June 10, 2020

COMMENTS ON THE CALIFORNIA GEOLOGIC ENERGY MANAGEMENT DIVISION PUBLIC HEALTH NEAR OIL AND GAS RULEMAKING

Submitted to:

California Department of Geologic Energy Management Division
Department of Conservation
801 K Street, MS 24-02
Sacramento, CA 95814
ATTN: Public Health Near Oil & Gas Rulemaking
CalGEMRegulations@conservation.ca.gov

Submitted by the following Last Chance Alliance Organizations:

Center for Biological Diversity
350.org
Alliance of Nurses for Healthy Environments
Climate Hawks Vote
The Climate Center
Consumer Watchdog
Earthjustice
Earthworks
Food and Water Action
Friends of the Earth
Greenpeace
Mothers Out Front
Rootskeeper
San Diego 350
SoCal 350 Climate Action
Sunflower Alliance

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I. Introduction and Summary

The undersigned organizations respectfully submit these comments regarding the California Geologic Energy Management Division's (CalGEM) forthcoming health and safety regulations addressing the harms from oil and gas activity. Our organizations are members of the Last Chance Alliance, formed to address the ongoing climate, health, and environmental justice emergency caused by the oil and gas industry in California. Last Chance Alliance members are environmental, health, justice, faith, labor, community, parent, and consumer organizations calling on California's elected leaders to stop new fossil fuel development, phase out existing oil and gas production through a just transition, and immediately implement a health and safety buffer zone between oil and gas activities and where people live, work, and go to school.

These comments supplement the June 10, 2020 comment letter filed by organizations with Voices in Solidarity against Oil in Neighborhoods (VISIÓN), which we support and incorporate by reference.

California's oil and gas production pollutes the air we breathe with known cancer-causing chemicals like benzene, formaldehyde, and cadmium[1]; ozone-forming chemicals like nitrogen oxides, volatile organic compounds, and methane[2]; and particulate matter including diesel exhaust and silica dust that cause lung and heart problems.[3]

Research has found that people living near drilling sites have a higher risk for developing cancer[4] increased asthma attacks,[5] higher hospitalization rates,[6] and more upper respiratory problems and rashes.[7] Among pregnant women, living closer to drilling sites is associated with a

[1] California Council on Science Technology, An Independent Scientific Assessment of Well Stimulation in California Volume II: Potential Environmental Impacts of Hydraulic Fracturing and Acid Stimulation (July 2015) ("CCST Study") at 409-410, *available at* https://ccst.us/reports/an-independent-scientific-assessment-of-well-stimulation-in-california-volume-2/.
[2] *Id.* at 186.
[3] *Id.* at 46, 187.
[4] McKenzie, Lisa M. et al., Ambient nonmethane hydrocarbon levels along Colorado's Northern Front Range: Acute and chronic health risks, 52 Environmental Science and Technology 4514 (2018).
[5] Rasmussen, Sara G. et al., Association Between Unconventional Natural Gas Development in the Marcellus Shale and Asthma Exacerbations, 176 JAMA Internal Medicine 9 (2016).
[6] Jemielita, Thomas et al., Unconventional Gas and Oil Drilling Is Associated with Increased Hospital Utilization Rates, 10 PLoS ONE 8: e0137371 (2015).
[7] Rabinowitz, Peter M. et al., Proximity to Natural Gas Wells and Reported Health Status: Results of a Household Survey in Washington County, Pennsylvania, 123 Environmental Health Perspectives 1 (2015).

higher risk of having babies with birth defects,[8] premature births and high-risk pregnancies,[9] and low- birthweight babies.[10]

Many Californians living near active oil and gas wells suffer from terrible symptoms such as nosebleeds, headaches, and worsened asthma.[11]

In 2015, the California Council on Science and Technology completed a statewide scientific study on the harms and risks of fracking. The CCST's scientific panel found that air pollution from all phases of oil and gas production (not just fracking) threatens public health. **The CCST panel recommended that health and safety buffers be instituted around all oil and gas wells to protect against the grave health risks from these exposures.**[12] The CCST found that the most significant exposures to toxic air contaminants such as benzene occur within a half mile of active oil and gas development.[13] As detailed below, **the scientific support for the immediate implementation of a health buffer of at least 2,500 feet is overwhelming.**

CalGEM's forthcoming regulations must provide long-overdue protection through a health and safety buffer of at least 2,500 feet. The front-line communities that have long suffered an unfair and disproportionate burden from fossil fuel production ―and all affected Californians―have waited long enough.

Moreover, the COVID-19 pandemic has shown just how deadly oil industry pollution is and has made the need for protection all the more urgent. Multiple studies have found that exposure to higher amounts of air pollution also increases a population's vulnerability to the coronavirus. A major study of air pollution and COVID-19 mortality in the United States found that exposure to even a small increase in fine particulate matter ($PM_{2.5}$) was linked to an 8% greater chance of dying from COVID-19.[14] Five additional major studies linking air pollution and higher COVID-19 death rates are discussed below.

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[8] McKenzie, Lisa M. et al, Ambient Non-Methane Hydrocarbon Levels Along Colorado's Northern Front Range: Acute and Chronic Health Risks, 52 Environmental Science & Technology 8 (2018)
[9] Casey, Joan A., Unconventional Natural Gas Development and Birth Outcomes in Pennsylvania, USA, 27 Epidemiology 2 (2016).
[10] Tran, Kathy V. et al., Residential Proximity to Oil and Gas Development and Birth Outcomes in California: A Retrospective Cohort Study of 2006-2015 Births, 128 Environmental Health Perspectives 6 (June 2020) ("Tran 2020"), https://ehp.niehs.nih.gov/doi/full/10.1289/EHP5842; Stacy, Shaina L. et al., Perinatal Outcomes and Unconventional Natural Gas Operations in Southwest Pennsylvania, 10 PLoS ONE 6 (2015).
[11] CCST Study at 417-420; Shamasunder, B. et al., Community-Based Health and Exposure Study around Urban Oil Developments in South Los Angeles, International Journal of Environmental Research and Public Health, 15 Int'l J. of Envtl. Res. of Pub. Health 1 (2018).
[12] CCST Study at 433.
[13] CCST Study at 414.
[14] Wu, Xiao et al., Exposure to air pollution and COVID-19 mortality in the United States, medRxiv (April 5, 2020) ("Xiao 2020"), https://doi.org/10.1101/2020.04.05.20054502; see also Friedman, Lisa, *New Research Links Air Pollution to Higher Coronavirus Death Rates,* N.Y.Times, April 17, 2020, https://www.nytimes.com/2020/04/07/climate/air-pollution-coronavirus-covid.html.

Californians breathe some of the dirtiest air in the nation. The top five oil-producing counties in California (Kern, Los Angeles, Ventura, Monterey, and Fresno) each received an 'F' grade for particle pollution air quality in the American Lung Association's 2020 State of the Air report.[15] The two largest oil and gas-producing regions in California are in the San Joaquin and South Coast air basins, which are classified as "extreme" nonattainment areas for ozone.[16]

Oil and gas production emits significant amounts of $PM_{2.5}$, nitrogen oxides, and other types of air pollution that are making communities overburdened by pollution even more vulnerable. For example, a Kern County forecast found that by 2035 the oil and gas industry would be the biggest source of NOx in the county, accounting for 70% of all emissions.[17]

The toxic air pollution emitted from oil and gas production is an unacceptable danger to nearby communities, and Californians desperately need a health buffer to reduce the harm and risks from these pollutants. The health and safety buffer is further needed to address the additional dangers discussed below including water contamination, explosions and other acute hazards, and climate change.

First and foremost, the health and safety regulations must include **a mandatory setback of at least 2,500 feet between all types of oil and gas activity and sensitive receptors such as homes, schools, and hospitals.**

We emphasize that 2,500 feet is a **minimum** distance for the setback. A 2,500 foot setback is on the lower end of the range of distances where research has determined harmful health and quality of life impacts from toxic emissions and exposures can occur. Many studies support a much larger setback distance.[18] We urge you to follow the recommendations of public health experts, independent scientists, environmental organizations, and most of all, communities that continue to be most harmed by oil and gas pollution by adopting a setback adequate to protect public health and safety.

In addition to moving forward with a regulation to implement a science-based setback, CalGEM should immediately stop issuing new permits within the setback that would allow extended and

[15] American Lung Association, State of the Air 2020 (2020), http://www.stateoftheair.org/assets/SOTA-2020.pdf.
[16] Long, Jane C.S. et al., *Chapter 1: Introduction*, California Council on Science and Technology, An Independent Assessment of Well Stimulation in California Volume II: Potential Environmental Impact of Hydraulic Fracturing and Acid Stimulations (July 2015) at 44.
[17] Kern County Planning and Community Development Department, Final Environmental Impact Report for the Revisions to the Kern County Zoning Ordinance – 2015 (C) Focused on Oil and Gas Permitting, SCH #2013081079 (Nov. 9, 2015) ("Kern EIR") at 4.3-120, Table 4.3-42.
[18] Shonkoff, Seth B.C. et al., Human Health and Oil and Gas Development: A review of the Peer-reviewed Literature and Assessment of Applicability to the City of Los Angeles, PSE Health Energy (2019) ("Shonkoff 2019"); Wong, Nicole J., Existing Scientific Literature on Setback Distances from Oil and Gas Development Sites, Stand Together Against Neighborhood Drilling Los Angeles (June 2017) ("Wong") at 1.

expanded oil and gas operations close to sensitive receptors and prolong exposure to dangerous pollution.

Finally, CalGEM's health and safety regulations must begin phasing out existing oil and gas operations within the health and safety buffer. Setbacks will not adequately protect public health and safety if existing operations are allowed to continue indefinitely. California must begin rapidly reducing the number of wells operating near sensitive receptors.

These measures would improve the health and safety of communities overburdened by pollution, reduce medical costs associated with illness and treatment, kickstart jobs in wellsite remediation, and help the state meet its greenhouse gas reduction targets.

Moreover, these health and safety regulations should be one critical part of broader efforts to phase out fossil fuel extraction in our state. We reiterate our request that state regulators stop issuing permits to drill new wells statewide, and commit to a just transition plan to phase out all existing extraction over time. Prioritizing front-line communities through swift adoption of a health and safety setback is a much-needed, independently supported step in a just transition away from fossil fuels and toward a safe, sustainable, and just future.

II. Background

A. Oil and Gas in California

With more than 107,000 oil and gas wells, California is one of the nation's top oil-extracting states. The closer people live to oil and gas wells, the more likely they will be exposed to toxic air contaminants and the more elevated their risk of associated health effects.[19] Because of the close proximity between oil and gas wells and sensitive receptors, communities have long suffered from illnesses caused by exposure to the pollution.

Approximately 5.4 million Californians live within a mile of at least one oil or gas well, and 850,000 live within 2,500 feet of at least one well.[20] In Kern County, about 4,120 active oil and gas wells are within 2,500 of a sensitive receptor such as a home, school, daycare facility, senior center, healthcare facility, or playground.[21] In Los Angeles, about 1.7 million people live within 1 mile of an active oil or gas well, and of that group, more than 32,000 people live within 100 m

[19] Wong at 1.
[20] Ferrar, Kyle, Impact of a 2,500' Oil and Gas Well Setback in California, FracTracker Alliance (July 2, 2019) ("Ferrar 2019"), https://www.fractracker.org/2019/07/impact-of-a-2500-oil-and-gas-well-setback-in-california/.
[21] FracTracker Alliance, Kern County: Oil and Gas Activities by the Number, Informational table (May 28, 2019) ("Informational Table"), https://www.fractracker.org/a5ej20sjfwe/wp-content/uploads/2019/07/Kern-County-Active-Oil-and-Gas-Wells-Table_5_28_19_CTquestions_KFedits.pdf.

(about 328 feet) of an oil or gas well.[22] Statewide, approximately 9,835 active wells—13.1 percent of all active wells in the state—fall within 2,500 feet of a sensitive receptor.[23]

Wells are disproportionally located in low-income and communities of color already suffering from some of the worst air quality in the nation. Of the statewide population living within one mile of oil and gas development and in communities identified as most vulnerable by CalEPA's CalEnviroScreen 2.0, nearly 92 percent are people of color (69 percent Hispanic/Latino, 10 percent African American, 11 percent Asian, and 2 percent Other).[24] In Kern County, there are 16,690 active oil and gas production wells (roughly a quarter of all active wells in Kern) located in census blocks with median household incomes of less than 80% of Kern's area median income (AMI). By one estimate, 5,229 active, idle, and newly permitted wells are located within 2,500 feet of sensitive receptors in low-income communities.[25]

Oil and gas production involves the use of hundreds different types of chemicals, used at every step of the production process, including drilling, fluid injection, well stimulation, well maintenance, enhanced oil recovery, venting, flaring, waste disposal, transportation, and fugitive emissions. Harmful chemicals are used in drilling fluids, acids, well cleanout fluids, well stimulation fluids, breakers, proppants, gelling agents, biocides, carriers, and crosslinkers.[26] There is no doubt that these dangerous operations pose a threat to the health and safety to nearby communities.

California's oil is some of the dirtiest on the planet. Three-quarters of oil produced in California is as climate-damaging as notorious Canadian tar sands crude.[27] Energy-intensive extraction methods such as cyclic steam injection and hydraulic fracturing are commonly used and increase the pollution and safety risks associated with oil and gas production.

California has also experienced countless spills, leaks, and accidents resulting from fossil fuel production. Recent large-scale spills demonstrate the dangers of oil and gas production. In 2019, a massive spill in Kern County released 1.3 million gallons of oil and waste fluid, contaminating soil, harming wildlife and emitting dangerous gases into the air. This release was just one of many occurring in 2019, including one spill that had been activating on and off for about 15

[22] Wong at 1.
[23] Ferrar 2019.
[24] Natural Resources Defense Council, Drilling in California: Who's at risk? (October 2014).
[25] Ferrar (2019), Informational Table at 2.
[26] Stringfellow, William T. et al., Identifying chemicals of concern in hydraulic fracturing fluids used for oil production, 220 Environmental Pollution, 413 (2017).
[27] Wolf, Shaye and Kassie Siegel, Oil Stain: How Dirty Crude Undercuts California's Climate Progress (November 2017); Gordon, Deborah & Samuel Wojcicki, Need to Know: The Case for Oil Transparency in California, Carnegie Endowment for International Peace (March 15, 2017), *available at* http://carnegieendowment.org/2017/03/15/need-to-know-case-for-oil-transparency-in-california-pub-68166.

years, cumulatively releasing 85 million gallons of oil and waste fluid.[28] In 2019, 13 spills were reported in the Cymric oil field alone.[29] In 2015 the Plains All American pipeline Line 901, which runs along the Gaviota Coast in southern Santa Barbara County, ruptured on May 19, 2015, and spilled about 142,000 gallons of crude oil onto the shoreline and into the ocean.[30] This year, a truck carrying crude oil overturned and spilled 6,000 gallons of oil into the Cayuma River, which flows into the Twitchell Dam and reservoir.[31]

High chronic rates of accidents illustrate that spills are unavoidable. According to the Office of Emergency Services, between January 2009 and December 2014, a total of 575 produced water spills and thirty-one chemical spills were reported in California.[32] Moreover, nearly eighteen percent of produced water spills and ten percent of chemical spills affected waterways.[33] There were thirty-one chemical spills in oil fields, nine of them acid spills.[34] One acid spill ruptured beyond a secondary containment apparatus and spilled 5,500 gallons of hydrochloric acid.[35] The number of incidents reported is likely smaller than the number of actual spills and leaks, either because they have not been discovered, or operators have not reported them.

Wastewater disposal has also caused significant environmental damage. California's wastewater contains benzene, radioactive materials, and other harmful substances that have contaminated groundwater near disposal sites. CalGEM has also allowed thousands of wastewater disposal wells to inject directly into aquifers that should have been protected under the federal Safe Drinking Water Act.[36] Despite acknowledging the error years ago, many disposal wells continue to inject wastewater into protected aquifers.[37]

Californians also face health and safety risks from the toxic legacy of past oil and gas projects. An independent scientific study found that there are thousands of deserted "orphan" wells and

[28] California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Oil Field Surface Expressions Database, Chevon Cymric Oil Spill, https://www.conservation.ca.gov/calgem/Pages/Chevron-Cymric-oil-spill.aspx (last visited May 2, 2020).
[29] *Ibid*.
[30] Magnoli, Giana, Plains *All American Pipeline Faces 46 Criminal Charges in Refugio Oil Spill*, Noozhawk, May 17, 2016, https://www.noozhawk.com/article/plains_faces_criminal_charges_in_santa_barbara_countys_refugio_oil_spill.
[31] Associated Press, *Overturned tanker spills 6K gallons of oil near California dam*, Mercury News, March 21, 2020, https://www.mercurynews.com/2020/03/21/overturned-tanker-spills-6k-gallons-oil-near-california-dam/.
[32] CCST Study at 345.
[33] *Id.* at 345.
[34] *Id.* at 127.
[35] *Id*. at 128.
[36] Bohlen, Steve, State Oil and Gas Supervisor, California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Letter to Jane Diamond, Director, Water Division, U.S. EPA Region IX, re: Class II Oil and Gas Underground Injection Control (Feb. 6, 2015).
[37] Wilson, Janet, *Proposal Would Allow Oil Companies Keep Injecting Wastewater into Kern County Aquifers*, Desert Sun, Aug. 20, 2019, https://www.desertsun.com/story/news/environment/2019/08/20/california-oil-injection-wells-aquifers-water-supplies-environment/1807384001/.

more than 17,000 long-term idle wells in California.[38] These unattended wells can act as conduits for gas and fluids to migrate into groundwater or collect at the surface, causing water contamination, toxic air emissions, and explosions.[39] CalGEM acknowledges that deserted and idle wells "present several hazards to the environment as well as public health and safety. Deteriorating wells can create a conduit for contaminants such as hydrocarbons, lead, salt, and sulfates to enter freshwater aquifers and pose potential risks to surface water, air quality, soils and vegetation."[40]

Finally, California's oil and gas production contributes to climate change, which threatens public health and safety in myriad ways, including heat waves, drought, extreme weather events, air quality degradation, vector-borne disease, and more.

B. Rulemaking Background

In a 2015 study of oil and gas operations in California, the California Council of Science and Technology concluded, "The closer citizens are to these industrial [oil and gas] facilities, the higher their potential exposure to toxic air emissions and higher risk of associated health effects."[41] The authors further stated, "Emissions concentrated near all oil and gas production could present health hazards to nearby communities in California."[42] While the study focused on well stimulation, it concluded that risks were attributable to oil and gas generally. For example, benzene emissions occur throughout the extraction process regardless of whether fracking, injection, or any other extreme extraction techniques are employed. Thus, the study recommended a science-based health and safety buffer be implemented to protect health and safety from all types of oil and gas operations.[43]

CalGEM has long had the duty to "prevent, as far as possible, damage to life, health, property, and natural resources."[44] CalGEM must also "protect[ ] public health and safety and environmental quality, including reduction and mitigation of greenhouse gas emissions associated with the development of hydrocarbon and geothermal resources in a manner that meets the energy needs of the state."[45] On November 19, 2019, Governor Newsom announced

[38] California Council on Science and Technology, Orphan Wells in California: An Initial Assessment of the State's Potential Liabilities to Plug and Decommission Orphan Oil and Gas Wells (2020) (CCST Orphan Well Study); California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Idle Well Program Report on Idle & Long-Term Wells in California, Reporting Period: Jan. 1, 2018 to Dec. 31, 2018 (July 2019) ("CalGEM Idle Well Report"), https://www.conservation.ca.gov/calgem/idle_well/Pages/idle-well-program-report.aspx.
[39] CCST Orphan Well Study.
[40] CalGEM Idle Well Report.
[41] CCST Study at 44.
[42] *Id*. at 44.
[43] *Id*. at 46, 433.
[44] Cal. Pub. Res. Code, § 3106(a).
[45] *Id*. at § 3011(a).

that his administration would adopt regulations that would "protect residents and communities near oil and gas extraction sites."[46]

III. Health Impacts of Oil and Gas

A growing body of research demonstrates the adverse health effects caused by a proximity to oil and gas activity. Studies have shown alarming data showing increased public health risks for people living near oil and gas activity, including the following:

- Residents living within a half mile (2,640 feet) of an oil and gas well were at an increased risk of respiratory, neurological, and reproductive health effects, and cancer due to exposure to trimethylbenzenes, xylenes, benzene and hydrocarbons.[47]
- Rates of acute lymphocytic leukemia were higher among children and young adults living near active wells.[48] The authors cited exposure to benzene in the air and in groundwater as potential causes.
- Cancer risks within 500 feet of an oil and gas well increased by 830%.[49]
- There are elevated cancer risks based on air monitoring data collected between 350 and 3,700 feet away from active wells.[50]
- In a new study from California, analyzing nearly 3 million birth certificates in the state, researchers found that newborns in rural areas between 2006 and 2015 were 40% more likely to have a low birth weight if their mother lived within a kilometer of a high-producing oil or gas well.[51] "Being born of low birth weight or small for gestational age can affect the development of newborns and increase their risk of health problems in early childhood and even into adulthood," according to the paper's senior author.[52]
- Additional studies on reproductive harm from oil and gas development include the following: In the San Joaquin Valley, mothers who were exposed to oil and gas pollution were more

[46] California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Press Release: California Announces New Oil and Gas Initiatives (Nov. 19, 2019), https://www.conservation.ca.gov/index/Pages/News/California-Establishes-Moratorium-on-High-Pressure-Extraction.aspx.
[47] McKenzie, Lisa M. et al., Human health risk assessment of air emissions from development of unconventional natural gas resources, 424 Science of the Total Environment, 79 (2012) ("McKenzie 2012").
[48] McKenzie, Lisa M. et al., Childhood Hematologic Cancer and Residential Proximity to Oil and Gas Development, 12 PLoS ONE 2: e0170423 (2017).
[49] McKenzie, Lisa M. et al, Ambient Non-Methane Hydrocarbon Levels Along Colorado's Northern Front Range: Acute and Chronic Health Risks, 52 Environmental Science & Technology 8, 4514 (2018), https://doi.org/10.1021/acs.est.7b05983.
[50] McMullin, Tami S. et al., Exposures and Health Risks from Volatile Organic Compounds in Communities Located near Oil and Gas Exploration and Production Activities in Colorado (U.S.A.), 15 Int'l J. of Envtl. Res. of Pub. Health 7 (2018), https://doi.org/10.3390/ijerph15071500.
[51] Tran 2020.
[52] Manke, Kara, *Living Near Oil and Gas Wells Tied to Low Birth Weight in Infants*, Berkeley News, June 3, 2020, https://news.berkeley.edu/2020/06/03/living-near-oil-and-gas-wells-tied-to-low-birth-weights-in-infants/.

likely to experience preterm births.[53] Mothers who lived near the highest density of active wells were 30 percent more likely to give birth to a child who had congenital heart defects (CHD) and 2 times more likely to give birth to a child with neural tube defects.[54,55] Pregnant women living within one mile of six or more wells reported lower birth weights and higher rates of small size for gestational age.[56] Proximity to wells correlated with increased rates of preterm births and higher risk pregnancies.[57] A study of more than 1.1 million births in Pennsylvania found evidence of a greater incidence of low-birth-weight babies and significant declines in average birth weight among pregnant women living within 3 km of drilling sites.[58] There were significant impacts on birthweights within 1 km (3,281 feet) of active wells.[59] The closer the mother's residence at birth to fracking wells, the more negative are the effects on the infants' birth health.[60] Data showed lower birthweights within 2.5 km (8,202 feet) of an active well. [61] Well density also increased the risk – an additional well drilled within 2.5 km of maternal residence was associated with a 7 percent increase in low birth weight, a 5 g reduction in term birth weight, and a 3 percent increase in premature birth.[62] A study of Texas births and fetal deaths showed a significant link between well distance and density and adverse birth outcomes up to ten miles (52,800 feet away).[63]

- Exposure to oil and gas pollution was associated with higher rates of cardiovascular disease[64] and higher rates of hospitalization.[65]

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[53] Gonzalez, David J.X., Oil and Gas Production and Spontaneous Preterm Birth in the San Joaquin Valley, CA, Environmental Epidemiology 4:e099 (2020).
[54] McKenzie, Lisa M. et al., Birth Outcomes and Maternal Residential Proximity to Natural Gas Development in Rural Colorado, 122 Environmental Health Perspectives 4 (2014).
[55] McKenzie, Lisa M. et al., Congenital heart defects and intensity of oil and gas well site activities in early pregnancy, 12 Environment International (2019).
[56] Stacy, Shaina L. et al., Perinatal Outcomes and Unconventional Natural Gas Operations in Southwest Pennsylvania, 10 PLoS ONE 6 (2015).
[57] Casey, Joan A. et al., Unconventional natural gas development and birth outcomes in Pennsylvania, USA, 27 Epidemiology 2, 163 (2016).
[58] Currie, Janet et al., Hydraulic fracturing and infant health: New evidence from Pennsylvania, 3 Science Advances e1603021 (2017).
[59] *Ibid*.
[60] Apergis, Nicholas et al., Fracking and infant mortality: fresh evidence from Oklahoma, 26 Environmental Science and Pollution Research (2019), https://link.springer.com/article/10.1007/s11356-019-06478-z#ref-CR10.
[61] Hill, Elaine L., Shale gas development and infant health: Evidence from Pennsylvania, 61 Journal of Health Economics, 134 (2018), https://doi.org/10.1016/j.jhealeco.2018.07.004.
[62] *Id*.
[63] Whitworth, Kristina W. et al., Maternal Residential Proximity to Unconventional Gas Development and Perinatal Outcomes Among a Diverse Urban Population in Texas, 12 PloS ONE 7:e0180966 (2017), https://doi.org/10.1371/journal.pone.0180966; Whitworth,, Kristina W. et al., Drilling and Production Activity Related to Unconventional Gas Development and Severity of Preterm Birth, 126 Environmental Health Perspectives 3 (2018), https://doi.org/10.1289/EHP2622.
[64] McKenzie, Lisa M. et al., Relationships between indicators of cardiovascular disease and intensity of oil and natural gas activity in Northeastern Colorado, 170 Environmental Research, 56 (2019), https://doi.org/10.1016/j.envres.2018.12.004.
[65] Jemielita, Thomas et al., Unconventional Gas and Oil Drilling Is Associated with Increased Hospital Utilization Rates, 10 PLoS ONE 8: e0137371 (2015).

- People reported higher rates of asthma within 1,500 feet of two Los Angeles oil production sites.[66] These results align with other studies show higher rates of pediatric asthma hospitalization,[67] asthma exacerbation,[68] and other respiratory illness[69] elsewhere in the country.
- Residents within 1km (3,281 feet) of active wells reported sleep disruption, headache, throat irritation, stress or anxiety, cough, shortness of breath, sinus problems, fatigue, nausea, and wheezing.[70]
- Increased number of reported upper respiratory symptoms and skin conditions among residents who lived less than 1 km (3,280 feet) from an active well when compared with residents who lived more than 2 km (6,561 feet) from an active well.[71]
- Twelve different chemicals of high concern, including benzene, toluene, and naphthalene, were found in urine samples of residents near oil and gas production.[72]

These studies complement others that have found dangerous concentrations of chemicals known to cause adverse human health effects near oil and gas operations, including the following:

- High concentrations of volatile organic compounds, including formaldehyde at 2,591 feet and benzene up to 885 feet away from wells.[73] Benzene, a known human carcinogen, is emitted from nearly all oil and gas development.[74] Dilution rates of even small quantities of benzene, a known human carcinogen, cannot be assumed safe even at 3,000m (9,843 feet).[75]
- People residing within 0.75 km (2,461 feet) of an active well measured elevated levels of exposure to polycyclic aromatic hydrocarbons (PAH).[76]

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[66] Shamasunder, B. et al., Community-Based Health and Exposure Study around Urban Oil Developments in South Los Angeles International Journal of Environmental Research and Public Health 1, 138 (2018), https://doi.org/10.3390/ijerph15010138.
[67] Willis Mary D. et al., Unconventional Natural Gas Development and Pediatric Asthma Hospitalizations in Pennsylvania, 166 Environmental Research, 402 (2018), https://doi.org/10.1016/j.envres.2018.06.022.
[68] Rasmussen, Sara G. et al., Association Between Unconventional Natural Gas Development in the Marcellus Shale and Asthma Exacerbations, 176 JAMA Internal Medicine 9, 1334 (2016).
[69] Rabinowitz, Peter M. et al., Proximity to Natural Gas Wells and Reported Health Status: Results of a Household Survey in Washington County, Pennsylvania, 123 Environmental Health Perspectives 1, 21 (2015).
[70] Weinberger, Beth et al., Health Symptoms in Residents Living Near Shale Gas Activity: A Retrospective Record Review from the Environmental Health Project, 8 Preventive Medicine Reports, 112 (2017), http://www.sciencedirect.com/science/article/pii/S2211335517301353.
[71] Rabinowitz, Peter M. et al., Proximity to Natural Gas Wells and Reported Health Status: Results of a Household Survey in Washington County, Pennsylvania, 123 Environmental Health Perspectives 1, 21 (2015).
[72] Crowe, Elizabeth et al., When the Wind Blows: Tracking Toxic Chemicals in Gas Fields and Impacted Communities, Coming Clean, 28 (2016), https://comingcleaninc.org/wind-blows.
[73] Macey, Gregg P. et al., Air concentrations of volatile compounds near oil and gas production: a community-based exploratory study,13 Environmental Health 1, 82 (2014) ("Macey 2014").
[74] CCST Study 377.
[75] U.S. Environmental Protection Agency, Screening Procedures for Estimating the Air Quality Impact of Stationary Sources Revised: EPA 454/R-92-019 (Oct. 1992); Shonkoff 2019.
[76] Paulik, Blair L., Environmental and Individual PAH exposures near rural natural gas extraction, 241 Environmental Pollution, 397 (2018).

- A study oil and gas found high levels of chemicals with potential to cause hematological (blood) and neurotoxicity impacts out to 2,000 feet.[77]
- Air samples from five different states, showed eight volatile chemicals, including benzene, formaldehyde, hexane, and hydrogen sulfide, exceeded federal limits in a number of instances near oil and gas sites.[78] Residents who collected these air samples reported headaches, dizziness or light-headedness, irritated, burning, or running nose, nausea, and sore or irritated throat.[79]
- Exposures of hydrogen sulfide combined with VOCs produced potentially new harmful exposures that could be detected at distances up to 2 km (6,561 feet).[80]
- A literature survey concluded that "the most significant exposures to toxic air contaminants such as benzene, aliphatic hydrocarbons and hydrogen sulfide occur within 1/2 mile (2,640 ft) from active oil and gas development."[81]
- Elevated levels of endocrine disrupting chemicals in water sources were detected one mile (5,280 feet) away from oil and gas operations with known spills or incidences.[82] The study noted that near contaminated facilities, some of the animals in the area were no longer producing live offspring.

Collectively, numerous studies indicate measurable health impacts at distances greater than 2,500 feet. Shonkoff (2019) found "studies outside of California indicate that the most significant exposures to toxic air contaminants such as benzene, aliphatic hydrocarbons and hydrogen sulfide occur within 1/2 mile (2,640 ft) from active oil and gas development."[83] One study suggested 5,249 feet was the minimum setback distance from dwellings such as schools, hospitals, and other spaces where infants and children may frequent.[84] Many experts conclude that 1 – 1.25 miles is the appropriate setback distance.[85]

[77] ICF, Final Report: Human Health Risk Assessment for Oil & Gas Operations in Colorado, Colorado Department of Public Health and Environment (Oct. 17, 2019).
[78] Macey 2014.
[79] *Id*. at 5.
[80] Haley, Marsha et al., Adequacy of Current State Setbacks for Directional High-Volume Hydraulic Fracturing in the Marcellus, Barnett, and Niobrara Shale Plays, 124 Environmental health perspectives 9, 1323 (2016).
[81] Shonkoff 2019.
[82] Kassotis, Christopher D. et al., Estrogen and Androgen Receptor Activities of Hydraulic Fracturing Chemicals and Surface and Ground Water in a Drilling-Dense Region, 155 Endocrinology 3, 897 (2014).
[83] Shonkoff 2019 at 14.
[84] Webb, Ellen et al., Neurodevelopmental and neurological effects of chemicals associated with unconventional oil and natural gas operations and their potential effects on infants and children, 33 Reviews on Environmental Health 1 (2017).
[85] Greiner, Lydia et al., Environmental Health Project Technical Reports Issue 4: Health and Unconventional Oil & Gas Development: Delphi Study Results, Southwest Pennsylvania Environmental Health Project (Sept. 8, 2016), https://www.environmentalhealthproject.org/sites/default/files/assets/resources/issue-4-health-and-unconventional-oil-gas-development-delphi-study-results.pdf.

High pollution levels also increase the population's vulnerability to other types of risks to health. The COVID-19 pandemic has shown just how deadly oil industry pollution is and has made the need for protection all the more urgent. Multiple studies found that exposure to higher amounts of air pollution also increases a population's vulnerability to the coronavirus. A major study of air pollution and COVID-19 mortality in the United States found that exposure to even a small increase in fine particulate matter ($PM_{2.5}$) was linked to an 8% greater chance of dying from COVID-19.[86]

A second study in Europe found that populations exposed to higher levels of nitrogen dioxide (NO_2) experienced higher rates of mortality during the coronavirus pandemic and concluded "long-term exposure to this pollutant may be one of the most important contributors to fatality caused by the COVID-19 virus in these regions and maybe across the whole world."[87]

A study in England found that higher levels of ozone (O_3), nitrogen oxide (NO), and NO_2 are significantly associated with COVID-19 deaths.[88] Similarly, a study in Italy concluded that air pollution should be considered an additional co-factor in the high level of COVID-19 mortality in Northern Italy, noting that people living in areas with high pollution levels are more likely to develop chronic respiratory conditions and are more vulnerable to infective agents.[89]

Two studies from China found that short term exposure to higher concentrations of air pollutants including $PM_{2.5}$, PM_{10}, CO, NO_2 and O_3 is associated with an increased risk of COVID-19 infection.[90]

Health and safety risks manifest in several ways from oil and gas operations. The adverse health impacts demonstrated in the above studies are consistent with other research finding air emissions and other types of pollution high enough to cause harm. A brief overview of the main types and sources of pollution are listed below, with further support provided in the appendices that follow.

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[86] Xiao 2020; see also https://www.nytimes.com/2020/04/07/climate/air-pollution-coronavirus-covid.html.
[87] Ogen, Yaron, Assessing Nitrogen Dioxide (NO2) Levels as a Contributing Factor to Coronavirus (COVID-19) Fatality, 720 Science of the Total Environment 138605 Adv. Online Pub. (July 15, 2020) ("Ogen 2020"), https://doi.org/10.1016/j.scitotenv.2020.138605.
[88] Travaglio, Marco et al., Links Between Air Pollution and COVID-19 in England, medRxiv (April 28, 2020), https://doi.org/10.1101/2020.04.16.20067405.
[89] Conticini, Edoardo et al., Can Atmospheric Pollution Be Considered a Co-factor in Extremely High Level of SARS-CoV-2 Lethality in Northern Italy?, 261 Environmental Pollution 114465 (June 2020), https://doi.org/10.1016/j.envpol.2020.114465.
[90] Tian, Huaiyu et al., Risk of COVID-19 is Associated with Long-term Exposure to Air Pollution, medRxiv (April 24, 2020), https://doi.org/10.1101/2020.04.21.20073700; Zhu, Yongjian, Association between short-term exposure to air pollution and COVID-19 infection: Evidence from China, 727 Science of the Total Environment (April 2020) https://doi.org/10.1016/j.scitotenv.2020.138704.

A. Air Pollution

Many adverse health impacts are the result of toxic air pollutants emitted from oil and gas operations at every stage of production. Hundreds of chemicals with known human health effects are involved in the production of oil and gas, and those pollutants can travel far from the well to nearby homes and other sensitive receptors.

Californians breathe some of the dirtiest air in the nation. The top five oil-producing counties in California (Kern, Los Angeles, Ventura, Monterey, and Fresno) each received an 'F' grade for particle pollution air quality in the American Lung Association's 2020 State of the Air report.[91] The two largest oil and gas-producing regions in California are in the San Joaquin and South Coast air basins, which are classified as "extreme" nonattainment areas for ozone.[92]

Oil and gas production emits significant amounts of $PM_{2.5}$, nitrogen oxides, and other types of air pollution that are making communities overburdened by pollution even more vulnerable. For example, a Kern County forecast found that by 2035 the oil and gas industry would be the biggest source of NOx in the county, accounting for 70% of all emissions.[93]

The toxic air pollution emitted from oil and gas production is an unacceptable danger to nearby communities, and Californians desperately need a setback to minimize the potential harm from these pollutants. A summary of the sources of pollution and types of toxic air contaminants is provided in Appendix A.

B. Water Contamination

Oil and gas operations put communities that rely on local groundwater in danger. About 85 percent of Californians rely on groundwater for at least some of their water supply, in particular during droughts.[94] In the San Joaquin Valley, groundwater accounts for more than 80 percent of water use during dry years.[95] Oil and gas operations have already contaminated valuable groundwater resources and threaten to degrade even more. The risk of further groundwater contamination provides additional support for a health and safety setback of 2,500 feet or more.

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[91] American Lung Association, State of the Air 2020 (2020), http://www.stateoftheair.org/assets/SOTA-2020.pdf.
[92] Long, Jane C.S. et al., *Chapter 1: Introduction*, California Council on Science and Technology, An Independent Assessment of Well Stimulation in California Volume II: Potential Environmental Impact of Hydraulic Fracturing and Acid Stimulations (July 2015) at 44.
[93] Kern EIR at 4.3-120, Table 4.3-42.
[94] Chappelle, Caitrin et al., Just the Facts: Groundwater in California, Public Policy Institute of California (May 2017), https://www.ppic.org/wp-content/uploads/JTF_GroundwaterJTF.pdf.
[95] Stokstad, Erik, Droughts Exposed California's Thirst for Groundwater, ScienceMag.org (April 16, 2020), https://www.sciencemag.org/news/2020/04/droughts-exposed-california-s-thirst-groundwater-now-state-hopes-refill-its-aquifers.

Spills could occur in a number of ways, including pipeline breaks, haul truck accidents, severe weather (causing overflow of pits or toppling of tanks), and equipment failure or corrosion. Deteriorating wells can create a conduit for contaminants such as hydrocarbons, lead, salt, and sulfates to enter freshwater aquifers and pose potential risks to surface water, air quality, soils and vegetation."[96] A study of groundwater contamination in Ohio found that 41 incidents were caused by leakage from orphaned wells.[97] Deserted and idle wells can leak methane and other gases into the air.[98]

Recent analysis by the USGS has revealed that water supply wells, including wells used for irrigation, contain chemicals that have migrated from oil and gas operations. In one study, for instance, water samples from the Fruitvale and Lost Hills oil field areas were found to contain hydrocarbons like benzene, ethylbenzene, and xylenes.[99] In some cases the levels of benzene, a cancer-causing chemical, were higher than the safe limit for drinking water.[100] In yet another study, samples from multiple water wells were found to contain high levels of radium, a radioactive element often found in oil-industry wastewater.[101] Eighteen percent of water wells sampled near the Fruitvale, Lost Hills, and South Belridge oil fields contained unsafe levels of the radioactive material.[102]

A list of studies demonstrating the harm to water supplies is provided in Appendix B.

C. Health Impacts of Climate Change

Not only does oil and gas affect nearby communities, the greenhouse gases emitted during the drilling, production, transportation, refining, and combustion processes contribute significantly to climate change. Climate change harms public health in many ways.

A 2,500 buffer would help reduce these impacts by ending the expansion of oil and gas within the buffer zone and phasing out existing production activities. If combined with a prohibition on new drilling, the 2,500-foot health and safety buffer around schools and homes would save 425

[96] CalGEM Idle Well Report.
[97] Groundwater Protection Council, State Oil and Gas Agency Groundwater Investigations and Their Role in Advancing Regulatory Reforms – A Two State Review: Ohio and Texas (2011).
[98] Townsend-Small, Amy et al., Emissions of Coalbed and Natural Gas Methane from Abandoned Oil and Gas Wells in the United States, 43 Geophys. Res. Letters 5, 2283 (2016) ("Townsend-Small 2016").
[99] Gillespie, Janice M. et al., Groundwater salinity and the effects of produced water disposal in the Lost Hills—Belridge oil fields, Kern County, California, 26 Environmental Geosciences 3, 73 (2019); Wright, Michael T., Groundwater Quality of a Public Supply Aquifer in Proximity to Oil Development, Fruitvale Oil Field, Bakersfield, California, 106 Applied Geochemistry, 82 (2019).
[100] McMahon, Peter B. et al., Preliminary Results from Exploratory Sampling of Wells for the California Oil, Gas, and Groundwater Program, 2014–15 (2017) ("McMahon 2017").
[101] McMahon, Peter B. et al., Occurrence and Sources of Radium in Groundwater Associated with Oil Fields in the Southern San Joaquin Valley, California, 53 Environmental Science & Technology 16, 9398 (2019) ("McMahon 2019").
[102] *Id*.

million metric tons of $CO2_e$.[103] A collection of references detailing the link between climate change and adverse health impacts is provided in Appendix C.

The oil industry often claims a reduction in California oil production will have minimal or even negative consequences for climate change, based on an unfounded theory that oil supply will be replaced by production outside of California, sometimes called the "perfect replacement theory." Economic studies have demonstrated this is not the case. (See Appendix D.) A reduction in California oil supply results is not replaced by increased production elsewhere. The reduction in oil supply in California results in real reductions in greenhouse gas emissions, and will therefore delivery health benefits to Californians. Multiple courts have struck down agencies' reliance upon the perfect replacement theory.[104] CalGEM must not adopt it here.

D. Explosions and other Catastrophic Hazards

There are also added risks from explosions and similar hazards. Haley et al. (2016) considered the minimum setback distance that would be safe in the event of a blow-out or explosion event at an oil or gas facility. They found that the average evacuation zone for such an event is 0.8 miles, or 4,224 feet, based on historical evacuation data.[105] Setbacks to guard against such hazards are important to consider since accidents have resulted from inadequate setback distances. For instance, on April 17, 2017, a one-inch abandoned pipeline exploded under a home in Firestone, Colorado, killing two people and badly burning a third. The gas well head was located just 178 feet from the home.[106] A proper setback in place could have prevented this tragedy.

Even older, deserted wells that have not been active for years can cause blowouts or even explosions, such as the violent eruption at a construction site in Marina del Rey in January 2019.[107]

E. Noise

[103] Oil Change International, The Sky's Limit California (May 2018), at 23.
[104] *See Wildearth Guardians v. U.S. Bureau of Land Management*, 870 F.3d 1222 (10th Cir. 2017) (calling the perfect replacement theory "irrational (i.e., contrary to basic supply and demand principles.)"; *see also WildEarth Guardians v. Zinke*, 2019 U.S. Dist. LEXIS 30357, at *32 (D. Mont. Feb. 11, 2019).
[105] Haley, Marsha et al., Adequacy of Current State Setbacks for Directional High-Volume Hydraulic Fracturing in the Marcellus, Barnett, and Niobrara Shale Plays, 124 Environmental Health Perspectives 9, 1323 (2016).
[106] Kelly, David, *Deadly House explosion in Colorado traced to uncapped pipe from gas well*, Los Angeles Times, May 2, 2017, http://www.latimes.com/nation/nationnow/la-na-colorado-explosion-20170502-story.html.
[107] Olalde, Mark and Ryan Menezes, *Deserted Oil Wells Haunt Los Angeles with Toxic Fumes and Enormous Cleanup Costs*, Los Angeles Times, March. 5, 2020 ("Olalde 2020"); Johnson, Pamela, *Well Near Berthoud Starts Spilling Drilling Mud 33 Years After It Was Capped*, Denver Post, Oct. 31, 2017 (300 barrels of drilling mud spilled).

Oil and gas operations can cause high levels of noise that may adversely affect nearby sensitive receptors.[108] Drilling and production involve equipment that produce noise exceeding 100 decibels, as evidenced by noise measurements at a Hermosa Beach oil operation.[109] Studies have found non-auditory impacts of noise on health such as annoyance, sleep disturbance, daytime sleepiness, hypertension, cardiovascular disease, and diminished cognitive performance in school children.[110]

IV. Principles of Health and Safety Regulations

CalGEM should adhere to the following set of principles when drafting the health and safety regulations.

A. Precautionary Principle

The regulations must reflect the precautionary principle, which dictates that decision makers err on the side of public health and safety when results are less than certain. In oil and gas operations, there are many unknowns that the regulations will have to account for. Large numbers of chemicals used in oil and gas operations are withheld from the public under dubious claims that they are trade secrets or otherwise confidential.[111] Other chemicals have not yet been tested for their effects on human health. Furthermore, air quality studies may not capture spikes in air pollution or high concentrations of pollutants. Regulations should account for potential harm to exceed data that is captured in studies and publicly available data. If choosing from a range of potential setback distances backed by evidence, for example, CalGEM should adopt the most protective setback distance that accounts for these unknown risks. We reiterate that 2,500 feet is the absolute minimum distance for a health buffer based on the science.

B. Accounting for Vulnerable Populations

The regulations should protect the most vulnerable residents, including children, pregnant women, and the elderly, not the average or most resilient. The CCST recommended setback distances consider vulnerable populations: "The scientific literature is clear that certain sensitive and vulnerable populations (e.g., children, asthmatics, those with pre-existing cardiovascular or respiratory conditions, and populations already disproportionately exposed to elevated air

[108] Allhouse, William B. et al., Community Noise and Air Pollution Exposure During the Development of a Multi-Well Oil and Gas Pad, 53 Environmental Science & Technology 12, 6597 (May 2019), https://doi.org/10.1021/acs.est.9b00052; Blair, Benjamin D. et al., Residential noise from nearby oil and gas well construction and drilling, 28 Journal of Exposure Science & Environmental Epidemiology, 538 (May 2018), https://doi.org/10.1038/s41370-018-0039-8.
[109] CCST Study at 431, table 6.7-2.
[110] *See e.g.*, Basner, Mathias et al., Auditory and non-auditory effects of noise on health, 383 The Lancet 9925, 1325 (2014); Hays, Jake et al., Public Health Implications of Environmental Noise Associated with Unconventional Oil and Gas Development, 580 Science of the Total Environment, 448 (2016).
[111] Shonkoff, Seth B.C. et al., Environmental Public Health Dimensions of Shale and Tight Gas Development, 122 Environmental Health Perspectives 8 (2014) ("Shonkoff 2014").

pollution) are more susceptible to health effects from exposures to environmental pollutants known to be associated with oil and gas development (e.g., benzene) than others. The determination of sufficient setback distances should consider these sensitive populations."[112] The regulations must also account the ways in which air pollution increases COVID-19 related risks, as discussed above.

C. Environmental Justice

Low-income communities and communities of color have suffered disproportionately from the adverse health impacts of oil and gas development. Regulations must address these racial and economic disparities by prioritizing the health and safety of those communities that have historically borne the brunt of the oil and gas industry's harmful legacy. CalGEM should also consider the benefits to communities harmed by refineries and other downstream facilities.

D. Decisions Must Be Based on Science and the Experiences of Impacted Communities

The regulations, including a mandatory setback distance, should be based on science. There is substantial, peer-reviewed, scientific evidence supporting setbacks of at least 2,500 feet. Evidence of adverse health impacts, air pollution, water contamination, and other harms provide ample support for the need for setbacks and other protective measures. In addition, communities experiencing oil and gas impacts in their daily lives should be heard and given due consideration.

Conversely, CalGEM must ignore political pressure from the oil and gas industry to weaken protections. Acceding to industry pressure has resulted in regulations that do not protect health and safety. For example, industry pressure to eliminate the prohibition on injection above the fracture pressure led to numerous large-scale oil spills in the first 12 months since CalGEM legalized the practice at the behest of the oil industry.[113] The problems were so severe that CalGEM then reinstated a moratorium on the practice.[114]

The oil industry will oppose the regulations on the basis of claimed job losses, but protecting public health and protecting California jobs and our economy go hand-in-hand. One California-specific study concluded that there would be major job creation in the state (~5,000 full-time equivalent jobs per year) under a policy scenario that ends approval of new oil wells, phases out existing production within a 2,500-foot health and safety buffer, and replaces the oil cutbacks with new construction of solar power.[115] In addition, CalGEM should use its existing authority to

[112] CCST Study at 433.
[113] Compare Cal. Code Regs. tit. 14, § 1724.10(i) (2018) with § 1724.10.3 (April 1, 2019).
[114] California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Notice to Operators 2020-02, Moratorium on New Approvals of Cyclic Steam Above Fracture Pressure (Jan. 7, 2020), *available at* https://www.conservation.ca.gov/calgem/for_operators/Pages/NoticetoOperator.aspx.
[115] Ackerman, Frank et al., Can Clean Energy Replace California Oil Production?, Synapse Energy Economics, Inc. (July 2018), https://www.synapse-energy.com/sites/default/files/Can-Clean-Energy-Replace-California-Oil-18-012.pdf.

order operators to carry out increased well plugging and remediation work, leading to additional job creation from this needed remediation work.

The oil and gas industry has been in decline for many years in California. The COVID-19 crisis will accelerate this trend, particularly as the economic downturn combines with the industry's history of debt accrual and mismanagement. California oilfield workers already face layoffs, with worse yet to come. The need has never been greater for thoughtful, immediate actions that will lay the groundwork for the future energy transition. We support a just transition for all workers affected by the inevitable decline of oil and gas production in California, and the specific assistance measures detailed in a May 18, 2020 letter to Governor Newsom.[116]

While we support a just transition for workers, we caution that CalGEM must not let inflated claims of job losses or divisive tactics from oil industry executives and their surrogates weaken or delay the urgently needed public health and safety buffer. CalGEM must be clear-eyed about the actual role that oil and gas plays in California employment: oil extraction, drilling, and refining together account for less than 21,000 of the state's more than 14.2 million jobs.[117] This is less than 0.2 percent of total employment. Even in Kern County, by far the most oil-dependent county, the oil and gas industry accounts for fewer than 4,900 jobs out of a total of 252,000, or less than 2 percent.[118] Enacting a health and safety buffer that affects approximately 10 percent of the state's existing oil wells will not lead to the inflated job losses claimed by oil industry spokespeople. By accelerating the pace of well remediation and enacting other just transition policies, the Newsom administration can more than offset any job losses that might be fairly attributed to the implementation of the health buffer.

E. People Over Profits - Objection to Monetizing Health and Lives

Regulatory analyses have a history of undervaluing the public health, safety, and environmental benefits of regulations and overestimating the costs to industry, while attempting to reduce people's health and lives to a monetized figure. Life and health cannot be reduced to one side of a "ledger" and compared against the dollars gained from producing oil. Using cost-benefit analysis alone omits and obscures the true value of life, health, and important benefits pertaining to quality of life that cannot be quantified. When conducting cost benefit analysis for this rulemaking CalGEM must make every effort to include all the benefits of the rule, avoid mistakes that overstate the projected costs to industry, and acknowledge that the value of our lives and health cannot be reduced to dollars and cents.

V. Recommended Regulations

[116] Ninety-Three Organizations, Letter to Governor Gavin Newsom and the California State Legislature re: Protect Workers and Communities, Not Fossil Fuel Polluters (May 18, 2020).
[117] Ackerman 2018 at 6.
[118] *Ibid*.

Based on the best available scientific information, and the principles discussed above, the following provisions must be included in the health and safety regulations.

A. The Health and Safety Regulations Must Include a Setback Distance of at Least 2,500 Feet

CalGEM must use its authority to protect public health and safety under Public Resources Code sections 3011 and 3106 to establish a health and safety buffer zone of no less than 2,500-feet, within which oil and gas operations shall not be permitted.

1. The Setback Should Apply to All Types of Oil and Gas Development

Oil and gas wells pose a threat to public health and safety no matter what type of production technique is employed. Some of the same toxic chemicals are used in drilling, conventional production, and unconventional production.[119] Therefore, the setback should apply to all types of oil and gas operations, including but not limited to any drilling, redrilling, deepening, reworking, sidetracking, well stimulation, and Enhanced Oil Recovery or other injection operations at a well located within 2,500 feet of a sensitive receptor.

2. "Sensitive Receptor" Should Be Defined Broadly

The setback distance should be measured to the nearest sensitive receptor. A sensitive receptor should include any building intended for human occupancy, including but not limited to residences, schools, hospitals, and businesses. Public recreational areas such as parks must be considered a sensitive receptor as well.

3. The Setback Distance Should Be Measured in the Manner Most Protective to Sensitive Receptors

The distance should be measured from the outside edge of the well pad or fence line closest to the sensitive receptor, whichever is greater in distance. The distance from a sensitive receptor should be measured from the point on the property boundary closest to the outside edge of the well pad or fence line. The regulations should ensure that the setback protects sensitive receptors located on the same parcel as oil and gas operations.

4. Regulations Should Clarify that the State Setback Is the Minimum Distance Permitted

Local governments must retain the ability to enact stronger protections at the local level, including banning oil and gas activity altogether if they choose. The regulations should clarify that state regulations do not preempt local land use authority or police power to ban or regulate the conduct and location of oil and gas activities, including but not limited to zoning, fire

[119] Stringfellow, William T. et al., Comparison of chemical-use between hydraulic fracturing, acidizing, and routine oil and gas development, 12 PloS ONE 4: e0175344 (2017).

prevention, public safety, nuisance, appearance, noise, fencing, hours of operation, abandonment, inspection, and establishment of health and safety buffer zones or setback requirements that are more stringent.

B. Regulations Should Address the Dangers to Health and Safety Posed by Existing Operations

In addition to denying new permits for oil and gas operations within the buffer zone, the regulations must also address the wells that already exist and operate within the buffer. Until these existing wells are addressed, nearby communities remain at risk.

1. Permits to Extend the Life of Wells Should Be Denied

Existing operations within the health and safety buffer should not be extended, expanded, enlarged, intensified, relocated, or otherwise modified beyond the express terms of any previously issued permit, order, or authorization under which the existing operations are carried out. CalGEM's regulations should prohibit permit approvals within the buffer for redrilling, sidetracks, injection, well stimulation, and other activities requiring a state permit under Public Resources Code division 3. Routine maintenance, plugging and abandonment activity, testing, and activities intended to increase the safety of the well should be exempt.

2. Existing Operations Should Be Rapidly Phased Out

In order to protect health and safety, existing operations within the buffer zone must be phased out within a set amount of time. Allowing operations to continue indefinitely is contrary to protecting public health and safety. Data show that the average production of a well in California dramatically and rapidly declines, such that by the fifth year, a new well is only producing a small fraction of its initial output.[120] Of the tens of thousands of idle wells in California, only a small number ever return to active production.[121] In addition, a substantial portion of wells in California produce less than five barrels a day, remaining marginally active primarily because the operator refuses to pay the cost of proper plugging and abandonment.[122] California's oil production is declining, and the regulations must not artificially prop up production at the cost of health and the environment.

The phase out requirement should apply to all wells, including idle and deserted wells. Tens of thousands of inactive wells across the state pose a risk to nearby communities by acting as a

[120] CCST Orphan Well Study at 15.
[121] CalGEM Idle Well Report at 13.
[122] CCST Orphan Well Study at 16.

conduit for fluids to migrate into groundwater or to escape at the surface. Allowing these wells to remain idle only increases their risk over time.[123]

The regulations should include an administrative process that would allow for extensions in those extremely rare circumstances in which operators can show the phase out period would cause a taking of their legally protectable property rights or impair a valid vested right under California law. (See further discussion in Section VI, infra.) The administrative process should be open to the public, allow for public participation, and must weigh the countervailing harm to the public if existing operations are maintained beyond the period provided by the regulations.

C. Other Protective Measures.

Other measures that CalGEM should implement in conjunction with the rulemaking include:

1. Emergency Regulations Implementing a Health and Safety Setback

CalGEM should exercise its authority to adopt emergency regulations to implement a health and safety buffer as soon as possible. The agency has previously relied on emergency rulemaking to adopt a set of regulations pertaining to underground injection projects. After it admitted that it had allowed thousands of Class II injection wells to inject waste fluid into aquifers that were supposed to be protected under the federal Safe Drinking Water Act, then-DOGGR adopted a set of emergency regulations that allowed operators to *continue* injecting contaminants until permanent regulations could be implemented.

While the finding of an "emergency" to protect the oil industry was dubious in the case of injection regulations, for health and safety regulations, there is an actual emergency. Each day we wait, communities near oil and gas activities are exposed to toxic and carcinogenic pollution known to cause serious health harms. CalGEM should provide immediate relief to those communities while the formal rulemaking process progresses.

2. Stop Issuing New Permits Statewide

The state should stop approving new oil and gas projects statewide. California only increases the environmental and public health costs by adding to the state's bloated inventory of oil and gas wells. Given the industry's devastating environmental, health, and climate harms, it does not make sense to continue permitting new and expanded oil and gas projects anywhere in the state. The sharp decline in demand and the low and even negative price of oil due to the COVID-19 downturn only strengthens the case to end new permitting.

[123] Ingraffea, Anthony et al., Assessment and Risk Analysis of Casing and Cement Impairment in Oil and Gas Wells in Pennsylvania, 2000–2012, 111 Proceedings of the Nat'l Acad. of Sciences of the U.S.A. 30, 10955 (July 29, 2014).

Reducing existing production statewide will reduce greenhouse gas emissions, improve regional air quality, and spur the state toward a healthier, more sustainable future.

3. Ban Fracking and Other Types of Extreme Extraction

Well stimulation (including hydraulic fracturing and acid stimulation) and enhanced oil recovery (including steamflood and cyclic steam injection) compound the dangers of oil and gas production and should be banned pursuant to CalGEM's authority and duty to protect public health and safety.

4. Enhance Environmental and Safety Requirements

Other regulatory measures, such as mandatory use of best available control technologies for each well and facility, may help reduce emissions, decrease the number of accidents, or delay inevitable mechanical integrity failures. While these may provide some health benefits to workers and surrounding communities, such measures should not be adopted as a substitute for a firm setback requirement. The only way to fully protect public health and safety from these dangerous oil drilling operations is to eliminate them.

VI. CalGEM's Legal Authority to Implement Health and Safety Regulations

CalGEM has the legal authority and the duty to protect residents from harm, and these regulations fit squarely within that authority.[124] The oil industry aggressively threatens and attempts to intimidate both the agency and the public with various incorrect claims, such as that CalGEM is powerless to act or that the state will may be liable for lost profits if it does. CalGEM must disregard all such incorrect and self-serving assertions and move quickly to protect public health.

A. A Health and Safety Buffer is Within CalGEM's Authority

CalGEM has the statutory duty to "prevent, as far as possible, damage to life, health, property, and natural resources."[125] A newly added statutory provision, effective January 1, 2020, also provides that "the purposes of this division include protecting public health and safety and environmental quality, including reduction and mitigation of greenhouse gas emissions associated with the development of hydrocarbon and geothermal resources in a manner that meets the energy needs of the state."[126] The legislature granted CalGEM broad authority "to adopt rules and regulations, which may be necessary to carry out the purposes" of the statute pertaining to oil and gas production.[127] CalGEM can effectuate the health and safety buffer by

[124] See, e.g., Cal. Pub. Res. Code §§ 3011, 3106(a).
[125] Cal. Pub. Res. Code § 3106(a).
[126] Cal. Pub. Res. Code § 3011 (a).
[127] *Id.* § 3013.

denying all discretionary permits within the buffer zone, and by phasing out existing operations within the buffer zone over time. Given oil and gas production's well-documented serious risks to life, health, property and natural resources, adopting a health and safety buffer of at least 2,500 feet is within CalGEM's authority. Indeed, in 2015, the CCST Report's authors recommended adopting a setback for all oil and gas projects activities.[128]

1. CalGEM May Deny Discretionary Permits

CalGEM oversees an oil and gas permitting program under which operators must obtain discretionary approvals for each of the following activities: drill a new well,[129] re-drill or rework an existing well,[130] abandon a well,[131] frack or conduct other well stimulation,[132] and inject into a well (for the purpose of oil and gas recovery or waste disposal).[133] Under this regulatory regime, which must adhere to CalGEM's statutory mandate to protect health, safety, and natural resources, CalGEM has clear authority and significant discretion to approve, deny, or condition any of these permits on those or other grounds. Like the more familiar discretionary land use approvals, such as development permits, plans and conditional use permits, applicants have no absolute right to receive any discretionary oil and gas permit from CalGEM.[134]

Oil companies that argue CalGEM has no discretion to deny oil and gas permits often cite statutory language that follows CalGEM's mandate to protect life, health, and natural resources, which states that the supervisor "shall also supervise the drilling, operation, maintenance, and abandonment of wells so as to permit the owners or operators of the wells to utilize all methods and practices known to the oil industry for the purpose of increasing the ultimate recovery of underground hydrocarbons and which, in the opinion of the supervisor, are suitable for this purpose in each proposed case[.]" [135] But this language underscores that CalGEM must exercise discretion—the section states that only extraction methods deemed "suitable" in the "opinion of the supervisor" are permissible.[136] Thus, the provision does not constrain, but rather reinforces, CalGEM's discretionary authority. Moreover, the lengthy second sentence of Section 3106(b) sets

[128] CCST Study at 45.
[129] Cal. Pub. Res. Code § 3203(a); Cal. Code Regs. tit. 14, § 1714.
[130] Cal. Code Regs. tit. 14, § 1714.
[131] *Ibid*.
[132] Cal. Pub. Res. Code § 3160 (d); Cal. Code Regs. tit. 14, § 1783.
[133] Cal. Code Regs. tit. 14, § 1724.6.
[134] *Hermosa Beach Stop Oil Coalition v. City of Hermosa Beach* 86 Cal. App. 4th 534, 552 (2001). ("well-established authority hold[s] that no right to develop vests until all final discretionary permits have been authorized…"); *Las Lomas Land Co., LLC v. City of Los Angeles* 177 Cal. App. 4th 837, 854 (2009) (no right to receive approval of site annexation, development agreement, and specific plan); *Smith v. County of L.A*, 211 Cal. App. 3d 188, 197 (1989) (no right to receive a conditional use permit, which "is, by definition, discretionary."); *Breneric Assoc. v. City of Del Mar*, 69 Cal. App. 4th 166, 183 (1998) ("Any significant discretion conferred upon the local agency defeats the claim of a property interest.").
[135] Cal. Pub. Res. Code § 3106(b).
[136] *Ibid*.

state policy *for interpreting oil and gas leases*. It specifies that, unless the parties to the lease agree otherwise, the lessee or contractor may "do what a prudent operator using reasonable diligence would do…." to extract oil and gas.[137] It does not, as industry often asserts, create a right to use any and all methods to extract oil and gas in California. Nor does it establish any state policy mandating the approval of all oil and gas activities regardless of the environmental costs. In short, there is nothing in this oft-cited provision that either compels CalGEM to grant any given permit application or undermines its mandate and ability to protect people and the environment.

2. CalGEM May Phase Out Existing Operations Within the Buffer

CalGEM need not and should not limit its health and safety regulations to new oil and gas activities; its broad authority allows the agency to address threats posed by existing operations as well. In general, CalGEM has the authority to terminate an operation in order to address a "compelling public necessity"[138] or prevent "a menace to the public health and safety or a public nuisance."[139] Here, the serious dangers facing communities near oil and gas justify CalGEM taking action to address existing operations within the buffer.

In addition, activities that were once lawfully permitted may, based upon new knowledge and society's evolving needs, later be prohibited.[140] As a general matter in the land use context in California, when an activity or land use that was previously lawful is prohibited, an existing facility or operation becomes known as a "non-conforming use." In California, a non-conforming use may continue if the operator has obtained a "vested right" by meeting three conditions. The property owner or operator: 1) must have obtained all necessary permits to complete the work in which it claims a vested right; 2) must have expended substantial hard costs in good faith reliance on those permits; and 3) must have in fact performed substantial work.[141]

As discussed, operators in California are required to obtain a number of different permits from DOGGR both to commence and continue their operations. Many local governments also require land use and safety permits. An operator has no vested right to drill for oil without having first obtained *all* required state and local permits.[142]

Moreover, even for existing facilities, at most, operators' vested rights are limited to the terms of the permits they currently possess.[143] Operators may not expand or enlarge their operations if it is

[137] *Ibid*.
[138] *Jones v. Los Angeles*, 211 Cal. 304, 314 (1930).
[139] *Davidson v. County of San Diego*, 49 Cal. App. 4th 639, 650 (1996) (finding a setback ordinance could override building owner's vested rights if "sufficiently necessary to the public welfare").
[140] *Village of Euclid, Ohio v. Ambler Realty Co.*, 272 U.S. 365, 387 (1926).
[141] *Davidson v. County of San Diego*, 49 Cal. App. 4th 639, 646 (1996).
[142] *Hermosa Beach Stop Oil Coalition v. City of Hermosa Beach*, 86 Cal. App. 4th 534, 552-553 (2001).
[143] *Russ Bldg. P'ship v. City & Cty. of San Francisco*, 44 Cal. 3d 839, 854 (1988).

a non-conforming use.[144] Even with the requisite permits, activities may be phased out so long as the prohibition allows for a reasonable phase-out or amortization period.[145]

Thus, CalGEM has more than ample authority to issue regulations that eliminate all oil and gas extraction in the health and safety buffer zone and that phase out existing operations over time throughout the state.

3. Oil Industry Arguments Are Erroneous

The oil industry has often attempted to dissuade state and local governments from taking protective measures against oil and gas pollution by claiming any action would result in an unconstitutional "regulatory taking" of an oil company or land owner's private property or violate their vested rights under California law. They then claim that the government body may be held financially liable for lost profits. But the oil industry purposely misstates established case law. A regulation prohibiting oil and gas activity within a health and safety buffer zone is extremely unlikely to effect an unconstitutional taking or violate vested rights.

As detailed below, there are many reasons why a regulation establishing a health and safety buffer would not take private property or violate established vested rights. Even before reaching the standard analysis, however, there is an additional overarching reason that all takings and vested rights claims from the oil and gas industry should fail. This reason is that oil and gas extraction is a public nuisance under existing background principles of nuisance and property law. Even in the rare instances where a taking would otherwise occur via prohibition of an activity, there is no taking if the restricted activity is a nuisance.[146] Similarly, in California, even where a valid vested right exists for an activity, it can be terminated immediately without compensation if the activity is a nuisance.[147]

Oil and gas production near where people live, work, and play is a public nuisance. The tremendous public health harms and safety risks discussed herein make this abundantly clear. In addition, oil and gas drilling is a public nuisance due to its climate harms. In fact, multiple state and governments are currently suing fossil fuel producers to recover damages from climate change for this very reason. The California Attorney General has recognized and supported these claims, defending local governments' rights to address nuisances stemming from fossil fuel extraction, which include "loss of land due to rising seas, reducing our drinking water supply by

[144] *Paramount Rock v. San Diego Cty.*, 180 Cal. App. 2d 217, 229 (1960).
[145] *Metromedia, Inc. v. San Diego*, 26 Cal. 3d 848, 882 (1980).
[146] In *Lucas*, the Supreme Court confirmed once again that all property is subject to "background principles of the State's law of property and nuisance[.]" 505 U.S. 1003, 1029.
[147] *Davidson v. County of San Diego* 49 Cal. App. 4th 639, 649 (1996) (Vested rights may be "impaired or revoked" for activities "constitut[ing] a menace to the public health and safety or a public nuisance."); *Livingston Rock and Gravel Co. v. Los Angeles* 43 Cal. 2d 121, 126,128 (1954); *Davidson*, 49 Cal. App. 4th at 649.

decreasing snowpack, harming air and water quality, reducing the productivity of our agriculture and aquaculture, decimating biodiversity and ecosystem health, and increasing the intensity of severe storms and wildfires."[148]

Setting aside this overarching point, even if one were to assume that some or all of the subject oil drilling did not rise to the level of a public nuisance, successful takings or vested rights claims against a health buffer regulation are still extremely unlikely, as discussed below.

State action to address the fossil fuel industry's adverse impacts to air quality, water quality, public health and safety, and the climate is a core function of government. It has long been the law of the land that "'all property in this country is held under the implied obligation that the owner's use of it shall not be injurious to the community' and the Takings Clause did not transform that principle to one that requires compensation whenever the State asserts its power to enforce it."[149] Where the state "reasonably concludes that the health, safety, morals, or general welfare would be promoted by prohibiting particular contemplated uses of land," compensation need not accompany prohibition.[150] Thus, when the activity being restricted is harmful to the surrounding residents or to the broader public, there should be no constitutional violation when a government acts to address these threats.[151]

A regulatory taking can occur in one of only two rare instances: (1) where a regulation deprives the property owner of 100 percent of the economic value of the property, *Lucas v. South Carolina Coastal Council* (1992)[152] (often called a "categorical taking"), or (2) where a regulation does not completely eliminate the economic value of the property, but nonetheless "goes too far" under the multi-factor test announced in *Penn Central Transportation Co. v. City of New York* (1978) 438 U.S. 104, 124 ("Penn Central") (often called a "Penn Central taking"). In applying *Penn Central*, courts consider three main factors: (1) the economic effect of the regulation, (2) the regulation's interference with reasonable investment-backed expectations, and (3) the character of the governmental action.[153] A regulation will not be found to cause a taking if any one of these three factors is not met.[154]

A court would be unlikely to find that a setback regulation causes an unconstitutional taking under either test. Under *Lucas*, the setbacks are unlikely to deprive all economic value of the

[148] *County of San Mateo v. Chevron*, No. 18-15499 (9th Cir. filed Jan. 29, 2019), California Attorney General Xavier Becerra, Brief for Amicus Curiae, at 15.
[149] *Keystone Bituminous Coal Ass'n v. DeBenedictis*, 480 U.S. 470 (1986).
[150] *Penn. Cent. Transp. Co. v. New York City*, 438 U.S. 104, 125 (1978).
[151] In *Keystone Bituminous Coal*, *supra*, for example, the Supreme Court found there was no unconstitutional taking when a state law restricted the amount of coal that could be extracted because the state's goal was "to arrest what it perceives to be a significant threat to the common welfare." 480 U.S. 470, 485.
[152] *See Lucas*, 505 U.S. 1003, 1018
[153] *See Penn Central*, 438 U.S. at 124.
[154] *See Allegretti & Co. v. County of Imperial* (2006) 138 Cal.App.4th 1261, 1277; *Bronco Wine Co. v. Jolly* (2005) 129 Cal.App.4th 988, 1035.

property, for many reasons. For example, the surface rights could retain value, or the operator could derive some value by operating outside of the buffer zone. For existing operations, many wells have already produced large quantities of oil and gas to recoup some or all of the costs of drilling. If the setback regulations include a phase-out period, some economic value could be gained for that duration. Thus, it would not constitute a categorical taking under *Lucas.*

Moreover, as noted above, even in the extremely rare instances where all economic value is destroyed, it is not a taking is the restricted activity is a nuisance.[155] Here, the scientific consensus about the fossil fuel industry's effect on the climate, together with countless studies linking fossil fuel production with other adverse environmental and public health harm, makes oil and gas production a clear nuisance and suggests that industry takings claims are doomed to failure for this reason alone. Importantly, the Supreme Court has stated explicitly that certain legal activities could *become* a nuisance if new information shows the activity to be a danger.[156]

Similarly, oil companies are unlikely to be able to prevail on a taking claim under the three *Penn Central* factors. First, just as in categorical takings, there is no taking when the restricted activity is a nuisance.[157] Furthermore, even if a court were to find that oil and gas operations do not rise to the level of a nuisance, where the "character" of government action has a "harm-preventing purpose," that factor will weigh strongly against a finding that a taking has occurred.[158] Addressing the adverse impacts of oil and gas development—air pollution, water degradation, climate change, and public health—would certainly serve a vital harm-preventing purpose. Thus, even when a regulation prevents a return on investment and results in a "serious economic loss," the fact that the law is designed to protect public health and safety will help guard against takings claims.[159]

Second, any claimant would need to demonstrate the economic impact and its investment-backed expectations in court. And courts have long recognized that regulations that significantly reduce property values—even by over 90 percent—are insufficient to demonstrate a taking.[160] Many existing operations have already provided companies with returns on investment, making takings

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[155] In *Lucas,* the Supreme Court confirmed once again that all property is subject to "background principles of the State's law of property and nuisance[.]" 505 U.S. 1003, 1029.
[156] *Lucas*, 505 U.S. at 1029 (stating that if a fault line were newly discovered under an existing nuclear power plant, the plant would become a nuisance and shuttering the plant would not be a compensable taking).
[157] *Appolo Fuels, Inc. v. United States,* 381 F.3d 1338, 1347 (Fed. Cir. 2004) (there is no taking where there is a nuisance, regardless of other factors); *see also Creppel v. United States* (Fed. Cir. 1994); *Creppel v. Unites States*, 41 F.3d 627, 631 (Fed. Cir.1994).
[158] *Rose Acre Farms, Inc. v. United States*, 559 F.3d 1260, 1281(Fed. Cir. 2009).
[159] *William C. Hass & Co. v. City and Cty. of San Francisco*, 605 F.2d 1117, 1121 (9th Cir. 1979); *see also Appolo Fuels, supra*, 381 F.3d at 1350-51.
[160] *Concrete Pipe & Products of Cal., Inc. v. Construction Laborers Pension Trust*, 508 U.S. 602, 645 (1993); *MHC Fin. L.P. v. City of San Rafael*, 714 F.3d 1118, 1127 (9th Cir. 2013) (81 percent diminution in value); *Village of Euclid, supra*, 272 U.S. at 384 (75 percent diminution); *Hadacheck v. Sebastian*, 239 U.S. 394, 405 (1915) (92.5 percent diminution); *William C. Hass, supra*, 605 F.2d 1117 (reduction in value from $2 million to $100,000).

difficult to show.[161] Claimants will be subject to discovery and will need to open their books and substantiate their claims under oath. In addition, the allowance of a phase-out period would further help ensure that claims of economic harm do not rise to the level of an unconstitutional taking.

Moreover, oil and gas production is inherently speculative, fluctuations in oil prices are always uncertain, and oil and gas activity regulations change over time. Recent market shifts have exposed the absurdity of oil industry claims that the government would be liable for huge sums of lost profits. The price of oil in recent weeks has plummeted, reaching *minus* $37 per barrel for West Texas Intermediate at one point.[162] Oil companies claiming to have a right to compensation would need to support those claims with actual evidence of how the health and safety regulations have interfered with their reasonable investment backed expectations. The break-even price for more than half of California oil production is $60 per barrel or higher.[163] Even before oil prices plunged, many oil companies were losing money on their California operations. In addition, California's oil companies have billions of dollars' worth of cleanup liabilities, and each new well or expansion of activity adds to these liabilities and must be factored into any claims about the oil industry's future claimed profits.[164] Bankruptcy was looming for some of the state's largest producers even before the economic downturn and drop in oil prices.[165] Oil and gas companies cannot simultaneously claim that they need regulatory relief because they are not financially sound, and that the state will be liable for vast lost profits should the state restrict their activities. Increasingly, oil and gas operators will find it impossible to demonstrate that regulations limiting oil extraction interfere with any reasonable investment backed expectations.

In addition, most operators have already recouped their capital investments within a short period of time, thus a short phase-out period for existing wells will allow oil companies to recover their costs in most cases. The feasibility of a rapid phase out was recently demonstrated by Culver City, which commissioned a study that found that amortization of capital investment was achieved within four years for one company's acquisition of wells within the City.[166] These

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[161] *Rith Energy v. United States*, 247 F.3d 1355, 1362 (2001) (finding no taking where mining company already mined a portion of coal deposit before being ordered to cease operations).
[162] British Broadcasting Corporation, *U.S. Oil Prices Turn Negative as Demand Dries Up*, BBC News, April 21, 2020, https://www.bbc.com/news/business-52350082.
[163] Erickson, Peter et al. How limiting oil production could help California meet its climate goals, Stockholm Environmental Institute (2018) at 5, https://www.sei.org/wp-content/uploads/2018/03/sei-2018-db-california-oil2.pdf.
[164] CCST Orphan Well Study (2020) (estimating total clean-up costs to be $9.2 billion).
[165] Williams-Derry, Clark, California Schemin': California Resources Corporation's Financial Distress Raises Questions About Cleanup—and What Occidental Petroleum Knew Before the CRC Spin-Off, Institute for Energy Economics and Financial Analysis (Feb. 2020), https://ieefa.org/wp-content/uploads/2020/02/California-Schemin_February-2020.pdf.
[166] Baker and O'Brien Incorporated, Capital Investment Amortization Study for the City of Culver City Portion of the Inglewood Oil Field, City of Culver City (May 29,2020), https://www.culvercity.org/home/showdocument?id=19134.

results are likely typical, and analysis of wells within the buffer would surely find that many if not most existing wells within the health buffer have already more than recouped the initial capital investment and will not require any phase-out period (even if one would have otherwise been required).

Conversely, CalGEM should not base its rulemaking on a recent report from the Los Angeles Petroleum Administrator purporting to analyze the fiscal impacts of implementing a proposed setback from oil and gas operations in Los Angeles. The report did not incorporate the proper legal and factual assumptions, resulting in a fundamentally flawed estimate of the costs of implementation.[167] The report grossly overestimated the costs of a setback for the public, and it should not be used as a basis to inform CalGEM's regulatory analysis here.[168] Errors included a misunderstanding of vested rights and takings law, and mistakenly assuming that all legal claims against the City would be successful, when in fact it is highly unlikely that any such claims would succeed. The report also assumed that cleanup costs would fall to the taxpayer rather than the oil companies. Under the law, operators must pay for remediation. The report also failed to account for the health, environmental, and economic benefits of implementing a setback.

Finally, the regulations could include an administrative process for determining exemptions in the extremely rare instance a claimant can demonstrate that a protected property right may be destroyed. The state could then either exempt the operation from the setback regulation or pay "just compensation" to the operator, taking into account the benefits of shutting down a dangerous operation. Any claims of economic harm to operators must be weighed against the benefits of the regulation. Health benefits, better air quality, protecting water resources, reducing greenhouse gas emissions, and increased property values resulting from less noise and pollution will greatly outweigh the claims of harm by industry. Given that oil industry profits are entirely speculative, liabilities are substantial, and harm to public health and the environment are clear, any claims that halting operations would open the state up to liability are highly dubious.

B. Other Health and Safety Regulations Are also within CalGEM's Authority.

Other health and safety measures are also squarely within CalGEM's authority and would not violate property rights. The same authority that allows CalGEM to deny permits within a health

[167] Ntuk, Uduak-Joe, Petroleum Administrator, Office of Petroleum and Natural Gas Administration, Letter to Los Angeles City Council re: Council File No. 17-0447 - Feasibility of Amending Current City Land Use Codes in Connection with Health Impacts at Oil and Gas Wells and Drill Sites (July 29, 2019), http://clkrep.lacity.org/onlinedocs/2017/17-0447_rpt_BPW_07-29-2019.pdf.

[168] For a full critique, see Hecht, Sean B., Co-Executive Director, Emmett Institute on Climate Change and the Environment, UCLA School of Law, Letter to Mike Feuer, Los Angeles City Attorney, re: Los Angeles City Authority for Setback from Oil and Gas Operation (Dec. 17, 2019); Bundy, Kevin P., Letter to Mike Feuer, City Attorney, City of Los Angeles re: Errors in Report of the City Petroleum Administrator on the Feasibility of Amending Current City Land Use Codes in Connection with Health Impacts at Oil and Gas Wells and Drill Sites (Oct. 3, 2019); Reynolds, Joel et al., Letter to Mike Feuer, Los Angeles City Attorney, re: Los Angeles City Authority for Setback from Oil and Gas Operations (Sept. 4, 2019).

and safety buffer can be applied to deny new permits statewide because it would prevent harm to life, health, property, and natural resources. An operator does not have a right to a discretionary permit and therefore has no legal right to continue an oil and gas operation that would require an operator to procure an additional permit. Because an operator would not be able to meet the first requirement, a ban on new permits for oil and gas projects would not violate oil operators' property rights.[169] CalGEM should also adopt a statewide phaseout and managed decline of existing oil and gas production under this broad authority.

VII. Note on Exhibits Submitted

We have concurrently submitted the documents listed in Appendix E "List of Exhibits Submitted" as PDF files on a flash drive, delivered via Fed-Ex on June 10th. CalGEM should consider these exhibits along with these comments and include them in the administrative record for this matter.

VIII. Conclusion

Thank you for the opportunity to comment. We hope that we can count on the agency to protect our communities by adopting a health and safety buffer of at least 2,500 feet, prohibit new permits within the buffer, and begin phasing out existing operations. We look forward to working with CalGEM over the course of the rulemaking process.

Sincerely,

Hollin Kretzmann, Senior Attorney
Kassie Siegel, Climate Law Institute Director
Center for Biological Diversity
Lead Contacts for Letter
hkretzmann@biologicaldiversity.org
ksiegel@biologicaldiversity.org

Additional Organizational Signatories (continued on next page):

Matt Leonard, Special Projects, 350.org
Barbara Sattler, Member of Board of Directors, Alliance of Nurses for Healthy Environments
RL Miller, President, Climate Hawks Vote

[169] See *Las Lomas Land Co. LLC v. City of Los Angeles*, 177 Cal. App. 4th 837, 853 (2009) ("a benefit is not a protected property interest under the due process clause if the decision maker has the discretion to grant or deny the benefit."); *Smith v. Cty of Los Angeles*, 211 Cal. App. 3d 188, 197 (1989) (finding no "fundamental right, vested or otherwise, in or to a conditional use permit which is, by definition, discretionary."); *Metropolitan Outdoor Advert. Corp. v. City of Santa Ana*, 23 Cal. App. 4th 1401, 1404 (1994) (finding no implicit understanding that a use permit with an expiration date would be renewed).

Ellie Cohen, CEO, The Climate Center
Liza Tucker, Consumer Advocate, Consumer Watchdog
Colin O'Brien, Staff Attorney, Earthjustice
Jennifer Krill, Executive Director, Earthworks
Alexandra Nagy, California Director, Food & Water Action
Nicole Ghio, Senior Fossil Fuel Program Manager, Friends of the Earth
Caroline Henderson, Senior Climate Campaigner, Greenpeace
Sandy Naranjo, California Organizing Manager, Mothers Out Front
David Braun, Director, Rootskeeper
Jeff Eidt, Co-Founder, SoCal 350 Climate Action
Elaine Maltz, Legislative Committee Co-Chair, San Diego 350
Shoshana Wechsler, Coordinator, Sunflower Alliance

Appendix A: Air Pollution

Many of the harms to public health stem from the toxic air emissions emitted from oil and gas activities. Harmful air pollutants are emitted during every stage of oil and gas development, including drilling, completion, well stimulation, production, and disposal, as well as from transportation of water, sand, and chemicals to and from the well pad.[170]

Drilling and casing the wellbore require substantial power from large equipment. The engines used typically run on diesel fuel, which emits particularly harmful types of air pollutants when burned. These operations can produce VOCs, NOx, methane, and ethane, all of which are potent ground-level (tropospheric) ozone precursors.[171] VOCs can form ground-level (tropospheric) ozone when combined with nitrogen oxides ("NO_X") from compressor engines, turbines, other engines used in drilling, and flaring,[172] in the presence of sunlight. This reaction can diminish visibility and air quality and harm vegetation. Many regions around the country with substantial oil and gas operations are now suffering from extreme ozone levels due to heavy emissions of these pollutants.[173]

Similarly, high-powered pump engines are used in the fracturing and completion phase. The well stimulation stage can emit diesel exhaust, VOCs, particulate matter, ozone precursors, silica, and acid mists.[174] This too can amount to large volumes of air pollution.[175] The diesel equipment used to pump fluids into the well produces nitrogen oxide ("NOx") and particulate matter ("PM") emissions.[176] Additionally, some volatile organic compounds ("VOCs"), such as the BTEX compounds (benzene, toluene, ethylbenzene, and xylene), when exposed to light can transform into PM.

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[170] McCawley, Michael, Air Contaminants Associated with Potential Respiratory Effects from Unconventional Resource Development Activities, 36 Seminars in Respiratory and Critical Care Medicine 3, 379 (2015) ("McCawley 2015"); Shonkoff 2014.
[171] U.S. Environmental Protection Agency, Integrated Science Assessment for Ozone and Related Photochemical Oxidants (2013).
[172] *See, e.g.*, U.S. Environmental Protection Agency, Oil and Gas Sector: Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution: Background Technical Support Document for Proposed Standards (July 2011) at 3-6; Armendariz, Al, Emissions for Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements, Environmental Defense Fund (2009) ("Armendariz 2009") at 24.
[173] Armendariz 2009 at 1, 3, 25-26; Koch, Wendy, *Wyoming's Smog Exceeds Los Angeles' Due to Gas Drilling*, USA Today (May 9, 2011); Craft, Elena, Do Shale Gas Activities Play a Role in Rising Ozone Levels?, Environmental Defense Fund (2012); Colorado Oil and Gas Conservation Commission, Conservation Commission: Colorado Weekly and Monthly Oil and Gas Statistics (July 6, 2012) at 12.
[174] McCawley 2015; Shonkoff 2014.
[175] Brown, Heather P., Memorandum to Bruce Moore, U.S.EPA/OAQPS/SPPD re: Composition of Natural Gas for use in the Oil and Natural Gas Sector Rulemaking (July 28, 2011) at 3.
[176] Earthworks, Sources of Oil and Gas Pollution (2011); Bay Area Air Quality Management District, Particulate Matter Overview (2012).

The chemicals used in drilling and well stimulation fluids are harmful to human health. In a study of 353 chemicals used in the recovery of natural gas (e.g. drilling and/or fracking), it was found that more than 75 percent of the chemicals could adversely impact the skin eyes and sensory organs; 75 percent could impact the respiratory and gastrointestinal systems; 40-50 percent could impact the nervous, immune, urinary, and cardiovascular systems; 37 percent could impact the endocrine system; and 25 percent could cause cancer and mutations.[177] Over a million pounds of fluids can be used in a given well drilling event, with many of the herein described toxic chemicals part of the fluid composition.[178] Between June 2013 and February 2017, more than 98 million pounds chemicals known to cause serious health effects ("toxic air contaminants") were used in oil and gas operations in Los Angeles County alone.[179]

Flaring and venting of gas are also potential sources of air emissions. Gas flaring and venting can occur in both oil and gas recovery processes when underground gas rises to the surface and is not captured as part of production. Emissions from flaring typically include carbon monoxide, nitrogen oxides, benzene, formaldehyde and xylene, but levels of these smog-forming compounds are seldom measured directly.[180,181] NOx and PM are both criteria pollutants which must be regulated under the National Ambient Air Quality Standards (NAAQS) due to their potential to cause primary and secondary health effects. They both contribute to the formation of ozone, another criteria pollutant.[182]

Fugitive emissions can occur at every stage of extraction and production, often leading to high volumes of gas being released into the air. Methane emissions from oil and gas production are as much as 270 percent greater than previously estimated by calculation.[183] Studies show that fugitive emissions from pneumatic valves (which control routine operations at the well pad by venting methane during normal operation) and equipment leaks are higher than EPA estimates.[184] This is of great concern because ground-level ozone can be formed by methane in

[177] Colborn, Theo et al. Natural Gas Operations from a Public Health Perspective. 17 Human and Ecological Risk Assessment 5, 1039 (2011).
[178] South Coast Air Quality Management District, Rule 1148.2 Oil and Gas Well Electronic Notification and Reporting, Public Information Portal, http://www.aqmd.gov/home/rules-compliance/compliance/1148-2 (last visited on April 27, 2020).
[179] Fleming, John, PhD. & Candice Kim, Danger Next Door: The Top 12 Air Toxics Used for Neighborhood Drilling in Los Angeles, Center for Biological Diversity and Stand-LA (Dec. 2017).
[180] Physicians for Social Responsibility and Concerned Health Professionals of NY, Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking, Fourth Edition (Nov. 17, 2016).
[181] California Council on Science and Technology, Advanced Well Stimulation Technologies in California (2016) (" CCST 2016") at 248; McKenzie 2012; Shonkoff 2014.
[182] U.S. Environmental Protection Agency, Criteria Air Pollutants (March 8, 2018), https://www.epa.gov/criteria-air-pollutants.
[183] Miller, Scot M. et al., Anthropogenic Emissions of Methane in the United States, 110 PNAS 50, 20018 (2013).
[184] Allen, David et al., Measurements of Methane Emissions at Natural Gas Production Sites in The United States, 110 PNAS 44, 17768 (2013); Harriss, Robert et al., Using Multi-Scale Measurements to Improve Methane Emission Estimates from Oil and Gas Operations in the Barnett Shale Region, Texas, 49 Environ. Sci. Technol., 7524 (2015).

substantial quantities as it interacts with nitrogen oxides and sunlight.[185] One paper modeled reductions in various anthropogenic ozone precursor emissions and found that "[r]educing anthropogenic CH_4 emissions by 50% nearly halves the incidence of U.S. high-O_3 events . . . ."[186] Methane leakage rates in California are similarly concerning.[187]

In addition, long-term exposure to hydrogen sulfide, contained in gas, is linked to respiratory infections, eye, nose, and throat irritation, breathlessness, nausea, dizziness, confusion, and headaches.[188]

Ethane, also a greenhouse gas, breaks down and reacts with sunlight to create smog. Ethane emissions have risen steeply in recent years due to U.S. oil and gas production. A recent study documented that ethane emissions in the Northern Hemisphere increased by about 400,000 tons annually between 2009 and 2014, with the majority coming from North American oil and gas activity, reversing a decades-long decline in ethane emissions.[189]

Evaporation from pits can also contribute to air pollution. Pits that store drilling waste, produced water, and other waste fluid may be exposed to the open air. Chemicals mixed with the wastewater—including the additives used to make fracking fluids, as well as volatile hydrocarbons, such as benzene and toluene, brought to the surface with the waste—can escape into the air through evaporation. Some pits are equipped with pumps that spray effluents into the air to hasten the evaporation process. Even where waste fluid is stored in so-called "closed loop" storage tanks, fugitive emissions can escape from tanks.

Truck traffic related to oil and gas extraction contributes to air emissions. Trucks capable of transporting large volumes of chemicals and waste fluid typically use large engines that run on diesel fuel, also increasing threats of NO_x and PM emissions.

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[185] Fiore, Arlene et al., Linking Ozone Pollution and Climate Change: The Case for Controlling Methane, 29 Geophys. Res. Letters 19, 1919 (2002) ("Fiore 2002"); U.S. Environmental Protection Agency, Oil and Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews;Proposed Rule, 76 Fed. Reg. 52,738 (Aug 23, 2011).
[186] Fiore 2002; *see also* Martin, Randal et al., Final Report: Uinta Basin Winter Ozone and Air Quality Study December 2010 - March 2011, Energy Dynamics Laboratory (2011) at 7.
[187] Duren, Riley et al., California's methane super-emitters, 575 Nature, 180 (Nov. 2019), https://doi.org/10.1038/s41586-019-1720-3; Cui, Yu Yan et al., Top-down Estimate of Methane Emissions in California Using a Mesoscale Inverse Modeling Technique: The San Joaquin Valley, 122 J. Geophys. Res. Atmos., 3686 (2017), available at doi:10.1002/2016JD026398.
[188] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Report to Congress on Hydrogen Sulfide Air Emissions Associated with the Extraction of Oil and Natural Gas EPA-453/R-93-045 (Oct. 1993), at i.
[189] Helmig, Detlev et al., Reversal of global atmospheric ethane and propane trends largely due to US oil and natural gas production, 9 Nature Geoscience, 490 (2016).

Many chemicals used in oil and gas production are designated as Hazardous Air Pollutants (HAPs).[190] For instance, ethylbenzene, formaldehyde, and methylene chloride are all known or suspected carcinogens, while methanol is linked to reproductive harm, and hydrochloric acid and hydrofluoric acid can cause both eye irritation and respiratory harm.[191]

Concentrations of these criteria pollutants along with two others, carbon monoxide and sulfur dioxide, have been shown to increase in regions where unconventional oil and gas recovery techniques are permitted. Criteria pollutants are associated with an array of health impacts:[192]

> *Nitrogen oxides* (NOx) react with ammonia, moisture, and other compounds to form small particles. These small particles penetrate deeply into sensitive parts of the lungs and can cause or worsen respiratory diseases, such as emphysema and bronchitis, and can aggravate existing heart disease, leading to increased hospital admissions and premature death. NO_x and volatile organic compounds react in the presence of heat and sunlight to form ozone.
>
> *Particulate matter* (PM) - especially fine particles - contains microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including: premature death in people with heart or lung disease, increased mortality, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.[193]
>
> *Sulfur Dioxide* (SO_2) – has been shown to cause an array of adverse respiratory effects including bronchoconstriction and increased asthma symptoms.[194] Studies also show a connection between short-term exposure and increased visits to emergency departments and hospital admissions for respiratory illnesses, particularly in at-risk populations including children, the elderly, and asthmatics.[195]

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[190] Sierra Club et al., Comments on New Source Performance Standards: Oil and Natural Gas Sector; Review and Proposed Rule for Subpart OOOO (Nov. 30, 2011) at 13.
[191] Agency for Toxic Substances and Disease Registry, ATSDR A-Z Index, https://www.atsdr.cdc.gov/az/a.html (last visited on April 24, 2020) ("ASTDR A-Z Index"); Center for Biological Diversity, Fracking and Dangerous Drilling in California: Briefing Book, Californians Against Fracking (Dec. 2017), https://www.biologicaldiversity.org/campaigns/california_fracking/pdfs/fracking-and-drilling-in-california.pdf.
[192] U.S. Environmental Protection Agency, Criteria Air Pollutants (March 8, 2018), https://www.epa.gov/criteria-air-pollutants.
[193] U.S. Environmental Protection Agency, Health and Environmental Effects of Particulate Matter (PM) (April 13, 2020), https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm; Ostro, Bart et al., Long-term Exposure to Constituents of Fine Particulate Air Pollution and Mortality: Results from the California Teachers Study, 118 Environmental Health Perspectives 3 (2010).
[194] U.S. Environmental Protection Agency, Sulfur Dioxide Basics (June 28, 2018), https://www.epa.gov/so2-pollution/sulfur-dioxide-basics#effects.
[195] *Ibid.*

Carbon Monoxide (CO) can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death.[196] Exposure to CO can reduce the oxygen-carrying capacity of the blood. People with several types of heart disease already have a reduced capacity for pumping oxygenated blood to the heart, which can cause them to experience myocardial ischemia (reduced oxygen to the heart), often accompanied by chest pain (angina), when exercising or under increased stress.[197] For these people, short-term CO exposure further affects their body's already compromised ability to respond to the increased oxygen demands of exercise or exertion.[198]

Ozone (O_3) can trigger or worsen asthma and other respiratory ailments.[199] It has been linked to pneumonia, COPD, asthma, bronchitis, emphysema, and premature death. Ground level ozone can have harmful effects on sensitive vegetation and ecosystems. Ozone may also lead to loss of species diversity and changes to habitat quality, water cycles, and nutrient cycles.

Likewise, the BTEX compounds, which contribute to the formation of criteria pollutants, pose great potential harms. Benzene, for instance, is a known human carcinogen that has been linked to blood disorders such as leukemia, immune system damage and chromosomal mutations. The other BTEX compounds (toluene, ethylbenzene, xylene) have varying effects, including damage to the brain and nervous system, kidneys, and liver, with symptoms of exposure including fatigue, drowsiness, headaches, dizziness, confusion, eye and respiratory tract irritation, and loss of muscle coordination.[200]

[196] U.S. Environmental Protection Agency, Basic Information about Carbon Monoxide (CO) Outdoor Air Pollution (Sept. 8, 2016), https://www.epa.gov/co-pollution/basic-information-about-carbon-monoxide-co-outdoor-air-pollution#Effects.
[197] *Ibid.*
[198] *Ibid.*
[199] U.S. Environmental Protection Agency, Health Effects of Ozone Pollution (Feb. 27, 2017), https://www.epa.gov/ozone-pollution/health-effects-ozone-pollution.
[200] Suh, Helen H. et al., Criteria Air Pollutants and Toxic Air Pollutants, 108 Environmental Health Perspectives Supplement 4, 625 (2000); ASTDR A-Z Index; Jia, Chuntong & Stuart Batterman, A Critical Review of Naphthalene Sources and Exposures Relevant to Indoor and Outdoor Air, 7 Int'l J. of Envtl. Res. and Pub. Health 7, 2903 (2010).

Appendix B: Water Degradation

Oil and gas activities pose a serious risk to public health and safety because the chemicals involved in the production process can contaminate nearby groundwater and surface water. In addition to the chemicals employed by oil and gas companies, the oil and gas itself is unsafe and can pollute water resources if fluids are allowed to migrate through underground pathways opened by the extraction process.

In California, a study of Kern County produced water found high concentrations of benzene, a known carcinogen. In some samples, benzene concentrations were as high as 18.0 mg/L, thousands of times above safe levels for drinking water.[201] Another recent California study reported that produced water from ninety-five percent of 630 fracked wells contained measurable, and sometimes elevated, concentrations of toxic BTEX (benzene, toluene, ethylbenzene and xylene) and PAH (polycyclic aromatic hydrocarbon) compounds.[202]

In a December 2016 report from the US EPA, the following factors were found to potentially impact water quality: (1) Water withdrawals for enhanced oil recovery or fracking in times or areas of low water availability; (2) Spills during the management of produced water, fracking fluids, or chemicals; (3) Injection of enhanced oil recovery or fracking fluids into wells with inadequate mechanical integrity; (4) Injection of fluids directly into groundwater resources; (5) Discharge of inadequately treated wastewater to surface water resources; and (6) Disposal or storage of wastewater in unlined pits. The compilation of this list was based on studies that found impacts to wastewater from the listed activities.[203]

Many toxic chemicals used in oil and gas extraction are water soluble and thus pose a direct threat to water quality. For example, hydrochloric acid is used to initiate rock fractures, ethylene glycol is used to prevent scale deposits in pipes, and glutaraldehyde is used to eliminate bacteria from produced water.[204] There are also chemicals that are directly associated with fossil fuels and produced water, such as the BTEX chemicals, that can contaminate water resources.

Furthermore, even of the chemicals that are reported, key information is often missing that would be necessary to evaluate their toxicity and potential health and environmental impacts. Of 316 chemicals used in hydraulic fracturing and acid treatments reported by oil and gas production operators in California, forty percent lacked environmental impact or toxicity data. Of that,

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[201] California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Benzene in Water Produced from Kern County Oil Fields Containing Fresh Water (1993) at 3-4.
[202] Chittick, Emily A. & Tanja Srebotnjak, An analysis of chemicals and other constituents found in produced water from hydraulically fractured wells in California and the challenges for wastewater management, 204 Journal of Environmental Management, 502 (2017).
[203] U.S. Environmental Protection Agency, Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States (2016) ("EPA 2016 HF Study") at ES-3.
[204] CCST 2016 at 381.

thirty-eight percent also lacked a CASRN number which serves as a unique numerical identifier of chemical substances. Only fifty-five percent of the reported chemicals had a CASRN, impact or toxicity data, and quantity of use or amount of emissions, all of which are necessary in assessing the chemical burden imposed by a given substance.[205]

These chemicals can be mobilized in a number of ways, one of which is spills. Several studies have noted spills of fracking fluids or additives, most of which were caused by equipment failure or human error. For instance, an EPA analysis characterized 151 spills of fracking fluids or additives on or near well sites in 11 states between January 2006 and April 2012. Of the total, 34% of the spills were due to equipment failure, 25% were due to human error, and more than 30% of the spills were from fluid storage units.[206] In addition, of the 151 spills analyzed by the EPA, the spill amount ranged from 5 gallons up to 19,320 gallons. Thirteen of the 151 spills reached a surface water body, with the largest spill volume reported reaching a water body being 7,350 gallons.[207]

Another way in which chemicals can be mobilized is through unintended flow pathways in the subsurface resulting from fluid injection for oil and gas production or disposal. A well with insufficient mechanical integrity (e.g. due to well casing and tubing leaks, uncemented annulus, gaps in cement, gaps between casing and cement) can allow unintended fluid movement. Also, the fracture network produced during injection could intersect sources of groundwater or surface water constituting a conduit for polluted water to flow. Finally, there have been instances where injection into one well has affected a nearby oil and gas well, resulting in spills of the nearby well.[208]

In Santa Barbara, the U.S. Geological Survey ("USGS") conducted a survey of the Orcutt Oil Field as part of the Regional Monitoring Program authorized by Senate Bill 4. USGS compiled historical information about the study area and collected groundwater samples from seven domestic, six irrigation, and three monitoring wells of varying depths and compared these samples to produced water samples collected from five oil wells and one injection site. Preliminary results show evidence of mixing between oil-field fluids and groundwater in four of

[205] CCST Study at 17.
[206] EPA 2016 HF Study at ES-22.
[207] *Id.* at ES-23.
[208] U.S. Environmental Protection Agency, Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States (2016).

the 16 wells sampled.[209] Similar evidence of contamination has since been found in the Fruitvale, Lost Hills, and South Belridge oil fields in Kern County.[210]

Finally, in California, unlined disposal pits for drilling and fracking waste are documented sources of contamination.[211] California is one of only a handful of states that allow oil operators to dump wastewater from oil and gas production into dangerous, open, unlined pits.[212] Pollutants can migrate from the disposal site to wells that are miles away.[213] The CCST reported that there is "ample evidence of groundwater contamination from percolation pits in California and other states."[214] In Kern County, California, the Central Valley Water Board found that several percolation pits in Lost Hills and North and South Belridge oil fields had impacted groundwater, and ordered their closure.

Summaries of recent collaborative studies between the State Water Resources Control Board and the US Geological Survey are provided below. Taken together, the studies demonstrate that oil and gas activities has caused significant contamination to the state's groundwater supplies. The potential harm to nearby water supply wells supports the implementation of a setback of at least 2,500 feet.

1. **McMahon, P.B. et al., Preliminary results from exploratory sampling of wells for the California oil, gas, and groundwater program, 2014-2015, United States Geological Survey (2017).**

This study analyzed the groundwater samples taken from USGS monitoring wells overlying or near oils friends in the Los Angeles Basin. The study found that groundwater samples showed high concentrations of total dissolved solids, contained oil field formation gas, e.g. methane, propane, butane, and adopted the isotopic signature of produced water. Taken together, these results indicate that the ground water samples had significantly mixed with the oil field formation water.

[209] Anders, Robert, et al., Abstract: Groundwater quality results from the Regional Monitoring Program Study of the Orcutt Oil Field, presented at California State Water Resources Control Board Stakeholder Meeting, February 25, 2019, Sacramento, California, United States Geological Survey (2019), *available at*: https://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/regional_monitoring/index.html.
[210] McMahon 2019; McMahon, 2017; Gillespie, Janice M. et al., Groundwater salinity and the effects of produced water disposal in the Lost Hills—Belridge oil fields, Kern County, California, 26 Environmental Geosciences 3, 73 (2019).
[211] Stringfellow, William T. et al., *Chapter 2: Impacts of Well Stimulation on Water Resources*, California Council on Science and Technology, An Independent Assessment of Well Stimulation in California, Volume II, (2015) at 110-113.
[212] California Regional Water Quality Control Board, Central Valley Region, Order R5-2017-0036 (April 6, 2017); Zirogiannis, Nikolaos et al., State Regulation of Unconventional Oil and Gas Development in the U.S.: An Empirical Evaluation, 11 Energy Research & Social Science 142 (2016) at Table A.3.
[213] Central Valley Regional Water Control Board, Staff Report, Valley Water Management Company, McKittrick 1 & 1-3 Facility, Kern County (Feb. 25, 2019).
[214] CCST Study.

2. **McMahon, P.B. et al., Occurrence and sources of radium in groundwater associated with oil fields in the Southern San Joaquin Valley, California, 53 Environmental Science & Technology 9398-9406 (2019).**

Similar to the McMahon 2017 study, the McMahon 2019 study showed that 18 percent of water samples taken from wells in or near oil fields were contaminated by radioactive material (i.e. radium) at levels beyond the maximum contaminant level thereby making the water unsuitable for human consumption. Groundwater contamination by radium was also traced to unlined wastewater disposal pits.

3. **Wright, M.T. et al., Groundwater quality of a public supply aquifer in proximity to oil development, Fruitvale oil field, Bakersfield, California, Applied Geochemistry (2019).**

In this study, samples were collected from 14 groundwater wells. Methane was detected in 11 of the 14 groundwater samples, which could be attributed to a leaky wellbore. Two of the samples had an isotopic signature similar to that of an oil and gas reservoir source, highlighting a connection between oil-bearing formations and the overlying groundwater aquifer. All of the samples collected had at least one volatile organic compound (VOC) detection and three of the samples contained petroleum hydrocarbons, particularly benzene.

4. **Gillespie, J.M. et al., Groundwater salinity and the effects of produced water disposal in the Lost Hills—Belridge oil fields, Kern County, California (2019).**

This study documents the influence of wastewater disposal pits and produced water injection disposal wells on groundwater reservoirs. The results found that oil and gas wastewater migrated approximately 1,525 and 550 meters from wastewater disposal pits and injection disposal wells, respectively.

Appendix C: Climate Change Health Impacts

Continued oil and gas development, will only accelerate and worsen the effects of climate change's effect on public health and well-being. A health and safety setback, combined with a phaseout of existing oil and gas production, would have a co-benefit of reducing greenhouse gas emissions, avoiding some of the harm to public health that would have resulted from the emissions attributable to California's oil and gas.

The Fourth National Climate Assessment concluded that "[t]he health and well-being of Americans are already affected by climate change, with the adverse health consequences projected to worsen with additional climate change."[215] The health impacts from climate change include increased exposure to heat waves, floods, droughts, and other extreme weather events; increases in vector-, food- and waterborne infectious diseases; decreases in the quality and safety of air, food, and water including rising food insecurity and increases in air pollution; displacement; and stresses to mental health and well-being.[216] Although everyone is vulnerable to health harms from climate change, populations experiencing greater health risks include children, older adults, low-income communities, some communities of color, immigrant groups, and persons with disabilities and pre-existing medical conditions.[217] The 2015 Lancet Commission on Health and Climate Change warned that climate change is causing a global medical emergency, concluding that "the implications of climate change for a global population of 9 billion people threatens to undermine the last half century of gains in development and global health."[218]

Climate change-driven health impacts are already occurring in the United States, particularly from illnesses and deaths caused by extreme weather events which are increasing in frequency and intensity.[219] Heat is the leading cause of weather-related deaths in the U.S., and extreme heat is projected to increase future mortality on the scale of thousands to tens of thousands of additional premature deaths per year across the U.S. by the end of this century.[220] Hot days have been conclusively linked to an increase in heat-related deaths and illnesses—particularly among older adults, pregnant women, and children—including cardiovascular and respiratory

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[215] U.S. Global Change Research Program, Impacts, Risks, and Adaptation in the United States, Fourth National Climate Assessment, Volume II (2018) ("USGCRP Vol. II 2018"), https://nca2018.globalchange.gov/ at 545.
[216] *Ibid*.; U.S. Global Change Research Program, The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment (2016) ("USGCRP 2016") ; Melillo, Jerry M et al. (eds.), Climate Change Impacts in the United States: The Third National Climate Assessment, U.S. Global Change Research Program (2014) at 221, https://www.globalchange.gov/browse/reports/climate-change-impacts-united-states-third-national-climate-assessment-0; Sheffield, Perry & Philip J. Landrigan, Global Climate Change and Children's Health: Threats and Strategies for Prevention, 119 Environmental Health Perspectives, 291 (2011).
[217] USGCRP Vol. II 2018 at 548; USGCRP 2016.
[218] Watts, Nick et al., Health and climate change: policy responses to protect public health, 386 The Lancet, 1861 (2015) at 1861.
[219] USGCRP Vol. II 2018 at 541.
[220] USGCRP 2016.

complications, renal failure, electrolyte imbalance, kidney stones, negative impacts on fetal health, and preterm birth.[221]

Air pollutants—particularly ozone, particulate matter, and allergens—are expected to increase with climate change.[222] Climate-driven increases in ozone will cause more premature deaths, hospital visits, lost school days, and acute respiratory symptoms.[223] In 2020, projected climate-related increases in ground-level ozone concentrations could lead to an average of 2.8 million more occurrences of acute respiratory symptoms, 944,000 more missed school days, and over 5,000 more hospitalizations for respiratory-related problems.[224] The continental U.S. could pay an average of $5.4 billion (2008$) in health impact costs associated with climate-related increases in ozone in 2020, with California experiencing the greatest impacts estimated at $729 million.[225]

Risks from infectious diseases are increasing as climate change alters the geographic and seasonal distribution of tick- and mosquito-borne diseases like Lyme disease and West Nile virus.[226] The risk of human exposure to Lyme disease—the most common vector-borne illness in the U.S.[227]— is expected to increase as ticks carrying Lyme disease and other pathogens become active earlier in the season and expand northward in response to warming temperatures.[228] The two species of ticks capable of spreading Lyme disease have already expanded to new regions of the U.S. partly because of rising temperatures: in 2015, they were found in more than 49 percent of counties in the continental U.S., a nearly 45 percent increase since 1998.[229] Rising temperatures and changes in rainfall have also contributed to the maintenance of West Nile virus in parts of the United States,[230] and cases of West Nile disease are projected to more than double by 2050 due in part to increasing temperatures, resulting in approximately $1 billion per year in hospitalization costs and premature deaths under a higher emissions scenario.[231]

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[221] USGCRP Vol. II 2018 at 544-545.
[222] U.S. Environmental Protection Agency, Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act; Final Rule, 74 Fed. Reg. 66496 (2009); USGCRP 2016.
[223] USGCRP 2016.
[224] Union of Concerned Scientists Climate Change and Your Health: Rising Temperatures, Worsening Ozone Pollution (2011).
[225] *Ibid*.
[226] USGCRP 2016.
[227] Schwartz, Amy M. et al., Surveillance for Lyme Disease — United States, 2008-2015, Centers for Disease Control and Prevention: 66 MMWR Surveillance Summaries SS-22 (2017).
[228] USGCRP 2016.
[229] Eisen, Rebecca J. et al., County-Scale Distribution of *Ixodes scapularis* and *Ixodes pacificus* (Acari: Ixodidae) in the Continental United States, 53 Journal of Medical Entomology 2, 349 (2016).
[230] Harrigan, Ryan J. et al., A continental risk assessment of West Nile virus under climate change, 20 Global Change Biology 8, 2417(2014); Paz, Shlomit, Climate change impacts on West Nile virus transmission in a global context, 370 Philosophical Transactions of the Royal Society B 20130561 (2015).
[231] USGCRP Vol. II 2018 at 552.

Numerous studies have emphasized that many lives could be saved with rapid reductions in greenhouse gas pollution.[232] The Fourth National Climate Assessment concludes that "reducing greenhouse gas emissions would benefit the health of Americans in the near and long term."[233] The Assessment projects that "by the end of this century, thousands of American lives could be saved and hundreds of billions of dollars in health-related economic benefits gained each year under a pathway of lower greenhouse gas emissions."[234] Another recent study reported that faster reductions in carbon pollution will prevent millions of premature deaths globally. Compared with a 2°C pathway, a 1.5°C pathway is projected to result in 153 million fewer premature deaths worldwide due to reduced PM 2.5 and ozone exposure, including 130,000 fewer premature deaths in Los Angeles metropolitan area.[235]

[232] Gasparrini, Antonio et al., Projections of temperature-related excess mortality under climate change scenarios, 1 Lancet Planet Health, e360 (2017); Hsiang, Solomon et al., Estimating economic damage from climate change in the United States, 356 Science, 1362 (2017); Silva, Raquel A. et al., Future global mortality from changes in air pollution attributable to climate change, 7 Nature Climate Change, 647 (2017); Burke, Marshall et al., Higher temperatures increase suicide rates in the United States and Mexico, 8 Nature Climate Change, 723 (2018); Shindell, Drew et al., Quantified, localized health benefits of accelerate carbon dioxide emissions reductions, 8 Nature Climate Change, 291 (2018).
[233] USGCRP Vol. II 2018 at 541.
[234] *Ibid*.
[235] Shindell, Drew et al., Quantified, localized health benefits of accelerate carbon dioxide emissions reductions, 8 Nature Climate Change, 291 (2018).

Appendix D: Oil Production in California Induces Oil Consumption

The perfect substitution theory posits that any oil produced in California will replace an identical amount that would have been imported from elsewhere. This is false. Numerous analyses show that perfect substitution for oil and gas production simply does not occur in the real world and is not a reasonable assumption. Oil and gas production operates in a global market where changes in U.S. production translate into shifts in global prices, global consumption, and associated greenhouse gas pollution.

A an analysis specific to California oil production estimated that each barrel of oil left unproduced would result in a net decrease of 0.5 barrels or production globally, and the reduction would likely be greater when factoring in high carbon-intensity of California's oil fields and downstream effects.[236] The effect would be greater still if factoring in a decrease in California's oil consumption decreases at the same time.

The report is consistent with other analyses showing leaving U.S. oil and gas undeveloped decreases global consumption. In short, every barrel of oil, and unit of gas, that is left undeveloped results in a significant reduction in global oil and gas consumption with associated decreases in greenhouse gas pollution, as detailed below.

A comprehensive analysis of the GHG consequences of ending new oil leasing on U.S. federal lands and waters found that ceasing new leasing would result in large GHG and climate benefits.[237] This study accounted for the effects of substitution by other fuels for the oil that would be foregone by ending new leasing. The study estimated that for each unit (QBtu) of federal oil production cut, other oil supplies would substitute for about half a unit (0.56 QBtu) and net oil consumption would drop by nearly half a unit (0.44 QBtu). In short, every barrel of federal oil left undeveloped would result in nearly half a barrel reduction in net oil consumption, with associated reductions in GHG emissions. The analysis estimated that ending new federal oil leasing would reduce 2030 global CO_2 emissions from oil consumption by 54 Mt CO_2, with an increase in CO_2 emissions from other fuels of 23 Mt CO_2, for a net emissions benefit of 31 Mt CO_2. The analysis recommended that "policy-makers should give greater attention to measures that slow the expansion of fossil fuel supplies."

As summarized by the study authors, oil and gas production operates in a global market, where increases or decreases in U.S. production translate into changes in prices and consumption:

[236] Erickson, Peter & Michael Lazarus, How limiting oil production could help California meet its climate goals, Stockholm Environment Institute (2018), https://www.sei.org/wp-content/uploads/2018/03/sei-2018-db-california-oil2.pdf.
[237] Erickson, Peter & Michael Lazarus, SEI Working Paper No. 2016-2: How would phasing out US federal leases for fossil fuel extraction affect CO_2 emissions and 2°C goals?, Stockholm Environment Institute (2016).

> [T]he oil market is also highly global, with oil readily traded among countries, and substantial infrastructure in place to do so. The US both imports and exports oil, and world and domestic oil prices very closely track each other (US EIA 2016).
>
> For this reason, we expect that changes in US oil production would affect an integrated global oil market, an assumption also made by many other analysts that have looked at changes in US oil supply (Bordoff and Houser 2015; Rajagopal and Plevin 2013; Allaire and Brown 2012; Metcalf 2007; IEC 2012). Though in the past the oil market could be strongly influenced by cartel behavior among a small number of producers, many analysts now see the market as more likely to behave competitively (The Economist 2016; US EIA 2016), meaning that increases or decreases in supply do translate into shifts in prices and, in turn, consumption.[238]

Similarly, an analysis published in the prominent journal *Nature Climate Change* concluded that increased oil production would significantly increase global oil consumption as the result of greater supplies and lower oil prices.[239] Using publicly available global oil supply curves from the International Energy Agency and peer-reviewed elasticities, the analysis estimated that each barrel of increased oil production would result in an increase of 0.59 barrels of global oil consumption.

An analysis of the effects of removing subsidies for U.S. oil and gas production found that decreases in the U.S. oil and gas supply would result in substantial decreases in global oil and gas consumption.[240] In the case of oil, the model estimated that a decrease of 600,000 barrels per day in U.S. oil supply, resulting from a drop in U.S. oil production due to subsidy removal, would lead to a decrease in global oil consumption of 300,000 to 500,000 barrels per day.[241] Decreased U.S. oil supply is only partially replaced by other sources of U.S., OPEC, and other rest-of-world supply. In short, each U.S. barrel not developed would result in a net reduction in global oil consumption of 0.5 barrels to 0.8 barrels. Similarly, for natural gas, a 1.06 to 1.32 Tcf per year decrease in U.S. natural gas supply would lead to a net reduction in global gas consumption of 0.94 to 1.06 Tcf per year,[242] which translates into a net reduction in global gas consumption of 0.7 to 1 unit for each unit of U.S. natural gas left undeveloped.

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[238] *Id.* at 23.
[239] Erickson, Peter & Michael Lazarus, Impact of the Keystone XL Pipeline on Global Oil Markets and Greenhouse Gas Emissions, 4 Nature Climate Change, 778 (2014).
[240] Metcalf, Gilbert E., The Impact of Removing Tax Preferences for U.S. Oil and Gas Production, Council on Foreign Relations (August 2016) ("Metcalf 2016"); Erickson, Peter, Rebuttal: Oil Subsidies—More Material for Climate Change Than You Might Think, Council on Foreign Relations Blog (Nov. 2, 2017), https://www.cfr.org/blog/rebuttal-oil-subsidies-more-material-climate-change-you-might-think.
[241] Metcalf 2016 at Table 2.
[242] *Id.* at Table 3.

An analysis by experts at Columbia University and the Rhodium Group on the effects of lifting U.S. crude oil export restrictions shows that U.S. oil production affects global crude oil prices,[243] which is only possible without perfect substitution. As illustrated in Figure 23 of the study, when U.S. crude oil exports are permitted, as they were by the lifting of the crude oil export ban in December 2015, all modeling groups agreed that the international oil market will respond to changes in U.S. production. Specifically, all modeling groups projected that global crude prices would decrease as U.S. production increases, resulting in an increase in global crude oil demand: "a 1.2 million b/d increase in U.S. production due to removing current export restrictions could result in anywhere between a 0 and 1 million b/d increase in global crude demand."[244] In short, this study demonstrates that crude oil operates in a global market, where increasing U.S. supply increases global demand and resulting greenhouse gas pollution.

Finally, the modeling results from a 2016 Bureau of Ocean Energy Management (BOEM) analysis of the lifecycle GHG emissions that would result from the 2017–2022 OCS Oil and Gas Leasing Final Proposed Program[245] estimated that leaving U.S. oil and gas undeveloped under the no-leasing alternative would result in a significant decrease in global oil consumption with associated reductions in GHG pollution.[246] Importantly, BOEM's global market model, MarketSim, estimated that foreign oil consumption would be reduced under the No Action Alternative by "approximately 1, 4, and 6 billion barrels of oil for the low-, mid-, and high-price scenarios, respectively, over the duration of the 2017–2022 Program."[247] Under the mid-price scenario, the model projected that each barrel of oil left undeveloped under the No Action Alternative would result in approximately a half-barrel decrease in global oil consumption. Specifically, the choice to leave ~8 billion barrels of oil undeveloped under the No Action Alternative in the mid-price scenario[248] would result in a reduction in global oil consumption of 4 billion barrels of oil.[249]

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[243] Bordoff, Jason & Trevor Houser, Navigating the U.S. Oil Export Debate, Columbia University Center on Global Energy Policy and the Rhodium Group (2015).
[244] *Id.* at 57.
[245] Wolvovsky, E. & W. Anderson, OCS Oil and Natural Gas: Potential Lifecycle Greenhouse Gas Emissions and Social Cost of Carbon, BOEM OCS Report 2016-065, Bureau of Ocean Energy Management (2016).
[246] *Id*. at 23. Unfortunately, in direct contradiction to its global oil market model MarketSim results, BOEM erroneously concludes that producing 3.7 billion barrels of oil in the Proposed Program would make no difference for GHG emissions, and would even reduce GHG emissions compared to the No Action alternative of no new leasing, by failing to account for the large-scale decrease in global oil consumption and the resulting enormous decrease in GHG pollution under the No Action Alternative. BOEM acknowledged that its GHG analysis was limited in "not fully capturing global market and GHG implications" (at Foreward) and in not including the GHG savings from reduced global oil and gas consumption in its emissions estimate for the No Action Alternative
[247] *Id.* at Table 6-2. Table 6-2 estimates production from the Final Proposed Program with a range of 2.2 billion barrels for the low price scenario, 3.7 billion barrels for the mid-price scenario, and 5.9 billion barrels for the high price scenario.
[248] *Id. at* Table 6-2.
[249] *Id.* at 23.

Although BOEM did not calculate the GHG emissions reductions from the decrease in global oil consumption, energy experts at the Stockholm Environment Institute (SEI) calculated the GHG benefits. Using standard energy contents (from the U.S. Department of Energy) and carbon contents (from the U.S. Environmental Protection Agency), and discounting the oil used in products and not combusted (International Energy Agency), SEI estimated that the reduction in global oil consumption would result in a savings of 2.3 billion tonnes CO_2 in high-price scenarios for oil, 1.6 billion in mid-price scenarios, and 0.4 billion in the low-price scenarios.[250]As the SEI analysis points out, the decreases in global GHG emissions under the No Action Alternative are enormous:

> These *decreases* in rest-of-world emissions dwarf the official estimated *increases* in US emissions that BOEM's official Programmatic Environmental Impact Statement reports for its No Action Alternative (relative to the Proposed Program), which instead amount to just 0.13 billion, 0.12 billion and 0.013 billion tonnes CO_2 for the high, mid, and low-price scenarios, respectively. Those calculations *exclude* the far larger emissions attributable to the global market effect.[251]

If BOEM were to account for the effects of reducing U.S. oil production on international oil consumption, the global GHG impact of the No Action Alternative over the life of the 2017-2022 Program would be a decrease of up to 2.3 billion tonnes of CO_2 which is greater than a year's worth of emissions from the entire U.S. transportation section (i.e., 1.7 billion tonnes CO_2).[252]

In sum, numerous scientific and economic analyses, including those by federal agencies, show that the assumption of perfect substitution in GHG analyses for U.S. oil and gas production is unfounded and unreasonable, and dramatically misrepresents the GHG and climate impacts from oil and gas leasing and development.

[250] Erickson, Peter, Final Obama administration analysis shows expanding oil supply increases CO_2, Stockholm Environment Institute (Jan. 30, 2017), https://www.sei.org/perspectives/expanding-oil-supply-increases-co2/.
[251] *Id.*
[252] *Id.*

Appendix E: List of Exhibits Submitted

The documents listed below have been submitted on a flash drive and should be considered by the agencies and included in the administrative record for this matter.

Ex. 1: Ackerman, Frank et al., Can Clean Energy Replace California Oil Production?, Synapse Energy Economics, Inc. (July 2018)

Ex. 2: Allen, David et al., Measurements of Methane Emissions at Natural Gas Production Sites in The United States, 110 PNAS 44 (2013)

Ex. 3: Allhouse, William B. et al., Community Noise and Air Pollution Exposure During the Development of a Multi-Well Oil and Gas Pad, 53 Environmental Science & Technology 12 (May 2019)

Ex. 4: American Lung Association, State of the Air 2020 (2020)

Ex. 5: Anders, Robert et al., Abstract: Groundwater Quality Results from the Regional Monitoring Program Study of the Orcutt Oil Field, presented at California State Water Resources Control Board Stakeholder Meeting, February 25, 2019, Sacramento, California, U.S. Geological Survey (2019)

Ex. 6: Apergis, Nicholas et al., Fracking and Infant Mortality: Fresh Evidence from Oklahoma, 26 Environmental Science and Pollution Research (2019)

Ex. 7: Armendariz, Al, Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements, Environmental Defense Fund (2009)

Ex. 8: Associated Press, *Overturned Tanker Spills 6K Gallons of Oil Near California Dam*, Mercury News, March 21, 2020

Ex. 9: Baker and O'Brien Incorporated, Capital Investment Amortization Study for the City of Culver City Portion of the Inglewood Oil Field, City of Culver City (May 29, 2020)

Ex. 10: Basner, Mathias et al., Auditory and Non-auditory Effects of Noise on Health, 383 The Lancet 9925 (2014)

Ex. 11: Bay Area Air Quality Management District, Particulate Matter Overview (2012)

Ex. 12: Blair, Benjamin D. et al., Residential Noise from Nearby Oil and Gas Well Construction and Drilling, 28 Journal of Exposure Science & Environmental Epidemiology (May 2018)

Ex. 13: Bohlen, Steve, State Oil and Gas Supervisor, California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Letter to Jane Diamond, Director, Water Division, U.S. EPA Region IX, re: Class II Oil and Gas Underground Injection Control (Feb. 6, 2015)

Ex. 14: Bordoff, Jason & Trevor Houser, Navigating the U.S. Oil Export Debate, Columbia University Center on Global Energy Policy and the Rhodium Group (2015)

Ex. 15: British Broadcasting Corporation, *U.S. Oil Prices Turn Negative as Demand Dries Up*, BBC News, April 21, 2020

Ex. 16: Brown, Heather P., Memorandum to Bruce Moore, U.S.EPA/OAQPS/SPPD re: Composition of Natural Gas for use in the Oil and Natural Gas Sector Rulemaking (July 28, 2011)

Ex. 17: Bundy, Kevin, Letter to Mike Feuer, City Attorney, City of Los Angeles re: Errors in Report of the City Petroleum Administrator on the Feasibility of Amending Current City Land Use Codes in Connection with Health Impacts at Oil and Gas Wells and Drill Sites (Oct. 3, 2019)

Ex. 18: Burke, Marshall et al., Higher Temperatures Increase Suicide Rates in the United States and Mexico, 8 Nature Climate Change (2018)

Ex. 19: California Council on Science and Technology, Advanced Well Stimulation Technologies in California (2016)

Ex. 20: California Council on Science and Technology, An Independent Scientific Assessment of Well Stimulation in California Volume II: Potential Environmental Impact of Hydraulic Fracturing and Acid Stimulations (2015)

Ex. 21: California Council on Science and Technology, Excerpts from An Independent Scientific Assessment of Well Stimulation in California Volume II: Potential Environmental Impact of Hydraulic Fracturing and Acid Stimulations (2015)

Ex. 22: California Council on Science and Technology, Orphan Wells in California: An Initial Assessment of the State's Potential Liabilities to Plug and Decommission Orphan Oil and Gas Wells (2020)

Ex. 23: California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Benzene in Water Produced from Kern County Oil Fields Containing Fresh Water (1993)

Ex. 24: California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Idle Well Program Report on Idle & Long-Term Wells in California, Reporting Period: Jan. 1, 2018 to Dec. 31, 2018 (July 2019)

Ex. 25: California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Notice to Operators 2020-02, Moratorium on New Approvals of Cyclic Steam Above Fracture Pressure (Jan. 7, 2020)

Ex. 26: California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, Press Release: California Announces New Oil and Gas Initiatives (Nov. 19, 2019)

Ex. 27: California Regional Water Quality Control Board, Central Valley Region, Order R5-2017-0036 (April 6, 2017)

Ex. 28: Casey, Joan A. et al., Unconventional Natural Gas Development and Birth Outcomes in Pennsylvania, USA, 27 Epidemiology 2 (2016)

Ex. 29: Center for Biological Diversity, Fracking and Dangerous Drilling in California: Briefing Book, Californians Against Fracking (Dec. 2017)

Ex. 30: Central Valley Regional Water Control Board, Staff Report, Valley Water Management Company, McKittrick 1 & 1-3 Facility, Kern County (Feb. 25, 2019)

Ex. 31: Chappelle, Caitrin et al., Just the Facts: Groundwater in California, Public Policy Institute of California (May 2017)

Ex. 32: Chittick, Emily A. & Tanja Srebotnjak, An Analysis of Chemicals and Other Constituents Found in Produced Water from Hydraulically Fractured Wells in California and the Challenges for Wastewater Management, 204 Journal of Environmental Management (2017)

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Ex. 34: Colorado Oil and Gas Conservation Commission, Conservation Commission: Colorado Weekly and Monthly Oil and Gas Statistics (July 6, 2012)

Ex. 35: Conticini, Edoardo et al., Can Atmospheric Pollution Be Considered a Co-factor in Extremely High Level of SARS-CoV-2 Lethality in Northern Italy?, 261 Environmental Pollution 114465

Ex. 36: Craft, Elena, Do Shale Gas Activities Play a Role in Rising Ozone Levels?, Environmental Defense Fund (2012)

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Ex. 40: Duren, Riley et al., California's Methane Super-Emitters, 575 Nature (Nov. 2019)

Ex. 41: Earthworks, Sources of Oil and Gas Pollution (2011)

Ex. 42: Eisen, Rebecca J. et al., County-Scale Distribution of *Ixodes scapularis* and *Ixodes pacificus* (Acari: Ixodidae) in the Continental United States, 53 Journal of Medical Entomology 2 (2016)

Ex. 43: Erickson, Peter, Final Obama administration analysis shows expanding oil supply increases CO_2, Stockholm Environment Institute (Jan. 30, 2017)

Ex. 44: Erickson, Peter, Rebuttal: Oil Subsidies—More Material for Climate Change Than You Might Think, Council on Foreign Relations Blog (Nov. 2, 2017)

Ex. 45: Erickson, Peter et al., Limiting Fossil Fuel Production as the Next Big Step in Climate Policy, 8 Nature Climate Change, 2037 (Dec. 2018)

Ex. 46: Erickson, Peter & Michael Lazarus, How Limiting Oil Production Could Help California Meet Its Climate Goals, Stockholm Environment Institute (2018)

Ex. 47: Erickson, Peter & Michael Lazarus, Impact of the Keystone XL Pipeline on Global Oil Markets and Greenhouse Gas Emissions, 4 Nature Climate Change (2014)

Ex. 48: Erickson, Peter & Michael Lazarus, SEI Working Paper No. 2016-2: How Would Phasing Out US Federal Leases for Fossil Fuel Extraction Affect CO2 Emissions and 2°C Goals?, Stockholm Environment Institute (2016)

Ex. 49: Ferrar, Kyle Impact of a 2,500' Oil and Gas Well Setback in California, FracTracker Alliance (July 2, 2019)

Ex. 50: Fiore, Arlene et al., Linking Ozone Pollution and Climate Change: The Case for Controlling Methane, 29 Geophys. Res. Letters 19 (2002)

Ex. 51: Fleming, John, PhD. & Candice Kim, Danger Next Door: The Top 12 Air Toxics Used for Neighborhood Drilling in Los Angeles, Center for Biological Diversity and Stand-LA (Dec. 2017)

Ex. 52: FracTracker Alliance, Kern County: Oil and Gas Activities by the Number Informational Table (May 28, 2019)

Ex. 53: Friedman, Lisa, *New Research Links Air Pollution to Higher Coronavirus Death Rates*, N.Y.Times, April 17, 2020

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Ex. 56: Gonzalez, David J. X., Oil and Gas Production and Spontaneous Preterm Birth in the San Joaquin Valley, CA, Joaquin Valley, CA, Environmental Epidemiology 4:e099 (2020)

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Ex. 58: Greiner, Lydia et al., Environmental Health Project Technical Reports Issue 4: Health and Unconventional Oil & Gas Development: Delphi Study Results, Southwest Pennsylvania Environmental Health Project (Sept. 8, 2016)

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Ex. 61: Harrigan, Ryan J. et al., A continental risk assessment of West Nile virus under climate change, 20 Global Change Biology 8 (2014)

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Ex. 63: Hays, Jake et al., Public Health Implications of Environmental Noise Associated with Unconventional Oil and Gas Development, 580 Science of the Total Environment (2016)

Ex. 64: Hecht, Sean B., Co-Executive Director, Emmett Institute on Climate Change and the Environment, UCLA School of Law, Letter to Mike Feuer, Los Angeles City Attorney, re: Los Angeles City Authority for Setback from Oil and Gas Operation (Dec. 17, 2019)

Ex. 65: Helmig, Detlev et al., Reversal of Global Atmospheric Ethane and Propane Trends Largely Due to US Oil and Natural Gas Production, 9 Nature Geoscience (2016)

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Ex. 74: Kelly, David, Deadly House explosion in Colorado Traced to Uncapped Pipe from Gas Well, Los Angeles Times, May 2, 2017

Ex. 75: Report for the Revisions to the Kern County Zoning Ordinance – 2015 (C) Focused on Oil and Gas Permitting, SCH #2013081079 (Nov. 9, 2015)

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Ex. 78: Last Chance Alliance Organizations, Letter to Governor Gavin Newsom and the California State Legislature re: Protect Workers and Communities, Not Fossil Fuel Polluters (May 18, 2020)

Ex. 79: Macey, Gregg P. et al., Air Concentrations of Volatile Compounds Near Oil and Gas Production: A Community-based Exploratory Study,13 Environmental Health 1 (2014)

Ex. 80: Magnoli, Giana, *Plains All American Pipeline Faces 46 Criminal Charges in Refugio Oil Spill*, Noozhawk, May 17, 2016

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Ex. 83: McCawley, Michael, Air Contaminants Associated with Potential Respiratory Effects from Unconventional Resource Development Activities, 36 Seminars in Respiratory and Critical Care Medicine 3 (2015)

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Ex. 96: Natural Resources Defense Council, Drilling in California: Who's at risk? (October 2014)

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Ex. 102: Paulik, Blair L., Environmental and Individual PAH exposures near rural natural gas extraction, 241 Environmental Pollution (2018)

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Ex. 117: Stokstad, Erik, *Droughts Exposed California's Thirst for Groundwater*, ScienceMag.org (April 16, 2020)

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