B. (2023, February). Fracking with “Forever Chemicals” in Texas. Physicians for Social Responsibility. Retrieved from

<https://psr.org/wp-content/uploads/2023/02/fracking-with-forever-chemicals-in-texas.pdf>

⁸ Environmental Protection Agency. (2015). *Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States (EPA 816-R-14-001)*. Retrieved from https://www.epa.gov/sites/default/files/2015-05/documents/revised_dfhf_guid_816r14001.pdf

⁹ Ariana A, Rosofsky A, Danforth C, Vorhees D. 2023. Potential Human Exposures to Produced Water from Onshore Oil and Gas Production. Research Brief 5. Boston, MA: Health Effects Institute Energy <https://www.heienergy.org/system/files/hei-energy-brief-5-produced-water.pdf>

¹⁰ Concerned Health Professionals of New York & Physicians for Social Responsibility. (2023). *Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking and Associated Gas and Oil Infrastructure (Ninth Edition)*. Retrieved from <http://concernedhealthny.org/compendium/>

¹¹ Johnston, J. E., Werder, E., & Sebastian, D. (2016). Wastewater Disposal Wells, Fracking, and Environmental Injustice in Southern Texas. *American Journal of Public Health*, 106(3), 550-556. <https://doi.org/10.2105/AJPH.2015.303000>

¹² Nobel, J. (2020, January 21). America’s Radioactive Secret, *Rolling Stone*. Retrieved from <https://www.rollingstone.com/politics/politics-features/oil-gas-fracking-radioactive-investigation-937389/>

¹³ Czolowski, E. D., Santoro, R. L., Srebotnjak, T., & Shonkoff, S. B. C. (2017, August 23). Toward Consistent Methodology to Quantify Populations in Proximity to Oil and Gas Development: A National Spatial Analysis and Review. *Environmental Health Perspectives*, 125(8), 086004. <https://doi.org/10.1289/EHP1535>

unconventional oil and gas development increased the risk of death¹⁴. Historically redlined neighborhoods are burdened with twice as many oil and gas wells¹⁵.

Fracking and drilling operations pollute the air with particulate matter (PM), volatile organic compounds (VOCs), including benzene, toluene, ethylene, and xylene (collectively called BTEX compounds), and nitrogen oxides (NOx) which directly impact health and also act as precursors to the formation of ground-level ozone¹⁶. In 2023, a report showed that the oil and gas industry was Colorado's number one source of ozone pollution¹⁷. All these air pollutants are associated with significant health risks.

Benzene, a carcinogen, is associated with an increased risk of cancers including leukemia¹⁸. Chronic exposure of toluene and xylene lead to neurodegenerative diseases¹⁹(i.e. diseases that lead to progressive decline of brain function, thus decline in mental and physical abilities). Nitrogen dioxide (NO₂) impacts lung health, leading to new cases of childhood asthma²⁰, increased asthma attacks and related emergency room visits and hospital admission²¹, and heart failure²². Children exposed to NO₂ have stunted lung growth²³. Ground-level ozone also impacts respiratory health and is associated with increased rates of emergency room visits and hospital admissions for asthma attacks²⁴. Fracking operations also produce 61 hazardous air

¹⁴ Li, L., Dominici, F., Blomberg, A. J., Bargagli-Stoffi, F. J., Schwartz, J. D., Coull, B. A., Spengler, J. D., Wei, Y., Lawrence, J., & Koutrakis, P. (2022, February). Exposure to Unconventional Oil and Gas Development and All-cause Mortality in Medicare Beneficiaries. *Nature Energy*, 7(2), 177-185. <https://doi.org/10.1038/s41560-021-00970-y>

¹⁵ Gonzalez, D. J. X., Nardone, A., Nguyen, A. V., et al. (2023). Historic redlining and the siting of oil and gas wells in the United States. *Journal of Exposure Science & Environmental Epidemiology*, 33, 76–83. <https://doi.org/10.1038/s41370-022-00434-9>

¹⁶ Srebotnjak, T., & Rotkin-Ellman, M. (2014). Fracking Fumes: Air Pollution from Hydraulic Fracturing Threatens Public Health and Communities (Report No. 14-10-A). Natural Resources Defense Council. Retrieved from <https://www.nrdc.org/sites/default/files/fracking-air-pollution-IB.pdf>

¹⁷ Stiffler, C., & Jalali, P. (January 2023). Clearing the Air: The Real Costs and Benefits of Oil and Gas for Colorado. *Colorado Fiscal Institute*. Retrieved from <https://www.coloradofiscal.org/wp-content/uploads/2023/01/OG-paper-1-5-23-final.pdf>

¹⁸ Centers for Disease Control and Prevention. (2018, April). Facts About Benzene. Retrieved from <https://emergency.cdc.gov/agent/benzene/basics/facts.asp>

¹⁹ Blanc P.D. Toluene and xylene. Olson K.R., & Anderson I.B., & Benowitz N.L., & Blanc P.D., & Clark R.F., & Kearney T.E., & Kim-Katz S.Y., & Wu A.B.(Eds.), [publicationyear2] *Poisoning & Drug Overdose*, 7e. McGraw-Hill Education. <https://accessmedicine.mhmedical.com/content.aspx?bookid=2284§ionid=248385622>

²⁰ Anenberg, S. C., Mohegh, A., Goldberg, D. L., Kerr, G. H., Brauer, M., Burkart, K., & et al. (January, 2022). Long-term trends in urban NO₂ concentrations and associated paediatric asthma incidence: estimates from global datasets. *Articles*, 6(1), E49-E58. [https://doi.org/10.1016/S2542-5196\(21\)00255-2](https://doi.org/10.1016/S2542-5196(21)00255-2)

²¹ Zheng, X. Y., Orellano, P., Lin, H. L., Jiang, M., & Guan, W. J. (2021). Short-term exposure to ozone, nitrogen dioxide, and sulphur dioxide and emergency department visits and hospital admissions due to asthma: A systematic review and meta-analysis. *Environment international*, 150, 106435. <https://doi.org/10.1016/j.envint.2021.106435>

²² Jia, Y., Lin, Z., He, Z., Li, C., Zhang, Y., Wang, J., Liu, F., Li, J., Huang, K., Cao, J., Gong, X., Lu, X., & Chen, S. (2023). Effect of Air Pollution on Heart Failure: Systematic Review and Meta-Analysis. *Environmental health perspectives*, 131(7), 76001. <https://doi.org/10.1289/EHP11506>

²³ American Lung Association. (2023,October). Nitrogen Dioxide. Retrieved from <https://www.lung.org/clean-air/outdoors/what-makes-air-unhealthy/nitrogen-dioxide>

²⁴ Zheng, X. Y., Ding, H., Jiang, L. N., Chen, S. W., Zheng, J. P., Qiu, M., Zhou, Y. X., Chen, Q., & Guan, W. J. (2015). Association between Air Pollutants and Asthma Emergency Room Visits and Hospital Admissions in Time Series Studies: A Systematic Review and Meta-Analysis. *PloS one*, 10(9), e0138146. <https://doi.org/10.1371/journal.pone.0138146>

pollutants²⁵ and high levels of deadly fine particulate matter (PM_{2.5})²⁶, which impacts virtually every part of our body. PM_{2.5} exposure has been associated with increased risk of high blood pressure²⁷, diabetes²⁸, asthma attacks²⁹, chronic kidney disease³⁰, heart attacks³¹, abnormal heart rhythms in the elderly³² and teenagers³³, stroke³⁴, Parkinson's disease, dementia³⁵, and premature death³⁶. PM_{2.5} crosses the placenta and reaches the fetus. PM_{2.5} exposure during pregnancy is associated with increased risk of pre-eclampsia³⁷ (high blood pressure during pregnancy), stillbirth³⁸, and found to impact the brain development of the fetus in the womb with lower motor, cognitive and language skills at two years of age.³⁹

²⁵ Garcia-Gonzales, D. A., Shonkoff, S. B. C., Hays, J., & Jerrett, M. (2019). Hazardous air pollutants associated with upstream oil and natural gas development: A critical synthesis of current peer-reviewed literature. *Annual Review of Public Health*, 40, 283-304. <https://doi.org/10.1146/annurev-publhealth-040218-043715>

²⁶ Nye, M., Knuckles, T., Yan, B., Ross, J., Orem, W., Varonka, M., Thurston, G., Dzomba, A., & McCawley, M. (2020). Use of tracer elements for estimating community exposure to Marcellus Shale development operations. *International Journal of Environmental Research and Public Health*, 17(6), 1837. <https://doi.org/10.3390/ijerph17061837>

²⁷ Yang, B. Y., Qian, Z., Howard, S. W., et al. (2018). Global association between ambient air pollution and blood pressure: A systematic review and meta-analysis. *Environmental Pollution*, 235, 576–588. <https://doi.org/10.1016/j.envpol.2018.01.001>

²⁸ He, D., Wu, S., Zhao, H., Qiu, H., Fu, Y., Li, X., & He, Y. (2017, September). Association between particulate matter 2.5 and diabetes mellitus: A meta-analysis of cohort studies. *Journal of Diabetes Investigation*, 8(5), 687-696. <https://doi.org/10.1111/jdi.12631>

²⁹ Fan, J., Li, S., Fan, C., Bai, Z., & Yang, K. (2016). The impact of PM2.5 on asthma emergency department visits: a systematic review and meta-analysis. *Environmental science and pollution research international*, 23(1), 843–850. <https://doi.org/10.1007/s11356-015-5321-x>

³⁰ Wathanavasin, W., Banjongjit, A., Phannajit, J., Eiam-Ong, S., & Susantitaphong, P. (2024). Association of fine particulate matter (PM2.5) exposure and chronic kidney disease outcomes: a systematic review and meta-analysis. *Scientific reports*, 14(1), 1048. <https://doi.org/10.1038/s41598-024-51554-1>

³¹ Farhadi, Z., Abulghasem Gorgi, H., Shabaninejad, H., Aghajani Delavar, M., & Torani, S. (2020, March 12). Association between PM2.5 and risk of hospitalization for myocardial infarction: A systematic review and a meta-analysis. *BMC Public Health*, 20(1), 314. <https://doi.org/10.1186/s12889-020-8262-3>

³² Wang, F., Ahat, X., Liang, Q., Ma, Y., Sun, M., Lin, L., Li, T., Duan, J., & Sun, Z. (2021). The relationship between exposure to PM2.5 and atrial fibrillation in older adults: A systematic review and meta-analysis. *Science of The Total Environment*, 784, 147106. <https://doi.org/10.1016/j.scitotenv.2021.147106>

³³ He, F., Yanosky, J. D., Fernandez-Mendoza, J., Chinchilli, V. M., Al-Shaar, L., Vgontzas, A. N., Bixler, E. O., & Liao, D. (2022, September 20). Acute impact of fine particulate air pollution on cardiac arrhythmias in a population-based sample of adolescents: The Penn State Child Cohort. *Journal of the American Heart Association*, 11(18), e026370. <https://doi.org/10.1161/JAHA.122.026370>

³⁴ Yuan, S., Wang, J., Jiang, Q., He, Z., Huang, Y., Li, Z., Cai, L., & Cao, S. (2019). Long-term exposure to PM2.5 and stroke: A systematic review and meta-analysis of cohort studies. *Environmental Research*, 177, 108587. <https://doi.org/10.1016/j.envres.2019.108587>

³⁵ Fu, P., Guo, X., Cheung, F. M. H., & Yung, K. K. L. (2019). The association between PM2.5 exposure and neurological disorders: A systematic review and meta-analysis. *The Science of the total environment*, 655, 1240–1248. <https://doi.org/10.1016/j.scitotenv.2018.11.218>

³⁶ Waidyatillake, N. T., Campbell, P. T., Vicendese, D., Dharmage, S. C., Curto, A., & Stevenson, M. (2021). Particulate Matter and Premature Mortality: A Bayesian Meta-Analysis. *International journal of environmental research and public health*, 18(14), 7655. <https://doi.org/10.3390/ijerph18147655>

³⁷ Yu, H., Yin, Y., Zhang, J., & Zhou, R. (2020). The impact of particulate matter 2.5 on the risk of preeclampsia: an updated systematic review and meta-analysis. *Environmental science and pollution research international*, 27(30), 37527–37539. <https://doi.org/10.1007/s11356-020-10112-8>

³⁸ DeFranco, E., Hall, E., Hossain, M., Chen, A., Haynes, E. N., Jones, D., Ren, S., Lu, L., & Muglia, L. (2015). Air pollution and stillbirth risk: exposure to airborne particulate matter during pregnancy is associated with fetal death. *PloS one*, 10(3), e0120594. <https://doi.org/10.1371/journal.pone.0120594>

³⁹ Morgan, Z. E. M., Bailey, M. J., Trifonova, D. I., et al. (2023). Prenatal exposure to ambient air pollution is associated with neurodevelopmental outcomes at 2 years of age. *Environmental Health*, 22(1), 11. <https://doi.org/10.1186/s12940-022-00951-y>

PM_{2.5} has also been shown to have a causal relationship with cardiovascular mortality⁴⁰, lung cancer,⁴¹ and new cases of childhood asthma.⁴² Establishing a causal relationship requires an abundance of rigorous scientific evidence and is a gold standard in medical research. Just as health professionals are able to recommend that quitting smoking saves lives, with causal evidence, we are able to unequivocally state that reducing air pollution—in this case by reducing fracking and our reliance on methane gas—will improve health and prevent premature deaths for Americans.

Proximity to oil and gas drilling sites impacts our health from the womb to grave, and is associated with: increased risk of preterm birth, low birth weight,⁴³ congenital birth defects including heart⁴⁴ and neural tube defects⁴⁵, increased rates (1.5-4 times) of asthma attacks⁴⁶, increased risk of childhood leukemia⁴⁷, hospitalizations for heart failure⁴⁸, increased rates of cancer, and premature death⁴⁹. A study from Colorado estimated that for people living within 500 feet of an active well, the lifetime risk of cancer is estimated to be eight times higher than the EPA estimate⁵⁰. Workers and their families who live near fracking operations are especially

⁴⁰ Brook, R. D., Rajagopalan, S., Pope, C. A., Brook, J. R., Bhatnagar, A., Diez-Roux, A. V., Holguin, F., Hong, Y., Luepker, R. V., Mittleman, M. A., et al; on behalf of the American Heart Association Council on Epidemiology and Prevention, Council on the Kidney in Cardiovascular Disease, and Council on Nutrition, Physical Activity and Metabolism. (2010). Particulate matter air pollution and cardiovascular disease: An update to the scientific statement from the American Heart Association. *Circulation*, 121, 2331–2378. <https://doi.org/10.1161/CIR.0b013e3181dbee1>

⁴¹ Turner, M. C., Andersen, Z. J., Baccarelli, A., Diver, W. R., Gapstur, S. M., Pope III, C. A., & et al. (2020, August 25). Outdoor air pollution and cancer: An overview of the current evidence and public health recommendations. *CA: A Cancer Journal for Clinicians*. Advance online publication. <https://doi.org/10.3322/caac.21632>

⁴² Thurston, G. D., Balme, J. R., Garcia, E., Gilliland, F. D., Rice, M. B., Schikowski, T., Van Winkle, L. S., Annesi-Maesano, I., Burchard, E. G., Carlsten, C., Harkema, J. R., Khreis, H., Kleeberger, S. R., Kodavanti, U. P., London, S. J., McConnell, R., Peden, D. B., Pinkerton, K. E., Reibman, J., & White, C. W. (2020). Outdoor Air Pollution and New-Onset Airway Disease. An Official American Thoracic Society Workshop Report. *Annals of the American Thoracic Society*, 17(4), 387–398. <https://doi.org/10.1513/AnnalsATS.202001-046ST>

⁴³ California Oil and Gas Public Health Rulemaking Scientific Advisory Panel, (2021, October), Response to CalGEM Questions for the California Oil and Gas Public Health Rulemaking Scientific Advisory Panel, Retrieved from https://www.conservation.ca.gov/calgem/Documents/public-health/Public%20Health%20Panel%20Responses_FINAL%20ADA.pdf

⁴⁴ McKenzie, L. M., Allshouse, W., & Daniels, S. (2019). Congenital heart defects and intensity of oil and gas well site activities in early pregnancy. *Environment International*, 132, 104949. <https://doi.org/10.1016/j.envint.2019.104949>

⁴⁵ Gaughan, C., Sorrentino, K. M., Liew, Z., Johnson, N. P., Clark, C. J., Soriano, M. Jr, Plano, J., Plata, D. L., Saiers, J. E., & Deziel, N. C. (2023). Residential proximity to unconventional oil and gas development and birth defects in Ohio. *Environmental Research*, 229, 115937. <https://doi.org/10.1016/j.envres.2023.115937>

⁴⁶ Rasmussen, S. G., Ogburn, E. L., McCormack, M., Casey, J. A., Bandeen-Roche, K., Mercer, D. G., & Schwartz, B. S. (2016). Association between unconventional natural gas development in the Marcellus Shale and asthma exacerbations. *JAMA Internal Medicine*. <https://doi.org/10.1001/jamainternmed.2016.2436>

⁴⁷ Clark, C. J., Johnson, N. P., Soriano, M., Jr, Warren, J. L., Sorrentino, K. M., Kadan-Lottick, N. S., Saiers, J. E., Ma, X., & Deziel, N. C. (2022). Unconventional Oil and Gas Development Exposure and Risk of Childhood Acute Lymphoblastic Leukemia: A Case-Control Study in Pennsylvania, 2009-2017. *Environmental health perspectives*, 130(8), 87001. <https://doi.org/10.1289/EHP11092>

⁴⁸ McAlexander, T. P., Bandeen-Roche, K., Buckley, J. P., Pollak, J., Michos, E. D., McEvoy, J. W., & Schwartz, B. S. (2020). Unconventional natural gas development and hospitalization for heart failure in Pennsylvania. *Journal of the American College of Cardiology*, 76(24), 2862-2874. <https://doi.org/10.1016/j.jacc.2020.10.023>

⁴⁹ Li, L., Dominici, F., Blomberg, A. J., Bargagli-Stoffi, F. J., Schwartz, J. D., Coull, B. A., Spengler, J. D., Wei, Y., Lawrence, J., & Koutrakis, P. (2022). Exposure to Unconventional Oil and Gas Development and All-cause Mortality in Medicare Beneficiaries. *Nature energy*, 7(2), 177–185. <https://doi.org/10.1038/s41560-021-00970-y>

⁵⁰ McKenzie, L. M., Blair, B., Hughes, J., Allshouse, W. B., Blake, N. J., Helmig, D., Milmo, P., Halliday, H., Blake, D. R., & Adgate, J. L. (2018). Corrections to "Ambient Nonmethane Hydrocarbon Levels Along Colorado's Northern Front Range: Acute and Chronic Health Risks". *Environmental science & technology*, 52(24), 14568–14569. <https://doi.org/10.1021/acs.est.8b06179>

at risk. There are now over 120 studies across the country documenting the public health harms of fracking and drilling operations⁵¹.

When determining public interest in LNG exports, the DOE must consider these grave effects on our health. Increased exports can only occur if there is increased drilling and fracking for methane gas. While fossil fuel companies reap the benefits of LNG exports, Americans living in proximity to oil and gas drilling operations will pay with their health and the health of their children. In 2016 alone, air pollution from the oil and gas sector “in the US resulted in 410,000 asthma exacerbations, 2,200 new cases of childhood asthma and 7,500 excess deaths, with \$77 billion in total health impacts.”⁶²

PUBLIC HEALTH AND HEALTH EQUITY HARMS OF VENTING AND FLARING

When drilling for methane gas and all along the supply chain, companies often have to vent excess gas to operate safely. This release of methane gas, a potent greenhouse gas, adds to the damage to our global climate. When looking at its climate-damaging impact over 20 years, one tonne of methane can be considered equivalent to 84 to 86 tonnes of carbon dioxide (CO₂). Studies have demonstrated that when supply chain methane leaks⁵³, venting, and flaring⁵⁴ are all taken into account, methane gas is no longer a “clean” option but can be as damaging to the climate as coal. This negates a crucial argument for the industry’s rationale⁵⁵ for exporting LNG as they claim that natural gas will displace more polluting fuels overseas.

Though more typically linked to shale oil extraction, flaring can also occur at gas production sites. Between 15%- 25% of natural gas produced in the United States is estimated to be “sour,” or contaminated with hydrogen sulfide⁵⁶. This gas must go through a purification process to become marketable. Not all operators find this process economical, so they burn the sour gas instead. Burning methane gas produces CO₂- a greenhouse gas, and several aforementioned air pollutants such as NO₂⁵⁷, particulate matter (PM), and VOCs, that are precursors for ground-level ozone, and black carbon (BC)⁵⁸, sulfur dioxide (SO₂)- best known to cause acid

⁵¹ Concerned Health Professionals of New York & Physicians for Social Responsibility. (2023). *Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking and Associated Gas and Oil Infrastructure (Ninth Edition)*. Retrieved from <http://concernedhealthny.org/compendium/>

⁵² Buonocore, J. J., Reka, S., Yang, D., Chang, C., Roy, A., Thompson, T., Lyon, D., McVay, R., Michanowicz, D., & Arunachalam, S. (2023). Air pollution and health impacts of oil & gas production in the United States. *Environmental Research: Health*, 1(2), 021006. <https://doi.org/10.1088/2752-5309/acc886>

⁵³ Deborah Gordon et al 2023 Environ. Res. Lett. 18 084008 DOI 10.1088/1748-9326/ace3db

⁵⁴ Zhang, Y., et al. (2020). Quantifying methane emissions from the largest oil-producing basin in the United States from space. *Science Advances*, 6, eaaz5120. <https://doi.org/10.1126/sciadv.aaz5120>

⁵⁵ Funded by *Cheniere Energy Inc.*, Roman-White, S. A., Littlefield, J. A., Fleury, K. G., Allen, D. T., Balcombe, P., Konschnik, K. E., Ewing, J., Ross, G. B., & George, F. (2021). LNG Supply Chains: A Supplier-Specific Life-Cycle Assessment for Improved Emission Accounting. *ACS Sustainable Chemistry & Engineering*, 9(32), 10857–10867. <https://doi.org/10.1021/acssuschemeng.1c03307>

⁵⁶ Q2 Technologies. H₂S Mitigation Technologies for Gas. Retrieved from <https://q2technologies.com/new/h2s-mitigation-technologies-for-gas-1/>

⁵⁷ Plant, G., Kort, E. A., Gorchoy Negron, A. M., Chen, Y., Fordice, G., & Harkins, C. (2024). In Situ Sampling of NO_x Emissions from United States Natural Gas Flares Reveals Heavy-Tail Emission Characteristic. *Environmental Science & Technology*, 58(3), 1509–1517. <https://doi.org/10.1021/acs.est.3c08095>

⁵⁸ Fortner, E. C., Brooks, W. A., Onasch, T. B., Canagaratna, M. R., Massoli, P., Jayne, J. T., Franklin, J. P., Knighton, W. B., Wormhoudt, J., Worsnop, D. R., Kolb, C. E., & Herndon, S. C. (2012). Particulate Emissions Measured During

rain, carbon monoxide(CO), and others⁵⁹. Thus, flaring, unsurprisingly, is associated with increased rates of preterm birth⁶⁰, hospitalizations due to breathing issues⁶¹, and premature death⁶², for residents who live near oil and gas operations. These impacts are disproportionately felt by Black, Indigenous⁶³ communities and communities of color. For example, Hispanic residents⁶⁴ living in the Eagle Ford area are exposed to significantly more fracking-associated flaring than white residents. A recent study estimated that emissions from oil and gas flaring and venting operations in the US resulted in “over \$7.4 billion in health damages, 710 premature deaths, and 73,000 asthma exacerbations among children annually” with disproportionate burden to low-income, Hispanic, and Native American communities.⁶⁵ Flaring also results in light and sound pollution with many nearby residents reporting disrupted sleep⁶⁶.

Increasing exports and accompanying upstream drilling will result in increased venting and flaring. The resulting damage to the global climate and the health of US residents is not in public interest.

PUBLIC HEALTH AND HEALTH EQUITY HARMS OF METHANE GAS TRANSPORTATION

Once extracted through drilling and fracking, methane gas is moved via an extensive network of gas pipelines, including to LNG export facilities. Compressor stations are located every 50-100 miles of pipeline to facilitate this movement⁶⁷. Compressor stations are known to generate high levels of air and climate pollution. According to one estimate from 2017,⁶⁸ compressor stations in the United States emitted over 52 million pounds of volatile organic compounds (VOCs), with higher levels of VOC emissions associated with higher levels of mortality. More LNG exports

the TCEQ Comprehensive Flare Emission Study. *Industrial & Engineering Chemistry Research*, 51(39), 12586–12592. <https://doi.org/10.1021/ie202692y>

⁵⁹ United States Environmental Protection Agency. (2018). *AP 42, Fifth Edition, Volume I Chapter 13: Miscellaneous Sources, Section 13.5 Industrial Flares*. Retrieved from https://www.epa.gov/sites/default/files/2020-10/documents/13.5_industrial_flares.pdf

⁶⁰ Cushing, L. J., Vavra-Musser, K., Chau, K., Franklin, M., & Johnston, J. E. (2020). Flaring from Unconventional Oil and Gas Development and Birth Outcomes in the Eagle Ford Shale in South Texas. *Environmental Health Perspectives*, 128(7), 77003. <https://doi.org/10.1289/EHP6394>

⁶¹ Blundell, W., & Kokoza, A. (2022). Natural gas flaring, respiratory health, and distributional effects. *Journal of Public Economics*, 208, 104601. <https://doi.org/10.1016/j.jpubeco.2022.104601>.

⁶² Chen, C., McCabe, D. C., Fleischman, L. E., & Cohan, D. S. (2022). Black carbon emissions and associated health impacts of gas flaring in the United States. *Atmosphere*, 13(3), 385. <https://doi.org/10.3390/atmos13030385>

⁶³ Lara J Cushing et al 2021 Environ. Res. Lett. 16 034032 DOI 10.1088/1748-9326/abd3d4

⁶⁴ Johnston JE, Chau K, Franklin M, Cushing L. Environmental Justice Dimensions of Oil and Gas Flaring in South Texas: Disproportionate Exposure among Hispanic communities. *Environ Sci Technol*. 2020 May 19;54(10):6289-6298. doi: 10.1021/acs.est.0c00410. Epub 2020 May 5. PMID: 32338877; PMCID: PMC8915929.

⁶⁵ Tran, H., Polka, E., Buonocore, J. J., Roy, A., Trask, B., Hull, H., & Arunachalam, S. (2024). Air Quality and Health Impacts of Onshore Oil and Gas Flaring and Venting Activities Estimated Using Refined Satellite-Based Emissions. *GeoHealth*, 8(3), e2023GH000938. <https://doi.org/10.1029/2023GH000938>

⁶⁶ Boslett, A., Hill, E., Ma, L., & Zhang, L. (2021). Rural Light Pollution from Shale Gas Development and Associated Sleep and Subjective Well-Being. *Resource and energy economics*, 64, 101220. <https://doi.org/10.1016/j.reseneeco.2021.101220>

⁶⁷ Energy Information Administration, Office of Oil and Gas. (2007). Natural Gas Compressor Stations on the Interstate Pipeline Network: Developments Since 1996 [Special Report]. U.S. Energy Information Administration. https://www.eia.gov/naturalgas/archive/analysis_publications/ngcompressor/ngcompressor.pdf

⁶⁸ Hendryx, M., & Luo, J. (2020). Natural gas pipeline compressor stations: VOC emissions and mortality rates. *The Extractive Industries and Society*, 7(3), 864–869. <https://doi.org/10.1016/j.exis.2020.04.011>.

result in increased pipeline development and transport⁶⁹, as noted by the Energy Information Administration (EIA) in 2023⁷⁰, and thus more pollution from compressor stations upstream. In essence, US residents in areas near methane gas pipelines and compressor stations will be paying the price of LNG exports with their health.

Pipelines are often sited in areas with existing environmental justice concerns and high social vulnerability indices⁷¹, violate land owner rights, infringe on Indigenous sovereignty⁷², and result in harms to local ecosystems and waterways. Health harms of these pipelines are not just limited to the time of construction because ongoing leaks and shockingly regular explosions⁷³ threaten community health as long as the pipelines are operational.

PUBLIC HEALTH AND HEALTH EQUITY HARMS OF THE LIQUEFACTION PHASE

Methane gas is prepared for export at LNG terminals through energy-intensive⁷⁴ processes. Supercooling methane to -260°F decreases the gas' volume by 600 times⁷⁵, making it easier to store and transport in large quantities. The energy needed to liquefy methane gas often comes from burning methane gas itself, leading to more air, water, and climate pollution. EIA estimates show that about 14% of the LNG "feed gas" is used for liquefaction.⁷⁶

Liquified methane gas is stored in large tanks powered to maintain low temperatures until ultimately loaded onto cryogenic tanker ships for export. Loading and unloading LNG results in fugitive emissions of methane⁷⁷. In addition, LNG terminal operations increase traffic from trucks, commonly fueled by diesel, and large tanker ships powered by fossil fuels. According to a 2024 report by the International Council on Clean Transportation (ICCT), in 2021, LNG

⁶⁹ Zaretskaya, V. (2023, July 31). Natural gas deliveries to U.S. LNG export facilities set a record in first-half 2023. *Today in Energy*. Retrieved from <https://www.eia.gov/todayinenergy/detail.php?id=57261>

⁷⁰ Fleury, K. (2023, December 12). New pipelines will bring significant volumes of natural gas to new LNG export terminals. *Today in Energy*. Retrieved from <https://www.eia.gov/todayinenergy/detail.php?id=61062>

⁷¹ Emanuel, R. E., Caretta, M. A., Rivers III, L., & Vasudevan, P. (2021). Natural Gas Gathering and Transmission Pipelines and Social Vulnerability in the United States. *Geophysical Research Letters*, 48(10), e2021GH000442. <https://doi.org/10.1029/2021GH000442>

⁷² Smithsonian National Museum of the American Indian. (2018). Treaties Still Matter: The Dakota Access Pipeline. Retrieved from <https://americanindian.si.edu/nk360/plains-treaties/dapl>

⁷³ Bureau of Transportation Statistics.. Hazardous Liquid and Natural Gas Pipeline Safety and Property Damage Data. Retrieved from <https://www.bts.gov/content/hazardous-liquid-and-natural-gas-pipeline-safety-and-property-damage-data>

⁷⁴ Cameron LNG. (2018). Natural Gas and the Liquefaction Process. Retrieved from <https://cameronlng.com/wp-content/uploads/2018/10/Natural-Gas-and-the-Liquefaction-Process-CLNG.pdf>

⁷⁵ U.S. Department of Energy, Office of Fossil Energy and Carbon Management. Liquefied Natural Gas (LNG). Retrieved from <https://www.energy.gov/fecm/liquefied-natural-gas-lng>

⁷⁶ U.S. Energy Information Administration. (2023, July 31). Natural gas deliveries to U.S. LNG export facilities set a record in first-half 2023. Retrieved from <https://www.eia.gov/todayinenergy/detail.php?id=57261>

⁷⁷ Comer, B., Beecken, J., Vermeulen, R., Sturup, E., Paschinger, P., Osipova, L., Gore, K., Delahaye, A., Verhagen, V., Knudsen, B., Knudsen, J., & Verbeek, R. (2024). Fugitive and unburned methane emissions from ships (FUMES): Characterizing methane emissions from LNG-fueled ships using drones, helicopters, and onboard measurements. International Council on Clean Transportation. Retrieved from <https://theicct.org/wp-content/uploads/2023/11/ID-64-%E2%80%93FUMES-ships-Report-A4-60037-FV.pdf>

carriers contributed to “82 percent of methane emissions from international shipping” with cruise ships and container ships at 3% and 2% respectively.⁷⁸

Increased LNG exports will result in increased operations at LNG terminals, and more truck and ship traffic, which will generate climate-damaging methane and air pollutants like PM_{2.5}, PM₁₀, NO_x, VOCs, SO₂, hazardous air pollutants⁷⁹, and cancer-causing diesel-engine exhaust.⁸⁰ The health burden of this cumulative air pollution falls disproportionately on workers and residents in whose neighborhoods these terminals are sited. In Texas, Louisiana, and Oregon, about 38 percent of the people living within three miles of the newly proposed LNG facilities are people of color and Hispanics or Latinos, and 39 percent are low-income.⁸¹

The industry’s claim that exporting our methane gas overseas enhances the nation’s energy security⁸² is a misleading one. In reality, it serves to increase the economic⁸³ and health burdens on US families. Therefore, it is imperative that the DOE finds construction and operation of LNG terminals, and LNG exports not in public interest.

HEALTH AND SAFETY RISKS OF LARGE-SCALE LNG STORAGE AND TRANSPORTATION

Liquefied methane gas, a highly flammable and explosive substance, presents a significant safety and security risk to the communities where its terminals are sited. In 2014, a liquefaction plant in Washington state was the site of a devastating explosion that injured five workers, necessitated a two-mile radius evacuation, and caused \$72 million in damages⁸⁴. Most recently, in June 2022, an explosion at the Freeport LNG plant in Texas rocked the surrounding community⁸⁵. In addition, given the concentration of LNG terminals in the Gulf Coast, concerns have been expressed about the potential for them to be targeted by terrorist activities, risking

⁷⁸ Cho, H. J. (2024, January 10). The International Council on Clean Transportation. Without more action, LNG could pull international shipping off its decarbonization course.<https://theicct.org/lng-could-pull-international-shipping-off-its-decarbonization-course-jan24/>

⁷⁹ Cheniere Corpus Christi Pipeline, L.P. (2014). Final Environmental Impact Statement Corpus Christi LNG Project Corpus Christi Liquefaction, LLC Docket No. CP12-507-000 Cheniere Corpus Christi Pipeline, L.P. Docket No. CP12-508-000 DOE Docket No. FE 12-97-LNG (FERC/EIS-0252F). Retrieved from <https://www.ferc.gov/sites/default/files/2020-05/corpuschristiFEIS.pdf>

⁸⁰ International Agency for Research on Cancer. (2024). List of Classifications: Agents classified by the IARC Monographs, Volumes 1–135. Retrieved from <https://monographs.iarc.who.int/list-of-classifications>

⁸¹ Environmental Integrity Project. (2020, October). Troubled Waters for LNG: The Covid-19 Recession and Overproduction Derail Planned Construction of Liquefied Natural Gas Terminals. Retrieved from <https://environmentalintegrity.org/wp-content/uploads/2020/10/LNG-Report-10.5.20-updated.pdf>

⁸² The Natural Gas Solution, American Petroleum Institute (2024). Increasing America's Energy Security. Retrieved from <https://naturalgassolution.org/increasing-americas-energy-security/>

⁸³ Williams-Derry, C. (2023, November 30). LNG exports have raised natural gas prices for U.S. households. Institute for Energy Economics and Financial Analysis. Retrieved from <https://ieefa.org/resources/lng-exports-have-raised-natural-gas-prices-us-households>

⁸⁴ U.S. Department of Transportation. Pipeline and Hazardous Materials Safety Administration. (2016, April 28). Failure Investigation Report – Liquefied Natural Gas (LNG) Peak Shaving Plant, Plymouth, Washington] https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/docs/FIR_and_APPENDICES_PHMSA_WUTC_Williams_Plymouth_2016_04_28_REDACTED.pdf

⁸⁵ PHMSA, FERC, & USCG. (2023). Freeport LNG Incident and Regulatory Response [Presentation slides]. Retrieved from https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2023-02/PHMSA-FERC-USCG%20Feb%2011%202023%20Freeport%20Information%20Session%20Presentation%20%28002%29_0.pdf

national security⁸⁶. Ironically, because of climate damage from burning fossil fuels, the Gulf Coast is at risk of severe hurricanes. These hurricanes pose a risk not only to LNG infrastructure, but also to the communities in which they are built⁸⁷.

PUBLIC HEALTH AND HEALTH EQUITY HARMS OF CLIMATE CHANGE

One of the final phases of the LNG life cycle is the combustion of methane gas, which produces air pollution and greenhouse gas emissions that worsen the damage to our global climate. The US does not count emissions from fossil fuel exports towards our national greenhouse gas inventory⁸⁸. However, no matter where they are generated, these emissions and the resulting global climate change hurt the health of the American public, and thus need to be taken into consideration by the DOE when determining public interest.

Climate change is already impacting the physical and mental health of Americans through more common and severe extreme heat, wildfires, hurricanes, and drought. As health professionals, we are currently caring for patients suffering these impacts and those of poor air quality, allergies, and changing patterns of infectious diseases across the country. According to the Fifth National Climate Assessment, *“Climate-related hazards will continue to grow, increasing morbidity and mortality across all regions of the US (very likely, very high confidence).”*⁸⁹ The Lancet Countdown on Health and Climate Change warns that climate change will deepen existing inequities⁹⁰. For example, according to the EPA, *“Black and African American individuals are 40% more likely than non-Black and non-African American individuals to currently live in areas with the highest projected increases in mortality rates due to climate-driven changes in extreme temperatures.”*⁹¹

2023 was the hottest summer since temperature record keeping began 174 years ago⁹². In 2022, average US summer temperatures were 2.3°F hotter compared to 1986-2005. While this change might seem small, among adults 65 years and older, when compared to 2000-2004, heat-related mortality increased 88% in 2018-2022. Without climate change-induced temperature increases, heat-related mortality would have been expected to increase 25% across the same period, according to the 2023 Lancet Countdown U.S. Policy Brief. The

⁸⁶ Zhu, R., Hu, X., Bai, Y., & Li, X. (2021). Risk analysis of terrorist attacks on LNG storage tanks at ports. *Safety Science*, 137, 105192. <https://doi.org/10.1016/j.ssci.2021.105192>.

⁸⁷ Lee, M. (2022, June 8). U.S. LNG surge may have a flood problem. *Energywire*. Retrieved from <https://www.eenews.net/articles/u-s-lng-surge-may-have-a-flood-problem/>

⁸⁸ Intergovernmental Panel on Climate Change. (2006). IPCC Guidelines for National Greenhouse Gas Inventories. Retrieved from <https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>

⁸⁹ Hayden, M.H., Schramm, P.J., Beard, C.B., Bell, J.E., Bernstein, A.S., Bieniek-Tobasco, A., Cooley, N., Diuk-Wasser, M., Dorsey, M.K., Ebi, K.L., Ernst, K.C., Gorris, M.E., Howe, P.D., Khan, A.S., Lefthand-Begay, C., Maldonado, J., Saha, S., Shafiei, F., Vaidyanathan, A., & Wilhelmi, O.V. (2023). Ch. 15. Human health. In A.R. Crimmins, C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, & T.K. Maycock (Eds.), Fifth National Climate Assessment. U.S. Global Change Research Program. <https://doi.org/10.7930/NCA5.2023.CH15>

⁹⁰ Costello, A., Abbas, M., Allen, A., et al. (2009). Managing the health effects of climate change. *Lancet*, 373, 1693-1733.

⁹¹ EPA. 2021. Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts.

U.S. Environmental Protection Agency, EPA 430-R-21-003. www.epa.gov/cira/social-vulnerability-report

⁹² NOAA National Centers for Environmental Information. (2024, January 17). 2023 was the warmest year in the modern temperature record. Climate.gov. Retrieved from <https://www.climate.gov/news-features/featured-images/2023-was-warmest-year-modern-temperature-record>

monetized value of these heat-related deaths was estimated to be more than \$11 billion. In 2022, \$81 billion were lost in potential income in the US from reduced labor⁹³.

Climate change also degrades air quality. Allergy season is starting earlier, lasting longer, and is more severe⁹⁴. On hot days, pollutants in stagnated air create ground-level ozone⁹⁵, which impacts lung health as described above, cutting into the air quality improvements made by the Clean Air Act. In 2023, over 100 million Americans⁹⁶ were exposed to unhealthy air quality due to Canadian wildfire smoke, with a 17% higher than expected emergency room visits for asthma attacks⁹⁷ between April-August 2023, illustrating the global nature of climate change and its health impacts on Americans.

Climate change is creating conditions more favorable for the transmission of infectious diseases. Increased abundance of ticks, in part due to warmer winters, is likely to increase the number of Lyme disease cases and other tick-borne illnesses⁹⁸. Valley fever is projected to spread north due to worsening drought⁹⁹ while *Vibrio vulnificus* or “flesh-eating bacteria” are thriving in warmer ocean waters, with 44.4% more of the US coastline favorable to their growth in 2022 than in 1982-2010¹⁰⁰.

Mental health impacts of climate change are being increasingly recognized as well. These range from anxiety, depression, and post-traumatic stress disorder reported during and after extreme weather events to climate anxiety reported by young people. Mental health impacts are felt disproportionately by Indigenous communities who are connected to the land¹⁰¹.

⁹³ Beyeler, N. S., Knappenberger, P., Hess, J. J., & Salas, R. N. (2023). 2023 Lancet Countdown on Health and Climate Change Policy Brief for the United States of America (Lancet Countdown U.S. Policy Brief). London, United Kingdom: Lancet Countdown. Retrieved from

https://www.lancetcountdownus.org/wp-content/uploads/2023/11/2023-Lancet-Countdown-U.S.-Brief_v1.pdf

⁹⁴ Anderegg, W. R. L., Abatzoglou, J. T., Anderegg, L. D. L., Bielory, L., Kinney, P. L., & Ziska, L. (2021). Anthropogenic climate change is worsening North American pollen seasons. *Proceedings of the National Academy of Sciences of the United States of America*, 118(7), e2013284118. <https://doi.org/10.1073/pnas.2013284118>

⁹⁵ American Lung Association. (2024, April 17). What Makes Air Unhealthy: Ozone. Retrieved from <https://www.lung.org/clean-air/outdoors/what-makes-air-unhealthy/ozone>

⁹⁶ National Centers for Environmental Information. (2024, January 12). Assessing the U.S. Climate in 2023. <https://www.ncei.noaa.gov/news/national-climate-202312>

⁹⁷ McArdle, C. E., Dowling, T. C., Carey, K., et al. (2023). Asthma-associated emergency department visits during the Canadian wildfire smoke episodes - United States, April-August 2023. *MMWR. Morbidity and Mortality Weekly Report*, 72, 926–932.

⁹⁸ Hayden, M.H., P.J. Schramm, C.B. Beard, J.E. Bell, A.S. Bernstein, A. Bieniek-Tobasco, N. Cooley, M. Diuk-Wasser, Michael K. Dorsey, K.L. Ebi, K.C. Ernst, M.E. Gorris, P.D. Howe, A.S. Khan, C. Lefthand-Begay, J. Maldonado, S. Saha, F. Shafiei, A. Vaidyanathan, and O.V. Wilhelmi, 2023: Ch. 15. Human health. In: *Fifth National Climate Assessment*. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. <https://doi.org/10.7930/NCA5.2023.CH15>

⁹⁹ Gorris, M.E., J.E. Neumann, P.L. Kinney, M. Sheahan, and M.C. Sarofim, 2021: Economic valuation of coccidioidomycosis (Valley fever) projections in the United States in response to climate change. *Weather, Climate, and Society*, 13 (1), 107–123. <https://doi.org/10.1175/wcas-d-20-0036.1>

¹⁰⁰ Beyeler, N. S., Knappenberger, P., Hess, J. J., & Salas, R. N. (2023). 2023 Lancet Countdown on Health and Climate Change Policy Brief for the United States of America (Lancet Countdown U.S. Policy Brief). London, United Kingdom: Lancet Countdown. Retrieved from https://www.lancetcountdownus.org/wp-content/uploads/2023/11/2023-Lancet-Countdown-U.S.-Brief_v1.pdf

¹⁰¹ Clayton, S., Manning, C. M., Speiser, M., & Hill, A. N. (2021). Mental Health and Our Changing Climate: Impacts, Inequities, Responses. Washington, D.C.: American Psychological Association, and ecoAmerica. <https://www.apa.org/news/press/releases/mental-health-climate-change.pdf>

PUBLIC HEALTH AND HEALTH EQUITY HARMS OF ORPHAN WELLS

Methane gas companies leave behind toxic legacies. Over 4.6 million people live within less than a mile of orphaned wells with more Hispanic/Latinos and Native Americans living in close proximity to these wells compared to the national average. 35% of orphan wells are located within less than 1 mile of a domestic groundwater well¹⁰². Abandoned wells continue to release methane and CO₂ contributing to climate change, with the latest EPA estimates showing 1.9 million metric tons of CO₂-e released in 2022¹⁰³, equivalent to emissions from the operation of five methane gas power plants in one year or over 450,000 cars being driven for a year¹⁰⁴. It's crucial to include this in the life cycle climate impacts when considering LNG exports. In addition, these orphaned wells continue to release toxic air pollution containing volatile organic compounds¹⁰⁵ like benzene, which are cancer-causing and can act as precursors of ground-level ozone that impacts lung health. More LNG exports, thus more fracking, will only lead to more orphan wells, further impacting the health and wellbeing of Americans.

PUBLIC HEALTH AND HEALTH EQUITY HARMS OF CARBON CAPTURE AND STORAGE

The oil and gas industry is now trying to greenwash LNG as a carbon-neutral¹⁰⁶ fuel by adding carbon capture and sequestration to their operations. However, so far, CCS has yet to be successful in its stated aim¹⁰⁷. Even in the hypothetical scenario that CCS were to somehow capture all CO₂ emissions from the LNG life cycle in an economically-feasible, scalable, and timely manner, this would not mitigate the climate damage caused by methane gas released during venting, flaring, leaks, and orphan wells as described above. Neither would it address any of the health and justice impacts to the American public that have been highlighted throughout this letter.

In fact, a health modeling study from Stanford showed that in the scenario where CCS is used on a fossil fuel-powered plant, social costs and air pollution increase¹⁰⁸ when compared to the transition to renewable energy-powered plants. These increased health harms of air pollution

¹⁰² Mary Kang et al 2023 Environ. Res. Lett. 18 074012 DOI 10.1088/1748-9326/acdae7

¹⁰³ EPA (2024) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022. U.S. Environmental Protection Agency, EPA 430-R-24-004.

<https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2022>.

¹⁰⁴ Environmental Protection Agency. (2024, January). Greenhouse Gas Equivalencies Calculator. Retrieved from <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results>

¹⁰⁵ DiGiulio, D. C., Rossi, R. J., Lebel, E. D., Bilsback, K. R., Michanowicz, D. R., & Shonkoff, S. B. C. (2023). Chemical Characterization of Natural Gas Leaking from Abandoned Oil and Gas Wells in Western Pennsylvania. *ACS Omega*, 8(22), 19443–19454. <https://doi.org/10.1021/acsomega.3c00676>

¹⁰⁶ Maramba, T. (2023, July 12). Decarbonized LNG: Making Energy Security and Net Zero Goals Possible. Fluor. Retrieved from <https://newsroom.fluor.com/featured-stories/blog-details/2023/Decarbonized-LNG-Making-Energy-Security-and-Net-Zero-Goals-Possible/default.aspx>

¹⁰⁷ Gibbons, B. (2024, April 25). In Illinois, a massive taxpayer-funded carbon capture project fails to capture about 90 percent of plant's emissions. Oil and Gas Watch. Retrieved from <https://news.oilandgaswatch.org/post/in-illinois-a-massive-taxpayer-funded-carbon-capture-project-fails-to-capture-about-90-percent-of-plants-emissions>

¹⁰⁸ Jacobson, M. Z. (2019). The health and climate impacts of carbon capture and direct air capture. *Energy & Environmental Science*, 12, 3567. <https://doi.org/10.1039/c9ee02709b>

will be localized and inequitably¹⁰⁹ fall on the predominantly Black, Indigenous, and low-income communities who are on the frontlines of the polluting LNG industry infrastructure.

Once captured, CO₂ is converted to a liquid and transported via pipelines. This CO₂ is then injected underground in storage wells or used to drill for oil and gas through a technique called enhanced oil recovery (EOR). Currently, over 80% of the captured CO₂ is used in EOR, ensuring not only ongoing reliance on fossil fuels but also suffering from health impacts of air pollution.¹¹⁰

Communities across the US are already seeing additional health harms from the rapidly growing carbon capture infrastructure. For example, in 2020, Denbury Enterprises' Delta pipeline experienced a sudden rupture and release of CO₂ gas near Satartia, Mississippi leading to 49 individuals being hospitalized for CO₂ poisoning¹¹¹. CO₂ is odorless, colorless, heavier than air, and displaces oxygen. This means that people, pets, and all living things around the leak are at risk of being choked to death. Satartia was not a one-off incident; residents of Sulphur, LA, were asked to shelter in place on April 3, 2024¹¹², because of a leak in a high-pressure CO₂ line. In addition, from 2007-2016, several incidents of CO₂ storage well blowouts impacted residents in neighboring communities, such as when a school in Wyoming was forced to close¹¹³ and houses evacuated due to leakage of CO₂ from a storage site 2016.

CONCLUSION

The Department of Energy should include the extensive body of peer-reviewed scientific evidence about the public health and health equity harms of each component of the LNG life cycle in your public interest determination analyses.

¹⁰⁹ Beyeler, N. S., DeJarnett, N. K., Lester, P. K., Hess, J. J., & Salas, R. N. (2022). 2022 Lancet Countdown on Health and Climate Change Policy Brief for the United States of America. Lancet Countdown U.S. Policy Brief, London, United Kingdom.

¹¹⁰ Zero Carbon Analytics. (2024, February). A closer look at CCS: Problems and potential. Retrieved from https://zerocarbon-analytics.org/wp-content/uploads/2024/02/2024-02-A-closer-look-at-CCS_-Problems-and-potential-1.pdf

¹¹¹ Zegart, D. (2021, August 26). The Gassing Of Satartia. HuffPost. Retrieved from https://www.huffpost.com/entry/gassing-satartia-mississippi-co2-pipeline_n_60ddea9fe4b0ddef8b0ddc8f

¹¹² Lakhani, N. (2024, April 19). 'Wake-up call': pipeline leak exposes carbon capture safety gaps, advocates say. The Guardian. Retrieved from <https://www.theguardian.com/us-news/2024/apr/19/exxon-pipeline-leak-carbon-capture-safety-gaps>

¹¹³ Joyce, S. (2016, November 5). What Happened In Midwest? The Mysterious Gas Leak That Shuttered A School. Inside Energy. Retrieved from <https://insideenergy.org/2016/11/05/what-happened-in-midwest-the-mysterious-gas-leak-that-shuttered-a-school/>

