The Honorable Kathy Hochul
Governor of New York State
NYS State Capitol Building
Albany, NY 12224

via electronic mail

April 22, 2024

Dear Governor Hochul,

We are a group of New York scientists and health professionals who extensively researched the risks and harms of hydraulic fracturing as New York State deliberated a decade ago on whether to prohibit or permit this unconventional form of shale gas extraction. New York made the right decision to ban fracking. We are writing now to urge you to sign into law the legislation (A8866/S8357) that bans drilling and fracking using carbon dioxide, an experimental practice that poses nearly all the same dangers as hydraulic fracturing with water and adds several new ones.

Background

The scientific evidence that several of us compiled in the *Compendium of Scientific*, *Medical*, *and Media Findings Demonstrating Risks and Harms of Fracking and Associated Infrastructure* (the Compendium) overwhelmingly indicates that the public health and climate risks from fracking are real and the range of environmental and economic harms wide. Our examination, now in a 9th edition and backed by nearly 2,000 peer-reviewed studies, shows that fracking—no matter how regulated—is innately threatening to human health and climate stability upon which human health depends.[1]

Separately, and based on a review of this same body of evidence by the New York Department of Health, then-Governor Cuomo announced a regulatory ban on high-volume hydraulic fracturing in December 2014. This was a scientifically sound decision that was later codified legislatively by the New York State 2021-22 budget, which added subdivision 3a to ECL 23-0501 to prohibit high-volume fracturing using water in oil and gas mining because of the many dangers high-volume hydraulic fracturing poses to the environment and to human health.

In the fall of 2023, a company began offering leases to landowners in the Southern Tier to undertake injection of liquefied carbon dioxide (CO2) into shale formations, with the intention to recover methane gas, while storing some of the CO2 in the shale formation. The company intends to import CO2 into New York via rail and/or high-pressure pipelines. Their goal is to inject CO2 and recover methane gas from one million acres across the Southern Tier, apparently

[1] Concerned Health Professionals of New York and Physicians for Social Responsibility, "Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking and Associated Natural Gas Infrastructure (Ninth Edition)," October 2023. https://concernedhealthny.org/compendium/.

considering their use of CO2 as a fracking agent not to be covered by existing laws addressing high-volume hydraulic fracturing. This loophole in our fracking ban needs to be closed.

Extracting gas with CO2 raises the same uncontrollable risks to climate and public health as fracking with water.

Whether water or CO2 is used, the technology of drilling is largely the same in both cases and brings with it the same innate harms. These include:

Smog and hazardous air pollution

As with water-based fracking, CO2-based shale gas extraction requires vertical and horizontal drilling. During this weeks-long process, toxic and radioactive substances that have been trapped inside the shale are released to the air, as is documented in more than 110 published studies compiled in the Compendium. These airborne contaminants include potent cancer-causing gases, such as benzene and formaldehyde. Air pollutants associated with drilling also include diesel exhaust, fine particles, hydrogen sulfide gas, nitrogen oxides, chlorine, and chemical precursors of ground-level ozone (smog), which can damage respiratory, cardiovascular, and nervous systems. Our research shows that air emissions from vertical and horizontal drilling can drift and pollute the air hundreds of miles downwind.

Toxic waste

Horizontal drilling brings to the surface prodigious volumes of solid waste in the form of drill cuttings that require specialized disposal. Drill cuttings are gooey, pulverized rock fragments removed from the well-bore by augurs during the drilling process. As documented in the Compendium, drill cuttings, especially those from the Marcellus Shale, often contain highly toxic metals and naturally occurring radioactive materials, including radium, lead, uranium, thorium, and polonium isotopes. Elevated levels of radium have been found in sediments downstream from landfills in Pennsylvania, Ohio, and New York State.

Climate harm

Natural gas is methane, a greenhouse gas 86 times more potent at trapping heat than CO2 over a twenty-year period. Notably, no matter how careful the process used to extract natural gas or how strict the regulations governing the practice, methane leakage is inevitable during drilling, processing, and transport. Periodic blowdowns and intentional venting of natural gas is required for routine operation and maintenance of equipment, including pipelines and the compressor stations that service them. The compiled research shows that methane escapes into the atmosphere from all parts of the extraction, processing, and distributing system at rates that sometimes exceed earlier estimates by a factor of two to six.

Further, once depleted and decommissioned, gas wells continue to provide a route for methane and injected CO2 to escape to the surface due to the deterioration of cement well casings and steel pipeline over time. As we documented in more than 30 studies, the problem of leaking wells is common, inevitable, and has no known solution. Cement plugs deteriorate over time and many wells leak from outside the well casing.

Hence, the injection of CO2 to recover natural gas runs counter to New York's nation-leading climate law, the Climate Leadership and Community Protection Act (CLCPA), which requires our state to reduce greenhouse gas emissions 40 percent by 2030 and 85 percent by 2050. To help achieve these goals, the State has denied permits for the proposed gas burning NRG Queens and Danskammer power plants, as well as for expansion of several gas pipelines. In accordance with the recommendations in the Climate Action Plan, the State is developing policies to further reduce reliance on methane and other fossil fuels.

Allowing CO2-based methane extraction undoes this progress. Not only will some fraction of the extracted methane escape into the atmosphere, most of it will be combusted, producing more CO2 emissions. These CO2 emissions will either escape to the atmosphere, increasing global warming, or, possibly, some portion will be captured and injected back into the ground, only to liberate more methane, produce more emissions, using more and more land resources while continuing reliance on fossil fuels and delaying the transition to a sustainable, renewable, cleaner, healthier energy future. In all of these ways, CO2-based methane extraction interferes with the attainment of New York's climate goals.

Acute housing shortages

As we documented in the Compendium, drilling and fracking operations inevitably bring an influx of out-of-state workers who create housing shortages and increase housing costs. As rental prices become unaffordable, local residents, especially households headed by single mothers, are displaced. For example, in a study published after our Compendium was released, researchers found that the fracking boom in Williams County, North Dakota triggered acute housing shortages as well as a spike in evictions and homelessness.[2]

Public health problems

As documented in more than 120 studies, people living near gas drilling operations experience higher rates of a multitude of health impacts, including cardiovascular and respiratory diseases including asthma, cancer, and premature death. Studies of mothers living near drilling sites find impaired infant health, especially elevated risks for low birth weight and preterm birth.

Additionally, the methane-containing shale formations in New York contain naturally occurring radioactive substances that are brought to the surface during the drilling process. Studies have

[2] Gershenson, C., Jin, O., Haas, J., & Desmond, M. (2024). Fracking Evictions: Housing Instability in a Fossil Fuel Boomtown. Society & Natural Resources, 37(3), 347–364. https://doi.org/10.1080/08941920.2023.2286640.

found radioactive dust, at levels that can cause health impacts, in homes within 16-30 miles downwind of drilling pads.

Noise and light pollution

No matter what the agent of fracking is, drilling operations bring 24/7 noise and light pollution into communities. As documented in more than 30 studies, drilling and fracking operations and ancillary infrastructure such as compressor stations expose workers and nearby residents to continuous noise and light pollution that is sustained for periods lasting many months. Chronic exposure to light at night is linked to adverse health effects, including breast cancer. Exposure to environmental noise pollution is linked to heart disease, high blood pressure, cognitive impairment, and sleep disturbance. In Colorado, noise levels in a residential area that were measured during construction and drilling of well pads exceeded thresholds known to increase the risk of cardiovascular diseases and hypertension.

Job losses and safety risks for workers

Drilling workers are at risk for exposure to radioactive substances, as well as many other health and safety risks. As documented in the Compendium, oil and gas extraction workers suffer annual fatality rates more than six times higher than the rate of all U.S. workers. In 2021, the most recent year for which data are available, 58 oil and gas extraction workers died on the job. The industry overall continues to have fatality rates at least four times the national average. Among 20 major industry groups, men in the labor sector "Mining, Quarrying, and Oil and Gas Extraction" suffer the highest suicide rate. Research also shows that retired oil and gas workers have the highest prevalence of self-reported poor health of all industry categories of retirees.

Several independent economic analyses compiled in our Compendium show that the promise of job creation, especially in the Marcellus Shale region of Appalachia, has been greatly exaggerated, with most of the fracking-related jobs going to out-of-area workers. Further, during the height of the fracking boom the most intensely drilled counties in Appalachia typically experienced both net job loss and population loss, and money that was expected to stay in the community was spent elsewhere.[9]

Mass industrialization of rural areas and harm to farming

Massive land clearing and forest fragmentation necessarily accompanies well site preparation and construction, as is documented in many dozens of studies. These land use changes pollute rivers and streams and increase erosion, sediment run-off, and risks for catastrophic flooding.

Drilling operations and pipeline construction compacts and damages agricultural soils in ways that can persist for decades. On average in the United States, each fracking well is associated with a 3.3-acre reduction in crop acreage. Dozens of studies find that drilling and fracking operations cause gross harm to forests and natural areas, including reduced tree cover, reduced

biodiversity, and sharp declines in bird and wildlife populations. Areas affected by such changes take decades to recover and, under natural conditions, may not recover at all.

Crime and social blight

Several dozen studies in the Compendium show that communities industrialized by fracking operations have experienced steep increases in rates of crime including sex trafficking, rape, assault, drunk driving, drug abuse, and violent victimization with the arrival of drilling and fracking operations. These outcomes carry municipal costs and public health consequences, especially for women. In the Marcellus Shale region, violent crime increased 30 percent in counties that experienced a fracking boom compared to those without fracking. Aggravated and sexual assaults were the crimes primarily responsible for this increase.

Social costs also include road damage, failed local businesses, strains on law enforcement and municipal services, and higher divorce rates. School districts report increased stress, increased absenteeism, and lower student test scores. Economic analyses have found that drilling and fracking activities threaten property values and can diminish tax revenues for local governments.

Earthquakes

Hydraulic fracturing operations are a known cause of earthquakes. As with water-based fracking, CO2-based gas extraction, along with other underground CO2 storage schemes, also raises risks for earthquakes. Although the pressures used when CO2 is the stimulating agent are lower than in hydraulic fracturing operations, CO2 creates more complicated and widely distributed fractures than does water and induces more geological swelling. All these factors increase earthquake risks.[3, 4, 5]

Extracting gas with CO2 introduces additional risks beyond those of hydraulic fracking.

Carbon dioxide used for natural gas extraction is ferried in pipelines and pressurized more than 1000 pounds per square inch, turning it into a dangerous, dense-phase ("supercritical") fluid. Because CO2 converts to carbonic acid in the presence of water, CO2 sequestered in shale can acidify ground water, leach metals from surrounding rock and dissolve cement in well casings.

Supercritical CO2 is corrosive to pipelines and prone to leak.

Extracting gas or oil with supercritical CO2 requires the construction of many hundreds of miles of CO2 pipelines. These are very dangerous to public health and safety. Because CO2 converts

[3] Lyu, Qiao, et al. 2021. The role of supercritical carbon dioxide for recovery of shale gas and sequestration in gas shale reservoirs. Energy and Environmental Science 14: 8.
[4] Nicol, A. et al., 2011. Induced seismicity and its implications for CO2 storage risk. Energy Procedia, 4.
[5] White, Joshua A. and William Foxall. 2016. Assessing induced seismicity risk at CO2 storage projects: Recent progress and remaining challenges. International J. Greenhouse Gas Control 49.

to carbonic acid in the presence of even tiny amounts of moisture, CO2 pipelines are prone to corrosion. Further, small leaks in CO2 pipelines can easily become massive breaches as escaping high-pressure CO2 turns to dry ice upon leaking into air. The rapid temperature shift so induced can cause steel pipe to "unzip" and release massive amounts of CO2 very quickly.

CO2 is an asphyxiant and a toxicant.

Ambient air contains about 0.04% CO2 (400 parts per million). This level, while sufficient to pose a risk to climate stability, poses no direct health harms to humans when inhaled. Higher levels, however, can represent acute health threats.

CO2 is classified as a hazardous substance by both the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH). For this reason, both agencies limit workplace exposures to below 0.5 percent. (OSHA's permissible exposure limit is 0.5 percent averaged over 8 hours, whereas NIOSH's recommended limit is 0.5 averaged over 10 hours.) NIOSH also recommends not exceeding 3.0 percent for more than 15 minutes and considers 4 percent CO2 "immediately dangerous to life and health." Exposure to CO2 concentrations higher than 17 percent are immediately fatal while exposure to CO2 levels higher than 10 percent is potentially fatal.

Inhalation exposures higher than OSHA and NIOSH limits are hazardous in two ways. First, CO2 is a well-known asphyxiant. When released in concentrated amounts, gaseous CO2, heavier than air, flows downward, rather than dispersing upward, and displaces oxygen, leading to oxygen deprivation. Second, because CO2 converts to an acid when in contact with water, CO2 exposure can sharply lower the pH of blood and bodily tissues (acidosis), causing acute harm to lungs, heart, and nervous system.[6]

CO2's ability to trigger both asphyxiation and acidosis upon inhalation, means that major CO2 pipeline ruptures can have health impacts up to two miles away.

The CO2 pipeline breach in Satartia, Mississippi in February 2020 caused a mass poisoning that necessitated the evacuation of over 200 people and left 45 people hospitalized. Because an invisible cloud of CO2 hugged the ground and displaced the oxygen needed for internal combustion engines to run, the accident impeded emergency response vehicles and attempted evacuations. Some exposed residents continue to suffer respiratory disabilities from this accident.[7]

More recently, residents of Sulphur Springs, Louisiana were forced to shelter in place when a high-pressure CO2 pipeline owned by Exxon breached on April 3, 2024, releasing an estimated

[6] Schettler, Ted. Carbon dioxide fact sheet. April 11, 2022. https://www.sehn.org/sehn/2022/4/11/carbon-dioxide-fact-sheet?rq=fact%20sheet.

[7] Zegart, Dan. The gassing of Satartia. Huffington Post. August 26, 2021.

2548 barrels of CO2 and triggering an emergency response that included a road closure. More than two hours passed before the operator arrive on the scene to remediate the problem.[8, 9]

CO2 can contaminate drinking water sources.

The chemical reactivity of CO2 when in contact with water allows it to dissolve rock and cement and potentially migrate into underground aquifers, poisoning drinking water for millions of people. Some of the CO2 injected in the process of extracting gas will return to the surface via the production wells, which bisect drinking water aquifers.[10]

Extracting gas with CO2 is highly experimental.

Little is known about the health risks of CO2-based shale gas extraction because almost no large, field-scale operations that couple natural gas extraction with carbon sequestration have been done. Certainly, none exist in densely populated regions such as New York State. The peer-reviewed literature on the public health harms of CO2 fracking is, therefore, non-existent. The papers that do consider the potential risks of CO2 fracking are few in number, mostly from China and India, and report the results of simulations, computational studies, and computer modeling rather than empirical data gathered from real-life field operations. There also exist a few laboratory studies that exposes pieces of shale to supercritical CO2 in laboratory settings. Almost all these papers point to significant data gaps and conclude that CO2-based shale gas extraction requires much more study before it is commercially ready.

Many of these studies raise concerns about how little is known about the flow of CO2 underground and its ability to create fractures, The behavior of supercritical CO2 during the fracturing process is complex and unclear. A 2023 Chinese study lists as a "challenge" to the future development of CO2 injection techniques into shale for purposes of natural gas extraction the problem of pipeline corrosion. "Carbonic acid generated after CO2 dissolution in water can also corrode metal materials such as well pipelines, and the corrosion forms are different under different conditions. These types of corrosion may lead to pipeline leakage, reservoir blockage, and reservoir pollution." The authors emphasized that more research is needed.[11]

Similarly, a 2022 study from India concludes that, "**for commercial application**, **more studies are required** to be carried out. Most of the studies assume laminar jet flow of supercritical CO2 without considering crack initiation. However, the rock-breaking efficiency and the fracture

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[8] Hefflinger, Mark. Exxon/Denbury CO2 Pipeline Leaks in Louisiana, Triggering Shelter in Place Order. April 5, 2024. https://pipelinefighters.org/news/denbury-co2-pipeline-leaks-in-louisiana-triggering-shelter-in-place-order/

[9] Lakhani, Nina. 'Wake-up call': pipeline leak exposes carbon capture safety gaps, advocates say. The Guardian. April 19, 2024. https://www.theguardian.com/us-news/2024/apr/19/exxon-pipeline-leak-carbon-capture-safety-gaps.

[10] Goodman, Angela et al. 2020. Shale pore alteration: potential implications for hydrocarbon extraction and CO2 storage. Fuel. 265.

[11] Wang, Lu et al. 2023. A systematic review of CO2 injection for enhanced oil recovery and carbon storage in shale reservoirs. International J. Hydrogen Energy 48.

propagation with various types of flows, like turbulent flow conditions, must also be considered."[12] [Emphasis added.]

Governor, Hochul, this is not our first letter urging your support of a ban on CO2-based natural gas extraction for New York State. But we hope that this communication—which, in a more fulsome way than in our earlier letters, lays out the scientific case against this dangerous and untested technology—will provide you all the evidence you need to sign A8866/S8357 into law, thus strengthening our statewide fracking ban.

Sincerely,

Larysa Dyrszka, MD
Concerned Health Professionals of New York
Physicians for Social Responsibility, New York

Robert Howarth, PhD
David R. Atkinson Professor of Ecology and Environmental Biology
Cornell University

Anthony Ingraffea, PhD, PE
Dwight C. Baum Professor of Engineering Emeritus
Cornell University

Kathleen Nolan, MD, MSL
Concerned Health Professionals of New York
Physicians for Social Responsibility, New York

Carmi Orenstein, MPH
Concerned Health Professionals of New York
Science and Environmental Health Network

Barton Schoenfeld, MD, FACC
Concerned Health Professionals of New York
Physicians for Social Responsibility, New York

Sandra Steingraber, PhD
Concerned Health Professionals of New York
Science and Environmental Health Network

Irene Weiser, DVM
Fossil Free Tompkins

[12] Agarwal, Mandira and Vamsi Krishna Kudapa. 2022. Comparing and performance of supercritical CO2 fracking with high energy gas fracking in unconventional shale. MRS Energy & Sustainability 9.