WARNING SIGNS

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Results from Community Air Monitoring Reveal Chemicals Linked to Health Hazards

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The *Environmental Health* journal article, "Air Concentrations of Volatile Compounds Near Oil and Gas Production: A Community-Based Exploratory Study" is also available at *http://comingcleaninc.org/warningsigns*.

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Gas fracking in Pennsylvania backyards.

Title Page
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Protection from air emissions at a drill site in Wyoming.

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GLOSSARY OF TERMS AND ABBREVIATIONS

AIR EMISSIONS
Gases, vapors and particulate matter released into air.

BENZENE
An aromatic hydrocarbon present to a minor degree in most crude oils. Used in manufacturing detergents, synthetic fibers, and petrochemicals, as a solvent, and as a component of high-octane gasoline. Benzene is a known human carcinogen.

BLOWOUT/BLOWDOWN
A blowout is the uncontrolled flow of reservoir fluids into the wellbore and potentially catastrophically to the surface or into another subsurface formation (subsurface blowout). A blowdown is the intentional venting of gas from a well or other production equipment.

BUCKET BRIGADE
The traditional definition of a bucket brigade is manual handing of buckets of water from one person to another in a line, to put out a fire. The term was adopted by environmental health advocates to describe using "bucket" air sampling methods for community monitoring of harmful chemicals.

CANCER RISK LEVEL
This report refers to the Environmental Protection Agency's Integrated Risk Information System (EPA IRIS) cancer risk levels, which are estimates of exposure levels that could increase cancer in 1 out of 10,000; 1 out of 100,000; and 1 out of 1,000,000 people exposed.

CARCINOGENIC
A substance that can cause cancer.

COMPRESSOR
A device that raises the pressure of a compressible substance such as vapor or gas, and creates a pressure differential to move the vapor or gas.

DEVELOPMENT WELL
A well drilled within the proved area of an oil or gas reservoir to the depth of a geological formation known to be productive.

DRILL PAD
Land surface area which houses the wellheads for oil and gas extraction. Drill pads can be a central location for multiple wells.

EXPOSURE
A condition of being subject to some effect or influence. This report primarily addresses exposure to hazards or health effects from air pollutants. According to the ATSDR (Agency for Toxic Substances and Disease Registry), acute exposure is contact with a substance that occurs once or for only a short time (up to 14 days). Chronic exposure is contact with a substance that occurs over a long time (more than one year).

FLARING
The burning of hydrocarbon gases that are considered excess or waste, for commercial, technical or safety reasons.

FLOW LINE
The surface pipe through which oil or gas (or other substances like water or mud) travels from a well to processing equipment or to storage.

FRACKING
A method of stimulating oil or gas production by opening new flow channels in the formation surrounding a production well. The process involves pumping of crude oil, diesel, water, or chemicals into a reservoir with such force that the reservoir rock is broken and results in greater flow of oil or gas from the reservoir. Also known as hydraulic fracturing.

GAS FIELD
The surface area, reservoir(s), wells, and production equipment in a given area developing fossil fuels, in which the primary product drilled for and produced is natural gas.

GAS WELL
A well that primarily produces gas. Legal definitions vary among the states.

HYDRAULIC FRACTURING
A method of stimulating oil or gas production by opening new flow channels in the formation surrounding a production well. It involves pumping of crude oil, diesel, water, or chemicals into a reservoir with such force that the reservoir rock is broken and results in greater flow of oil or gas from the reservoir. Also known as fracking.

HYDROGEN SULFIDE
Chemical formula H2S, also known as sour gas. Hydrogen sulfide is a flammable, colorless, extremely hazardous gas that is heavier than air, may travel along the ground and collects in low-lying areas. The gas is often associated with oil and gas development; toxic and smells like rotten eggs at low concentrations.

INJECTION WELL
A device that places fluid deep underground into porous rock formations, such as sandstone or limestone, or into or below the shallow soil layer. These fluids may be water, wastewater, brine (salt water), or water mixed with chemicals, or gasses. They are also wells through which fluids are injected into a subsurface formation to increase reservoir pressure and to displace oil, or into which waste is disposed. Also called an input well.

LIQUIFIED NATURAL GAS
Natural gas that is cooled to about –260°F at normal pressure, resulting in the condensation of the gas into liquid form, so that it can be transported.

METHANE
A gaseous hydrocarbon (at normal temperature and pressure) consisting of one carbon atom and four hydrogen atoms. The gas is colorless, odorless and flammable. It is also a potent and harmful greenhouse gas.

MINIMAL RISK LEVEL
The Agency for Toxic Substances and Disease Registry Minimal Risk Levels (MRL) are estimates of exposure levels to a hazardous substance at which a non-cancer effect is likely to be "without appreciable risk." Exposure to a hazardous substance at a higher level than an MRL may cause non-cancer health effects.

MONITORING
The periodic observation and orderly collection of data to evaluate the effects of oil and gas development.

NATURAL GAS
A highly compressible, highly expandible mixture of hydrocarbon and small quantities of non-hydrocarbons, with a low specific gravity, and occurring naturally in a gaseous form. Found in porous formations beneath the earth's surface, often in association with petroleum. The principal constituent is methane.

OIL
A simple or complex liquid mixture of hydrocarbons that can be refined to yield gasoline, kerosene, diesel fuel, and various other products.

OIL FIELD
The surface area, reservoir(s), wells, and production equipment in a given area developing fossil fuels, in which the primary product drilled for and produced is oil.

PAH
Abbreviation for polynuclear aromatic hydrocarbon; also called polycyclic aromatic hydrocarbons. PAHs are hydrocarbon compounds with multiple benzene rings. Typically, they are components of asphalts, crude oil, coal, coal tar pitch, fuels, and greases, and are formed during the incomplete burning of coal, oil, and gas. PAHs are toxic and bioaccumulate in the environment.

PETROLEUM
A substance occurring naturally in the earth in solid, liquid, or gaseous state and composed mainly of mixtures of chemical compounds of carbon and hydrogen. In some cases, petroleum refers only to oil. When used more generally, however, it is the name for hydrocarbons, including crude oil and natural gas and their products.

PIG, PIG LAUNCHER, PIG RECEIVER

Pig launchers and pig receivers are installed on pipelines to launch and receive pipeline inspection tools commonly known as pigs. A "pig" is a tool used in the pipeline industry and propelled by the product flow. It can be used to inspect the pipeline, to capture and record information on the pipeline, to clean it or physically separate different fluids in the pipeline. The launcher/launching station is an oversized section in the pipeline that is closed and the pressure-driven flow of the product in the pipeline is used to push the tool down the pipe until it reaches the receiving trap—the "pig catcher" (or "receiving station").

PIT

A hole dug out in the ground surface for temporary storage of fluids, drill cuttings and waste during drilling, stimulation and production operations. Also called an impoundment.

PRODUCTION

The phase of the petroleum industry that deals with bringing the hydrocarbons to the surface and separating them and storing, gauging, and otherwise preparing the product(s) for delivery. Also, may refer to the amount of oil or gas produced in a given period.

PUMP

A device that increases the pressure on a fluid or raises it to a higher level. Various types of pumps include the bottom hole pump, centrifugal pump, hydraulic pump, jet pump, mud pump, reciprocating pump, rotary pump, sucker rod pump, and submersible pump.

REGULATION

A rule or order, which is issued by an agency of the executive branch of government, that has the force of law. Regulations must be authorized by a statute and generally provide more details on a particular subject than does the authorizing statute.

REFINERY

An industrial operation that manufactures finished petroleum products from crude oil, unfinished oils, natural gas liquids, other hydrocarbons, and oxygenates.

SHALE

A fine-grained sedimentary rock composed mostly of consolidated clay or mud. Shale basins may contain oil or natural gas (shale oil, shale gas) trapped within the rock formations. It is considered to be a "tight" rock formation in contrast to a porous one, that necessitates lots of fluid and high pressures in order to release the gas.

STORAGE TANK

Tank for storing an accumulation of liquid hydrocarbons prior to its transfer to a pipeline company or other purchaser.

VOC

Abbreviation for volatile organic compound. VOCs are compounds that have a high vapor pressure and low water solubility. VOCs are often components of petroleum fuels, hydraulic fluids and paint thinners. VOCs interact with nitrogen oxides (NOx) in the presence of sunlight to create ozone, a secondary air pollutant.

VALVE

A device used to control the rate of flow in a line to open or shut off a line completely, or to serve as an automatic or semiautomatic safety device.

WELL

The hole made by the drilling bit for the purpose of finding or producing crude or natural gas or providing services related to the production of crude oil or natural gas.

EXECUTIVE SUMMARY

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Air monitoring training in Pennsylvania.

The United States' oil and gas boom has transformed hundreds of communities across the country—from rural areas and small towns to suburbs and cities—into industrial production zones. Oil and gas companies are using unconventional techniques such as hydraulic fracturing to extract deposits wherever they can be reached, even if those places are in the backyards of homes, near schools or places of worship, or on farmland. Oil and gas production uses hundreds of toxic chemicals that are emitted directly or escape into the air, exposing residents, workers, and animals.

This report provides results from community air monitoring in six states near oil and gas wells and other sites associated with oil and gas production processes, particularly hydraulic fracturing, or fracking.[1] Monitoring results revealed the presence of an array of airborne hazardous chemicals at levels higher than federal health and safety standards—in some cases, in concentrations that pose an immediate health threat to people.

The investigation by a team of scientists and community members (see page 12), published in *Environmental Health*, is the first peer-reviewed study of hazardous air pollutants near fracking and other oil and gas production sites in multiple U.S. locations. Residents of communities heavily affected by oil and gas production in Arkansas, Colorado, Ohio, Pennsylvania, New York and Wyoming were trained to collect samples using equipment and methods certified by federal agencies, which were then analyzed by an accredited independent laboratory. Residents collected air samples when they personally observed activity at the sites or when they suffered symptoms such as headaches, dizziness or breathing problems.

The analysis showed:

- Eight chemicals classified as volatile compounds, were found in concentrations in excess of either the U.S. Environmental Protection Agency's most hazardous cancer risk level or the minimal exposure levels for non-cancer risks (minimal risk level or MRL), set by the Agency for Toxic Substances and Disease Registry (ATSDR).[2] About 38 percent of the samples (29 of 76) contained concentrations of volatile compounds exceeding these federal standards.
- The chemicals that most often exceeded health and safety standards were formaldehyde, which is a known human carcinogen, and hydrogen sulfide, a nerve and organ toxin known by its rotten egg odor.
- Seven samples, all from Wyoming, contained hydrogen sulfide in concentrations ranging from more than twice to 660 times the level classified by the EPA as immediately dangerous to human life.[3]
- Fourteen samples—seven from Arkansas, six from Pennsylvania and one from Wyoming—contained concentrations of formaldehyde exceeding the EPA's most hazardous cancer risk level.
- Several other chemicals were detected at concentrations above health and safety standards. Four samples from Wyoming contained benzene, a known carcinogen, in concentrations above EPA's most hazardous cancer risk level. Seven samples from Wyoming and one from Pennsylvania contained hexane, a nerve toxin, at levels above either ATSDR minimal risk levels or the workplace safety standards for long-term exposure set by the Occupational Health and Safety Administration (OSHA). One Wyoming sample contained hexane at 7,000 times OSHA's minimal risk level. Five Wyoming samples contained levels of the nerve toxins toluene and xylene at levels exceeding either the short-term or long-term minimal risk levels.

As serious as these findings are, they don't give a full picture of the health hazards the communities face. This is because government standards are often based on levels considered safe for healthy, working adult men and do not account for the increased sensitivity of infants and children, the elderly and other vulnerable populations. Neither do government standards account for the effects of cumulative exposure to unknown chemicals or to multiple chemicals, even though most people in the United States are exposed to many other chemicals in our daily lives in our homes, at work or school, in vehicles, or from other sources. Nor do government standards account for the health hazards of unknown chemicals. For example, one Wyoming sample captured high levels of hydrogen sulfide, hexane, benzene and xylenes, plus six other identifiable volatile organic compounds (VOCs) and 15 other unidentified compounds the monitoring was not designed to measure.

Understanding the cumulative and life-cycle impacts of oil and gas development is critical to addressing these public health challenges.

THE INVESTIGATION BY A TEAM of scientists and community members is the first peer-reviewed study of hazardous air pollutants near fracking and other oil and gas production sites in multiple U.S. locations.

The research team also reviewed air quality monitoring studies conducted by regulatory agencies in five states. (See Appendix A.) State studies have found evidence of direct and "fugitive" air emissions, exposure to complex chemical mixtures, spikes of known or suspected cancer-causing chemicals and evidence of greater emissions during certain production stages. Some combination of the same compounds we found were detected in all of the studies we reviewed, but the regulators interpreted the results to suggest limited threats to health and safety.

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Toxic neighbors: Drill pad near a home in rural Wyoming.

TABLE 1

Summary of Findings of Air Monitoring at Oil and Gas Development Sites in Arkansas, Colorado, Pennsylvania and Wyoming

State	Nearest infrastructure	Chemical	Concentration (µg/m³)	% of ATSDR risk level	% of EPA cancer risk level
AR	compressor	formaldehyde	36	366% of chronic level	4,500%
AR	compressor	formaldehyde	34	345% of chronic level	4,250%
AR	compressor	formaldehyde	27	274% of chronic level	3,375%
AR	compressor	formaldehyde	28	286% of chronic level	3,500%
AR	compressor	formaldehyde	23	234% of chronic level	2,875%
AR	compressor	formaldehyde	44	120% of intermediate level	5,500%
AR	compressor	1,3-butadiene	8.5	n/a	284%
AR	compressor	formaldehyde	48	130% of intermediate level	6,000%
CO	waste pond	hydrogen sulfide	41	147% of intermediate level	n/a
PA	compressor	formaldehyde	8.3	n/a	1,038%
PA	compressor	formaldehyde	7.6	n/a	950%
PA	PIG launch	benzene	5.7	n/a	127%
PA	compressor	formaldehyde	61	124% of acute level	7,625%
PA	compressor	formaldehyde	59	120% of acute level	7,375%
PA	compressor	formaldehyde	32	325% of chronic level	4,000%
PA	compressor	formaldehyde	34	347% of chronic level	4,250%
WY	separator	hydrogen sulfide	590	602% of acute level	n/a
WY	separator	benzene	2,200	7,500% of acute level	48,890%
WY	separator	toluene	1,400	467% of chronic level	n/a
WY	separator	ethylbenzene	1,200	461% of chronic level	n/a
WY	separator	mixed xylenes	4,100	158% of intermediate level	n/a
WY	separator	n-hexane	22,000	1,041% of chronic level	n/a
WY	separator	benzene	31	106% of acute level	689%
WY	work-over rig	hydrogen sulfide	30	108% of intermediate level	n/a
WY	separator	benzene	230	784% of acute level	5,112%
WY	separator	mixed xylenes	317	146% of chronic level	n/a
WY	well	n-hexane	2,500	119% of chronic level	n/a
WY	separator	hydrogen sulfide	91	325% of intermediate level	n/a
WY	separator	benzene	110,000	374,915% of acute level	2,444,445%
WY	separator	toluene	270,000	7,200% of acute level	n/a
WY	separator	mixed xylenes	135,000	1,556% of acute level	n/a
WY	well	n-hexane	1,200,000	56,738% of chronic level	n/a
WY	separator	benzene	100	341% of acute level	2,223%
WY	compressor	benzene	35	120% of acute level	778%

CONTINUED ON NEXT PAGE

TABLE 1

Summary of Findings of Air Monitoring at Oil and Gas Development Sites in Arkansas, Colorado, Pennsylvania and Wyoming (continued)

State	Nearest infrastructure	Chemical	Concentration (µg/m³)	% of ATSDR risk level	% of EPA cancer risk level
WY	compressor	formaldehyde	46	125% of intermediate level	5,750%
WY	discharge canal	hydrogen sulfide	210	215% of acute level	n/a
WY	discharge canal	hydrogen sulfide	1,200	1,225% of acute level	n/a
WY	well pad	hydrogen sulfide	6,100	6,225% of acute level	n/a
WY	discharge canal	hydrogen sulfide	5,600	5,715% of acute level	n/a
WY	discharge canal	hydrogen sulfide	240	245% of acute level	n/a
WY	discharge canal	hydrogen sulfide	66,000	67,347% of acute level	n/a
WY	discharge canal	benzene	23	118% of intermediate level	512%

SUMMARY OF FINDINGS. Primary results of air samples taken by trained community members, at sites where unconventional oil and gas development activities occur. The samples show the presence of airborne chemicals, some at levels exceeding government health-based standards. Detailed monitoring results are available in the *Environmental Health* journal article.

Source: Macey, G et al. "Air Concentrations of Volatile Compounds Near Oil and Gas Production: A Community-Based Exploratory Study." *Environmental Health*, October 2014.

Air samples were taken when community residents could verify that activity was taking place at the sites or when they experienced symptoms. Thus, the project provides the range of potential exposure levels experienced by people living or working near these sites. The results from this independent study demonstrate that state regulators' studies are incomplete. Therefore, one cannot assume that there are no significant health threats from air pollution generated at oil and gas development sites.

For each place where air samples were taken, the report also provides personal testimonies from people who live there, showing deep concerns that their health and that of their families and community is being harmed by exposure to toxic chemicals from oil and gas development. Although the presence of air pollution does not prove a link to the symptoms reported by community residents, the information is enough to warrant a more precautionary approach to oil and gas activities—one that places greater emphasis on avoiding health hazards for all people living and working in drilling and production areas. The monitoring data is a warning sign that we must act to prevent chemical exposures that could endanger health.

In order to better protect the environment and public health, not only in these six states but in other places where production is occurring, federal and state agencies, legislators and the scientific community must act with greater accountability. Our recommendations include:

- More comprehensive air monitoring for toxic gases, and more rigorous enforcement by state regulators of air emissions near sites associated with fracking and other production activities.
- Full public disclosure of all chemicals, constituents and compounds used in fracking and other drilling and production activities, and the amounts used. Companies should not be allowed to hide toxic chemicals as trade secrets or "confidential business information."
- Use of a precautionary approach when regulating oil and gas development operations. If data is inconclusive, regulators should err on the side of protection of health.
- Investment by utilities and governments in common-sense energy efficiency measures and clean, renewable energy development, which can be safer and more cost effective than producing fossil fuels.
- Direct engagement of community residents affected by oil and gas development in decision-making over each stage of the extraction and production cycle.

CHAPTER ONE

PAYING FOR "CHEAP" ENERGY WITH OUR HEALTH

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Families all over the U.S., including in rural and urban communities and on tribal lands, are concerned about the health impacts of unconventional oil and gas development.

The United States' dependence on energy from fossil fuels has led to drilling, mining and other extraction and production processes that can cause severe, often irreversible, damage to the environment. In recent years, as industry demand for natural gas has risen,[4] so has the practice of hydraulic fracturing, or fracking, a process in which large volumes of water mixed with chemicals and sand are injected in underground wells to provide a pathway for gas and oil to travel to the surface.

According to the U.S. Energy Information Administration (EIA), in 2012 there were more than 482,000 producing natrual gas wells nationwide.[5] The National Petroleum Council reports that up to 95 percent of gas wells are fracked, accounting for more than two-thirds of all natural gas produced in the U.S.[6] The EIA also predicts that in 2015, U.S. total crude oil production may average up to 9.3 million barrels per day in 2015, the highest annual average level of oil production since 1972. And, the production of natural gas plant liquids is expected to increase from 2.6 million barrels per day in 2013 to 3.0 million in 2015.[7]

The natural gas industry often claims that is provides "cheap energy," but we are paying the price with the endangerment of public health. Workers, animals, and people living near drilling, fracking and other production activities and sites are exposed to harmful pollutants, including diesel exhaust from trucks and construction equipment, airborne toxic chemicals, and surface water and groundwater contaminants.

Numerous studies[8] show that the hundreds of toxic chemicals used in fracking and other production activities are linked to poor health, such as problems with our lungs, heart, nerves, hormones and immune system. Scientific studies have linked exposure to these chemicals to cancer, kidney disease and birth defects and other chronic illnesses or long-term health problems. Community health surveys[9] have shown links between fracking and other production activities and symptoms such as sinus and breathing problems, mood changes, muscle and joint pain, severe headaches, dizziness and nausea, nosebleeds, skin rashes and more. Ever-emerging reports suggest a link to maternal health problems during pregnancy.

LIFE-CYCLE IMPACTS

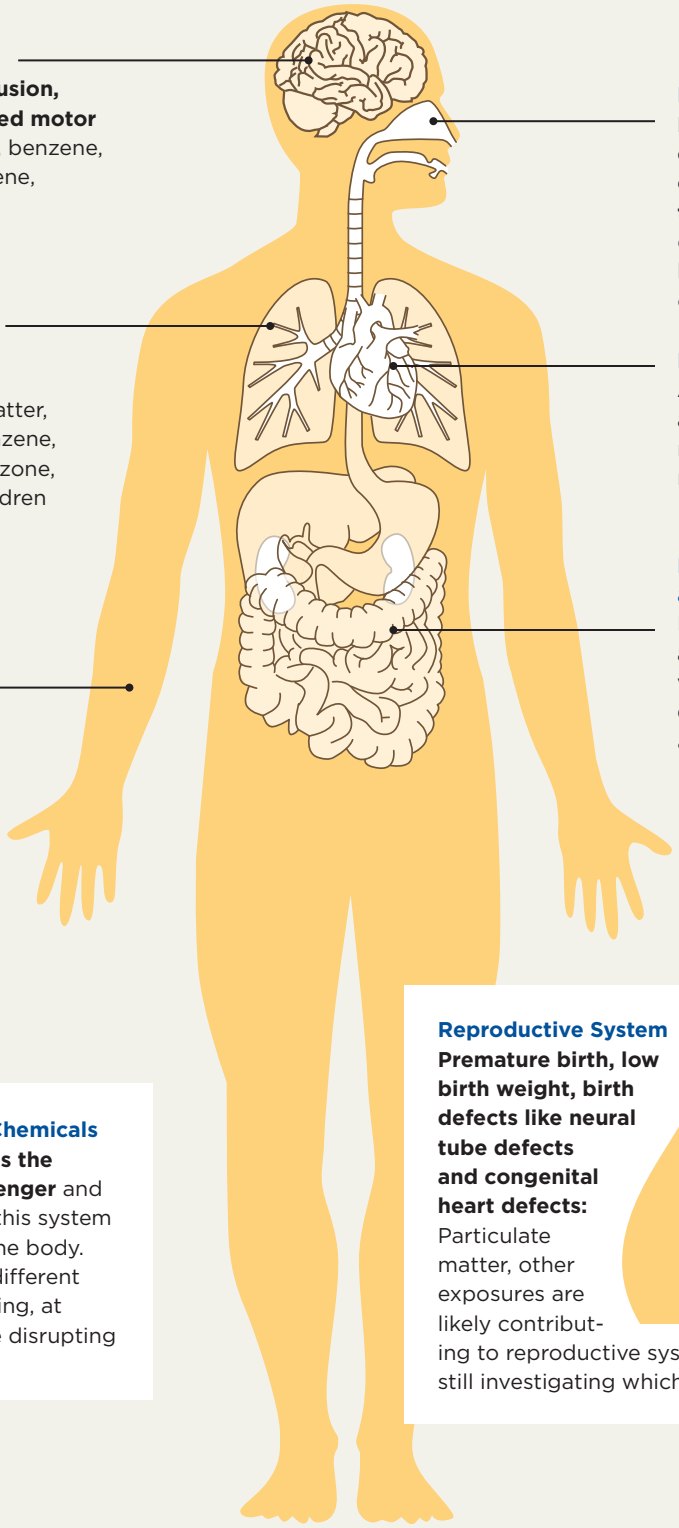
The health problems associated with fracking and other production activities are part of a cycle of hazards from every stage of fossil fuel extraction, chemical manufacturing and waste disposal.

Oil and gas are extracted from the earth, refined and used as feedstocks to make chemicals. Chemicals made from oil and gas are transformed into products like plastics, epoxies and resins. Chemicals are also used to extract and process other fossil fuels (like coal) for electricity and transportation. Oil and gas extraction and processing leaves toxic wastes in open pits or landfills from which they could leach into soil and water. Waste is sometimes

CONTINUED ON PAGE 12

FIGURE 1

Health Effects of Chemicals Associated with Oil and Gas Development



Brain and Nervous System
Dizziness, headache, confusion, memory problems, impaired motor function: hydrogen sulfide, benzene, toluene, ethylbenzene, xylene, methylene chloride

Lungs
Cough, asthma, difficulty breathing, COPD (chronic obstructive pulmonary disease), silicosis, lung cancer: Fine particulate matter, benzene, toluene, ethylbenzene, xylene, hydrogen sulfide, ozone, silica, radon, methane, Children and pregnant women are especially vulnerable to these impacts.

Skin
Irritation, rashes, hair loss: Benzene, toluene, nitrogen oxide

Eyes, Nose, and Throat
Rashes, irritation, tearing eyes, bloody nose, cancer of the nose and throat: benzene, toluene, ethylbenzene, xylene, hydrogen sulfide, nitrogen oxide, formaldehyde

Heart and blood
Anemia, chest pain, heart attack: arsenic, carbon monoxide, fine particulate matter, radium

Digestive System and Liver
Irritation of stomach and intestines, nausea, vomiting, diarrhea, liver damage: formaldehyde, arsenic, xylenes

Endocrine Disrupting Chemicals
The endocrine system is the body's hormonal messenger and exposures that impact this system can affect any part of the body. Of the more than 600 different chemicals used in fracking, at least 37% are endocrine disrupting chemicals.

Reproductive System
Premature birth, low birth weight, birth defects like neural tube defects and congenital heart defects: Particulate matter, other exposures are likely contributing to reproductive system effects but research is still investigating which chemicals are implicated.

© Amanda Wait/NonprofitDesign.com

This image indicates the common symptoms and health impacts known to be linked to chemicals associated with unconventional oil and gas development, including some of the chemicals captured in air samples as part of this project.

NOTE: For a description of health symptoms associated with specific chemicals, see the Agency for Toxic Substances and Disease Registry at *http://www.atsdr.cdc.gov/substances/ToxOrganSystems.asp*.

FIGURE 2

Life-Cycle Impacts of Oil and Gas Development

Impacts of oil and gas development occur throughout the process (such as exploration, extraction, transportation, refining) and throughout product life cycles (chemical and consumer product manufacturing, use and disposal). These images and stories provide real-life examples of the impacts felt by people and communities across the U.S.

Elk Basin, Wyoming

Produced water from oil development is discharged into **open-air canals.** While residents, livestock and wildlife are all exposed to the toxic air emissions coming from the water, the animals also have access to the water for drinking. "While sampling, at first I smelled rotten eggs along with a metallic taste in the back of my throat. Then an immediate headache, burning-runny eyes and nose, and a stiff neck with a tightness in my chest." *—Deb Thomas*

© Deborah Thomas

Pavillion, Wyoming

Gas separator sheds—where the extracted natural gas is separated from other heavier compounds—are another source of toxic emissions. "I was at home and was just overcome by this sickly sweet odor and an acid-like metallic taste. I went out to investigate. When I got there (to the separator shed), I started feeling tightness in my chest, nausea, throat irritation, neck stiffness, extreme dizziness, a headache and a runny nose." *—John Fenton*

© Elizabeth Crowe

Erie, Colorado

Oil and gas corporations want increased supply, and **new gas drilling pads** open up access to underground reserves. Wipe samples show that the gas drilling pads release chemical vapor clouds and toxic particulates, including silica dust, which drifts into nearby neighborhoods and playgrounds.

Erie, Colorado

Taking an air sample from a **waste water pond** gave all four air samplers headaches and nausea.

© iStockphoto/Danilin

Everywhere, USA

Exposure to industrial chemicals in **products we use every day**, from plastic toys to cleaners and construction materials, can be hazardous to our health. Many cancers, reproductive and developmental disorders, birth defects and other chronic illnesses are linked to these chemicals.

Clark, Wyoming

Central gathering facilities are places where raw gas is collected for future processing and shipment. When taking an air sample at this site, Caitlin Kennedy said, "It smelled like someone had turned a stove on without the pilot light on. I immediately got a headache, my nose started burning and I felt lightheaded."

Athens, Ohio

Waste from gas drilling and processing operations is also **injected into the ground**. Air samples at this waste site detected the same volatile organic compounds emitted at gas production sites.

Van Buren County, Arkansas and Susquenna County, Pennsylvania

Compressor stations pressurize and dehydrate natural gas after it has been extracted. Air samples showed an array of chemicals that may routinely be emitted from these stations. "We were all but knocked over by the smell...a really nauseating stench that made our eyes water and throat get really tight and also had a burning sensation." *—April Lane*

McDonald, Pennsylvania and Hungry Hill, New York

Gas pipelines are routinely cleared out for **maintenance** purposes, by blowing out the gas into the open air. One method for maintenance is called a "blow down." Samples taken before, during and after blow down show higher toxic chemical emissions during and after the blow down.

Mossville, Louisiana

The oil and gas development boom is helping drive **chemical production and manufacturing**. Biomonitoring and household dust studies in the historic African American community of Mossville, home to many chemical manufacturing facilities, show some of the highest recorded levels of deadly dioxin released by these corporations.

© Les Stone

Port Arthur, Texas

Oil is shipped to and processed in refineries like those in Port Arthur, on the Gulf Coast. People living near refineries report chronic health problems, ranging from headaches and dizziness to breathing disorders and cancers.

© Hilton Kelley

Houston, Texas

The Houston Ship Channel is home to a cluster of over 400 chemical plants and refineries along the Texas Gulf Coast, representing the largest petrochemical complex in the world, as well as ports that **ship fracked gas, oil and processed chemicals** overseas. Port community residents report symptoms including respiratory problems, cancers and other health impacts. "There are times when children cannot go outside to play because the air gets so bad outside it can cause them to have headaches or nose bleeds." *—Yudith Nieto*

© Chris Jordan-Bloch

injected underground, a practice which has been linked to earthquakes and potential groundwater contamination. And, plastics and other chemical-laden products often end up as waste in landfills or burned in incinerators.

At each step, community health is endangered by the contamination of air, water, land, food, consumer products and our bodies (see Figure 2, page 10). Each phase of the cycle is also a source of profit for the fossil fuel, chemical and waste industries. The chemical industry is the largest industrial consumer of natural gas in the country and virtually the sole user of all liquefied petroleum gas and natural gas liquids as a feedstock.[10] The chemical industry is the second-leading industrial consumer of all energy, second only to oil refining.

AIR POLLUTION FROM OIL AND GAS PRODUCTION

Fracking and other production activities use hundreds of chemicals the industry is not always required to disclose. In the Energy Policy Act of 2005, Congress exempted from regulation all chemicals used in fracking and other production activities except where diesel fuel is used. This limits the collection of data that is needed to understand the harm from toxic exposures. Communities often bear the burden of proof of harm from toxic exposures. While a direct link between chemical exposures and an individual's illness is difficult to prove, monitoring can measure the chemicals to which people living near fracking and other production sites are exposed.

Among residents of areas near heavy fracking and other production activities, concerns over water contamination have been a top priority, because of the potential of chemicals to leach into water supplies that may serve not just the local community but a larger region. Although air emissions have also been a concern, relatively fewer air monitoring studies have been conducted.

In 2012, grassroots organizations from six states (Figure 3) joined with Coming Clean, a national environmental health and justice collaborative, to monitor their communities' air for toxic chemicals. The goal of the project was to generate and publish data to inform state and federal policies to protect public health from chemical exposures due to fracking and other production activities.

Communities and organizations involved in the air monitoring project include:

- **Arkansas:** The group ArkansasFracking.org is working in Greenbrier, Quitman, Clinton, and other areas in north central Arkansas to gather data about central Arkansas' fracking boom, which local residents believe is a major cause of a sharp increase in health problems.
- **Colorado:** Parents in the rapidly growing town of Erie, east of Boulder, organized the group Erie Rising when gas drilling and fracking and other production activities moved from rural areas of the county to the middle of town, next to homes, schools and playgrounds.
- **Ohio:** Residents of eastern Ohio cities like Athens and Youngstown are concerned with the influx of fracking and other production activities that are not only putting their water supplies at risk, but appear to be linked to an increase in earthquakes. Groups such as Appalachia Resist, the Athens County Fracking Action Network and Frackfree Mahoning Valley want to make sure that health protection from fracking chemicals are top priority.
- **New York:** In Delaware County, New York, community members are facing the impacts of gas from other areas being sent to New York through new pipelines and compressor stations. Catskill Mountainkeeper, Hancock Residents for Preservation of the Catskills, and Catskill Citizens for Safe Energy have been taking air samples near compressor stations in advance of start up to document background air quality levels. Community members want to maintain the current de-facto moratorium on fracking and prevent industrialization of this corner of New York.
- **Pennsylvania:** Residents in Susquehanna County have been battling water contamination from fracking and other production activities for years. Breathe Easy Susquehanna County partnered with Coming Clean to do air monitoring to protect the community's health.
- **Wyoming:** Across Wyoming, people are concerned by the continuing impacts from thousands of oil and gas wells near homes, farms and communities. In the Pavillion, Clark and Deaver areas of the State, water testing has shown toxic contamination that includes high levels of chemicals known to be linked to cancer and other chronic illnesses. Clark Resource Council, Pavillion Area Concerned Citizens, and

their members, affiliated with the Powder River Basin Resource Council (PRBRC), are advocating for increased water testing and better air monitoring where development occurs. They recognize that stronger inspection and regulatory enforcement of the oil and gas industry is needed to protect water, air, property and human health.

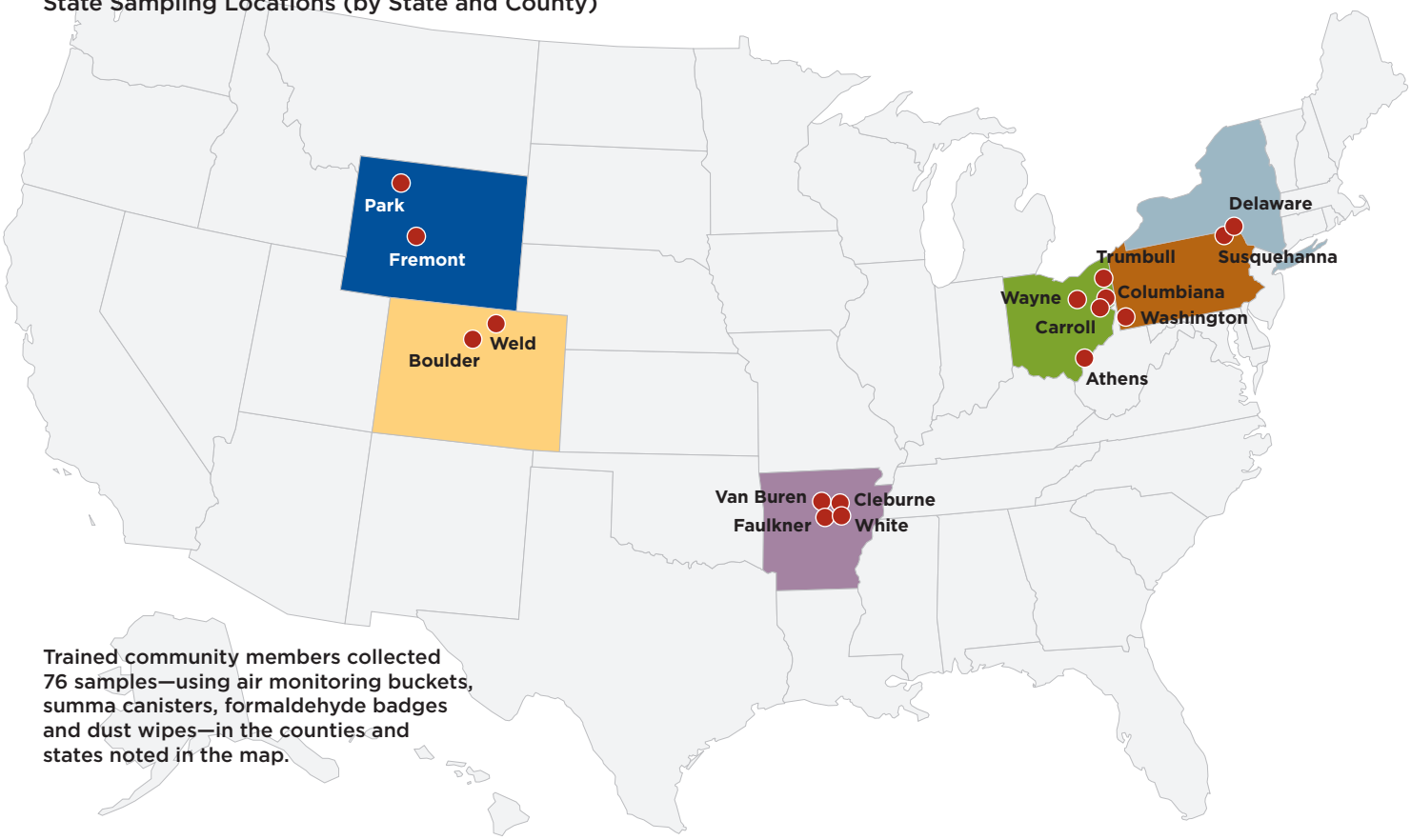
Other partners in the project included:

- ***The Alliance of Nurses for Healthy Environments***, a network of nurses promoting environmental health in public policies.
- ***The American Sustainable Business Council***, a network of small businesses working toward a healthy, sustainable economy.
- ***The Center for Environmental Health***, an advocacy organization supporting health as a priority in legislative and agency decision making.
- ***Commonweal***, an environmental, healing and research center using biomonitoring and other research techniques to protect and restore health.
- ***Global Community Monitor***, a nonprofit organization training, using and promoting community-based monitoring techniques in service of the environment and public health.
- ***Moms Clean Air Force***, a national network of parents taking action to reduce air pollution from fossil fuels.

A PRECAUTIONARY APPROACH TO DECISION-MAKING

Nationwide, scientists and community groups including those participating in this project advocate a precautionary approach[11] to regulatory decision making and policy action on fracking and other oil and gas production activities. This approach doesn't wait for severe harm to people and the environment to appear before taking action, but rather requires that industry, communities, legislatures, and regulators find and implement common-sense measures to prevent toxic chemical exposures and pollution that can make people sick. Precautionary action is critical to addressing disproportionate impacts to people of color and low-income communities. The organizations involved in this project support the Principles of Environmental Justice[12] which assert that all people have an equal right to health protection, regardless of race, ethnicity, income or other socioeconomic factors.

FIGURE 3
State Sampling Locations (by State and County)



Trained community members collected 76 samples—using air monitoring buckets, summa canisters, formaldehyde badges and dust wipes—in the counties and states noted in the map.

CHAPTER TWO

AIR SAMPLING PROTOCOLS

In order to collect air emissions data for this project, Global Community Monitor organized "Bucket Brigades" in six states to keep records of pollution incidents—location, nature, duration, wind and other weather conditions, health effects or property damage. The Bucket Brigade process included operating monitoring equipment to capture emissions for laboratory analysis, keeping logs to record how the incident was addressed—by a call to the appropriate regulatory agency or the company known or suspected to be the source of the pollution, or calls to alert neighbors. Residents were encouraged to take photos or video of their work for further documentation.

Air monitoring can help determine the types and levels of pollutants to which community residents and workers are exposed. The evidence gathered through the various monitoring devices supports personal testimonies of odors, nausea, stinging eyes, burning noses, sore throats, coughs, and other symptoms. The data helps bridge the gap between communities, regulators and industry, helping to determine whether or not companies are following the law and regulators are protecting public health. Samples provide a "snapshot in time" of air quality but not a complete list of pollutants or the full range of exposure.

The Bucket Brigade follows stringent quality control protocols originally designed with US EPA Region 9, and contracts with labs that use EPA-approved methods for analysis. Subsequent protocols were further refined with the Contra Costa Health Department in California, Region 6 EPA and the Delaware Department of Natural Resources and Environmental Control to assure Quality Control and Quality Assurance of the data.

FIGURE 4
Diagram of the Air Sampling Bucket

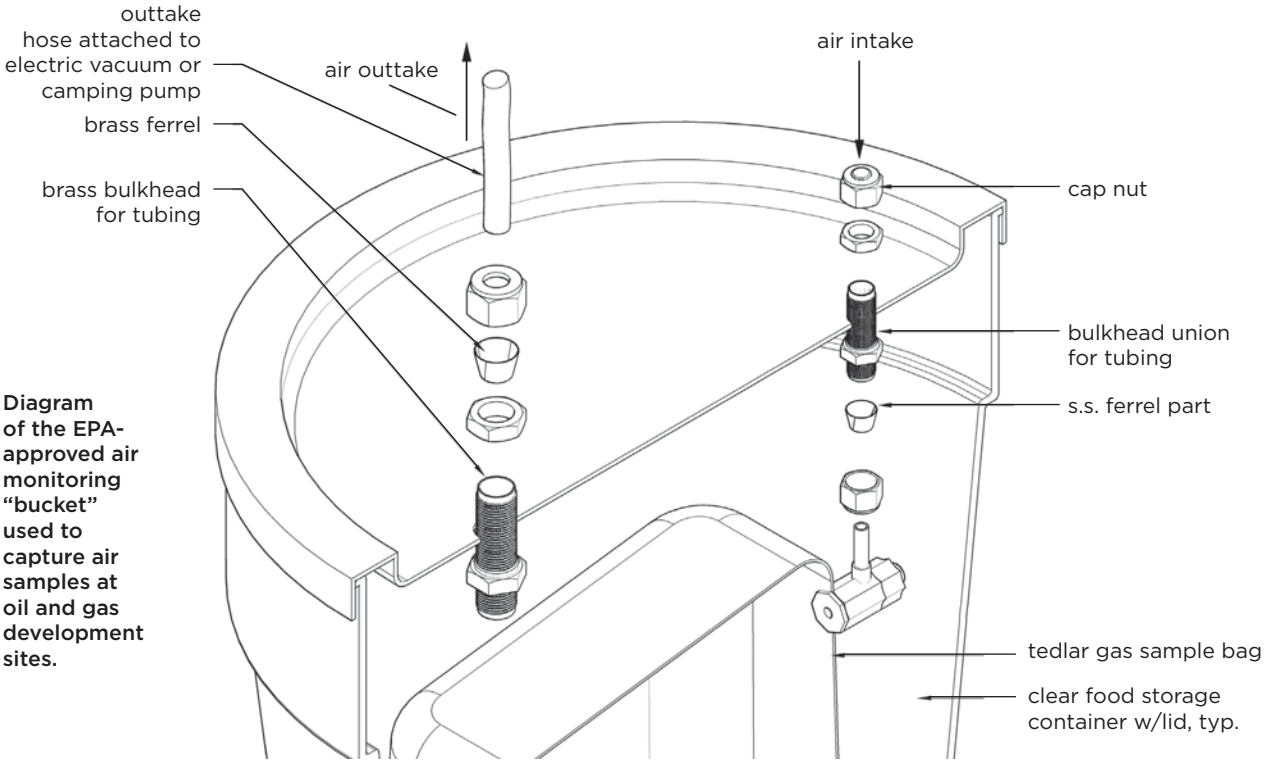


Diagram of the EPA-approved air monitoring "bucket" used to capture air samples at oil and gas development sites.

BUCKET SAMPLING

The monitoring bucket encloses a Tedlar bag and vacuum to draw air samples. Air is drawn for several minutes and captured in the bag. The bag is sealed, removed from the bucket and sent to ALS Environmental in Simi Valley, Calif., where it is analyzed by methods approved by federal regulators.[13] Their analyses can detect more than 70 volatile organic compounds and 20 sulfur compounds.

ONCE COMMUNITY MEMBERS are trained on the equipment, the buckets are kept at various locations in the community, selected based on the location of odors and health symptoms that have been experienced and reported on a consistent basis.

Once community members are trained on the equipment, the buckets are kept at various locations in the community, selected based on the location of odors and health symptoms that have been experienced and reported on a consistent basis. When an incident occurs, Bucket Brigade members join together to bring a bucket to the site of the odor incident and take a sample of the air at the time of the odor.

FORMALDEHYDE BADGE SAMPLING

Formaldehyde is monitored by a diffuse sampler, a "passive" badge hung in the sampling site, that absorbs and collects formaldehyde in the air for eight hours. Samples are stored and shipped refrigerated and sent to ALS Environmental for analysis.[14] This method is used because buckets or canisters are not designed to capture and measure formaldehyde.

SUMMA CANISTER SAMPLING

A Summa canister is a stainless steel vessel with a valve that is opened for up to 24 hours to collect an air sample. The valve is closed and the canister is sent to the lab, where the contents are analyzed[15] by EPA-approved methods for a wide range of volatile organic compounds.

© Ruth Breech

Formaldehyde badge clipped to an outdoor fence; a common air monitoring technique.

© Mollie McKinley

Summa canisters are frequently used by government agencies and communities to take air samples.

CHAPTER THREE

MONITORING RESULTS

Health researchers visit a compressor station site in Arkansas.

© Elizabeth Crowe

In this project, local groups sought to answer the troubling questions posed by oil and gas development in their communities:

- Are community members, workers, and animals being exposed to harmful airborne chemicals from fracking and other production activities?
- Do the known health effects of those chemicals give cause for concern?

Sampling results from the six states were varied, but taken together they validate community concerns that the air residents are breathing may be hazardous to health.

EXPOSURE STANDARDS

The federal government has set standards for many air pollutants, based on an estimated risk of health effects from exposure at a certain level. These are often referred to as safety levels, although a safe level of exposure is not always known. For some air pollutants, such as fine particulate matter (soot), the scientific community and federal regulatory agencies acknowledge that there is no safe level of exposure for humans.

Pollution levels captured by the monitoring project samples were compared to exposure standards set by the federal Agency for Toxic Substances and Disease Registry (ATSDR), for health effects other than cancer, and the EPA's Integrated Risk Information System (IRIS) for cancer.[16]

FINDINGS

Laboratory analysis of the samples identified eight compounds in the air at the various sites at levels greater than the levels identified by ATSDR and IRIS. Fifteen of 35 bucket samples and 14 of 41 formaldehyde badges captured concentrations of pollutants in excess of the ATSDR or IRIS levels. Hazardous levels of air pollutants were found in four of the five states where we conducted monitoring.

The chemicals that most often exceeded these standards were hydrogen sulfide and formaldehyde. Hydrogen sulfide can cause irritation to the eyes, nose, or throat,

difficulty breathing, headaches, poor attention span, and poor memory. Formaldehyde causes nose and eye irritation, increases the risk of asthma and is known to cause cancer. A summary of findings by state:

- **Arkansas:** The group ArkansasFracking.org took eight bucket samples in Faulkner County. One contained 1,3 butadiene above EPA risk levels. Butadiene irritates the nose, causes nervous system problems and causes cancer. Seven of the 13 formaldehyde badges contained pollutants above the ATSDR and IRIS levels. One of the passive samples taken at a residence had formaldehyde levels in excess of the highest (most dangerous) ATSDR and IRIS levels.
- **Colorado:** Of five bucket samples taken in Boulder and Weld counties by the group Erie Rising, one contained hydrogen sulfide in excess of ATSDR levels.
- **Ohio:** Appalachia Resist, Athens County Fracking Action Network and Frack Free Mahoning County took several samples near fracking sites in Athens, Carroll, and Trumbull counties. The samples contained no pollutants at concentrations that exceeded the ATSDR or IRIS levels.
- **Pennsylvania:** One of the four bucket samples taken by Breathe Easy Susquehanna County contained benzene at concentrations that exceeded the IRIS cancer risk level and n-hexane at concentrations that exceeded the ATSDR levels. Six of the 10 badge samples contained formaldehyde in excess of ATSDR or IRIS levels. Two of the samples exceeded both the highest (most dangerous) ATSDR and IRIS levels.
- **Wyoming:** Pavilion Area Concerned Citizens, Clark Resource Council and their members affiliated with PRBRC collected samples in Park and Fremont counties. In Park County, 9 of 10 bucket samples contained pollutants above the ATSDR or IRIS levels; seven contained high concentrations of hydrogen sulfide and four contained high levels of benzene; and one of five badge samples contained high concentrations of formaldehyde. In Fremont County, four of five bucket samples contained pollutants at concentrations in excess of the ATSDR or IRIS levels. One sample contained six chemicals exceeding these levels, including high levels of benzene. In addition, in seven of the Wyoming samples, there were four different hydrocarbon pollutants that do not have ATDSR or IRIS levels. The levels detected exceed National Institute of Occupational Safety and Health standards for workers. N-hexane was frequently found in both Park and Fremont counties.

FIGURE 5

Formaldehyde Levels Near Gas Pipeline Compressors that Exceed Health-Based Standards

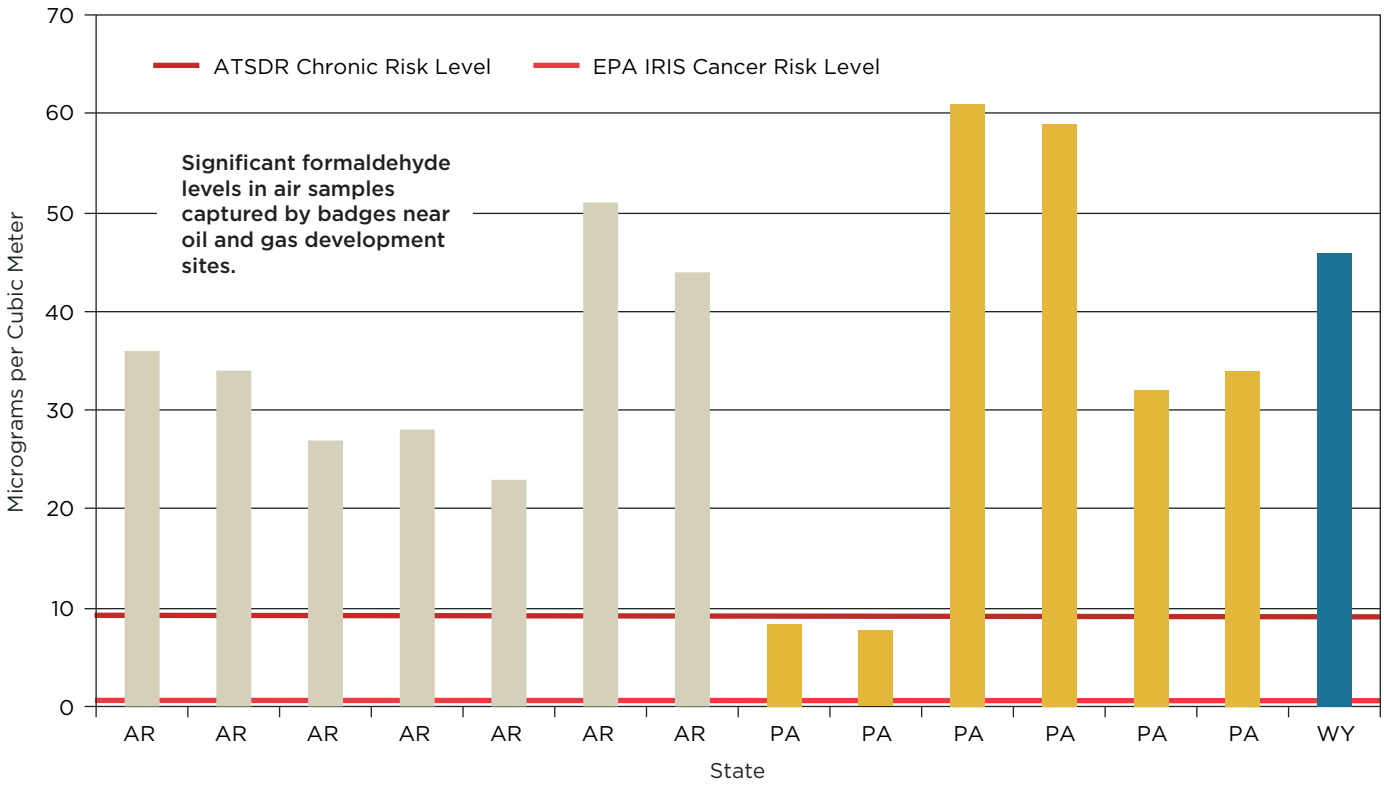


FIGURE 6

Hydrogen Sulfide Levels near Oil and Gas Sites that Exceed Health-Based Standards

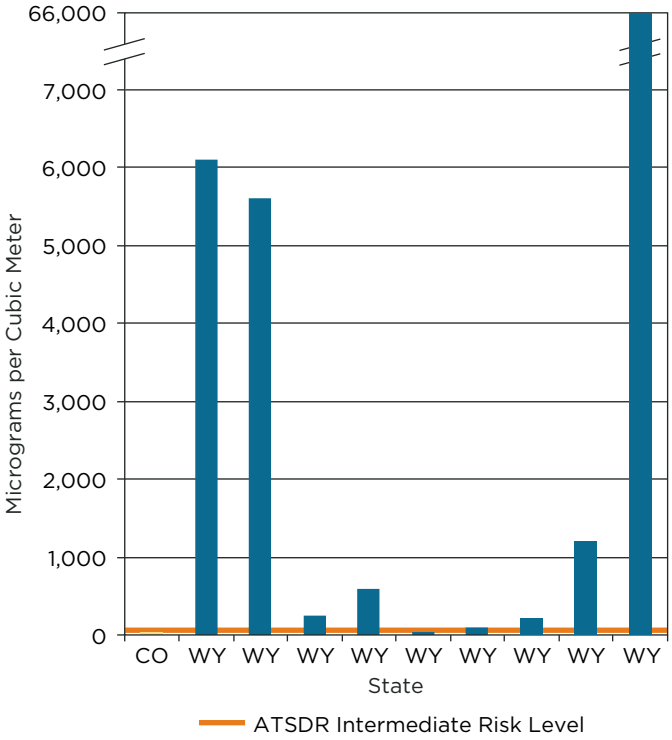
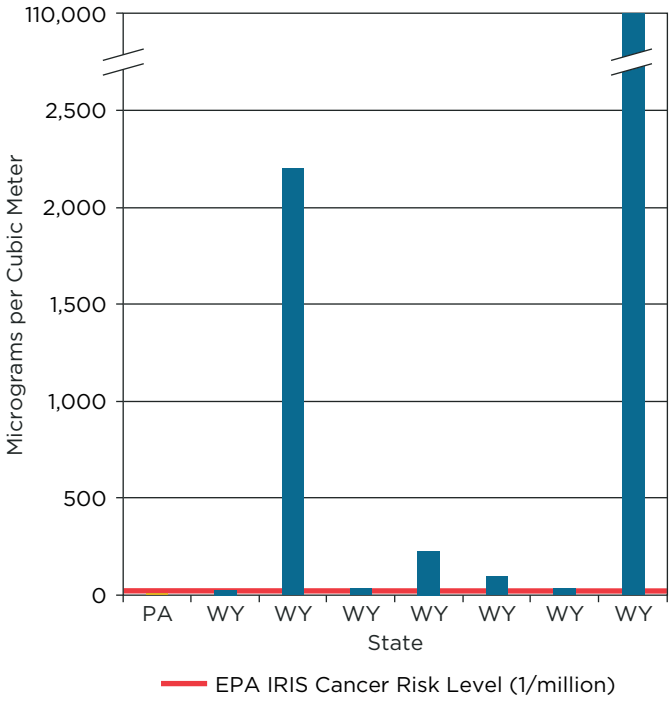


FIGURE 7

Benzene Levels near Oil and Gas Sites that Exceed Health-Based Standards



SAMPLING INDICATES THAT

local community members are being exposed to harmful airborne chemicals from fracking and other oil and gas production activities.

ANALYSIS

Studies show that more than 600 chemicals may be used in oil and gas development activities.[17] Our samples were analyzed for fewer than 100 compounds. Of the thousands of chemicals used in industry production and manufacturing, only a small number have been assigned a risk level by ATSDR or EPA. Therefore, this project is insufficient to fully capture or quantify the number or concentration of chemicals to which people working or living near fracking and other production sites are exposed.

Still, the results provide initial answers to the questions we posed. Sampling does indicate that local community members are being exposed to harmful airborne chemicals from fracking and other production activities and that the health effects known to be associated with those chemicals give justifiable cause for concern. Given how often we found pollutant concentrations that exceeded these levels in the few samples that were taken at each site, it's clear that air pollution around oil and gas development sites is a significant public health issue.

Based on the sample results, a precautionary approach means we should assume that harmful chemicals used for fracking and other production activities are just as likely to be released in Ohio as they are in Wyoming, and as likely to cause health impacts to communities in Arkansas or Colorado as they might in Pennsylvania. We need not have proof of harm to specific individuals to act to prevent chemical exposures that could endanger the health of workers and the community.

TABLE 2

Other Significant Chemical Levels Near Oil and Gas Development Sites Exceeding Health-Based Standards

County	Chemical	Standard	Standard Concentration (μg/m³)	Sample Concentration (μg/m³)	Percent of Standard Exceeded
Faulkner, AR	1,3-butadiene	EPA IRIS 1/10,000 cancer risk	3	8.5	283.3
Fremont, WY	ethylbenzene	ATSDR chronic MRL	260	1,200	461.5
Fremont, WY	mixed xylenes	ATSDR chronic MRL	217	4,100	1,889.4
Fremont, WY	mixed xylenes	ATSDR chronic MRL	217	317	146.1
Park, WY	mixed xylenes	ATSDR chronic MRL	217	135,000	62,212
Fremont, WY	toluene	ATSDR chronic MRL	300	1,400	466.7
Park, WY	toluene	ATSDR chronic MRL	300	270,000	90,000
Fremont, WY	n-hexane	ATSDR chronic MRL	2,115	22,000	1,040.2
Fremont, WY	n-hexane	ATSDR chronic MRL	2,115	2,500	118.2
Park, WY	n-hexane	ATSDR chronic MRL	2,115	1,200,000	56,737.6

Air samples also indicated high levels of other significant chemicals present at oil and gas development sites in various states.

BOX 1

Speaking Up: Health Care Providers

As fracking moves into more and more communities, there is a tremendous need for nurses, physicians, and other health care providers to become engaged. Most relevant for health care professionals are the negative health impacts to individuals and communities. Health care professionals have an edict for caring, for their patients, their families and by extension, the environment in which they live. Many of these environments are now affected by fracking.

Health care professionals are trained to investigate a problem, find a solution and then act to improve the health of patients. But we were not necessarily taught how to connect the symptoms of people living near oil and gas development sites—headaches, nausea, vomiting, nosebleeds, hair loss, low birth weights, cancers—to the harmful air and water emissions to which the people are exposed. Educating health care providers on the health impacts of fracking and other production activities is an essential first step.

Many health care providers are not aware of the gag rules that hinder their ability to honestly discuss with patients the chemical exposures they may have experienced from proximity to a fracking site. Providers are often unsure of how to address these health issues in their patients, so they are not able to fully assess the extent of exposures.

Many state and local communities have established boards or commissions to oversee the health and environmental impacts of fracking. Unfortunately, health care professionals are not routinely included. It is imperative to bring all voices to this crucial issue—not least the voices of health care providers whose professional experiences can help avoid health hazards for families and communities.

© Elizabeth Crowe

Nurses visit Capitol Hill to address the need for protective chemical standards.

— *Adelita Cantu and Katie Huffling*
Alliance of Nurses for Healthy Environments
http://envirn.org

CHAPTER FOUR

VOICES FROM THE FRONT LINES

© April Lane

Emily Lane, from Greenbrier, AR, warns a gas company truck driver that "fracking is not safe."

ARKANSAS

On February 27, 2011, Faulkner County, AR, was shaken by a magnitude 4.7 earthquake—one of more than 1,300 quakes in the county since late 2009. The state's Oil and Gas Commission has linked the quakes to four natural gas disposal wells operated by Chesapeake Energy, Deep Six and Clarita Operating, which have been shut down since late 2011.

Emily Lane of Greenbrier said the 4.7 quake jolted her from her belief that the rural area she grew up in was safe and peaceful, and she set out to learn more, starting a grassroots organization to help people who had been disrupted by living and working in the Fayetteville Shale.[18] But the earthquakes weren't the only thing disturbing area residents.

"Residents were suffering a combination of problems: fizzing water, funny-smelling air, persistent headaches," she said. "I experienced a gamut of symptoms—nausea, headache, itchy skin, sore throat. We have also had multiple residents complain of health effects from the air outside and inside their home: passing out, nosebleeds, memory loss, and a loss of sense of time."

Compounding these health problems was the impact of seeing a drilling rig inside Woolly Hollow State Park, where her father had worked and she had spent many happy times as a child.

"As I drove into the park for an evening under the stars," she said, "the drill rig shot out in front of me, lit up like a Christmas tree. I had no idea that a well had been permitted that close to the park and lake. I nearly fainted, stomach in my throat. I pulled my car over to the side of the road to gather myself. It took a bit of time to stop crying, but that feeling in my stomach is still here today.

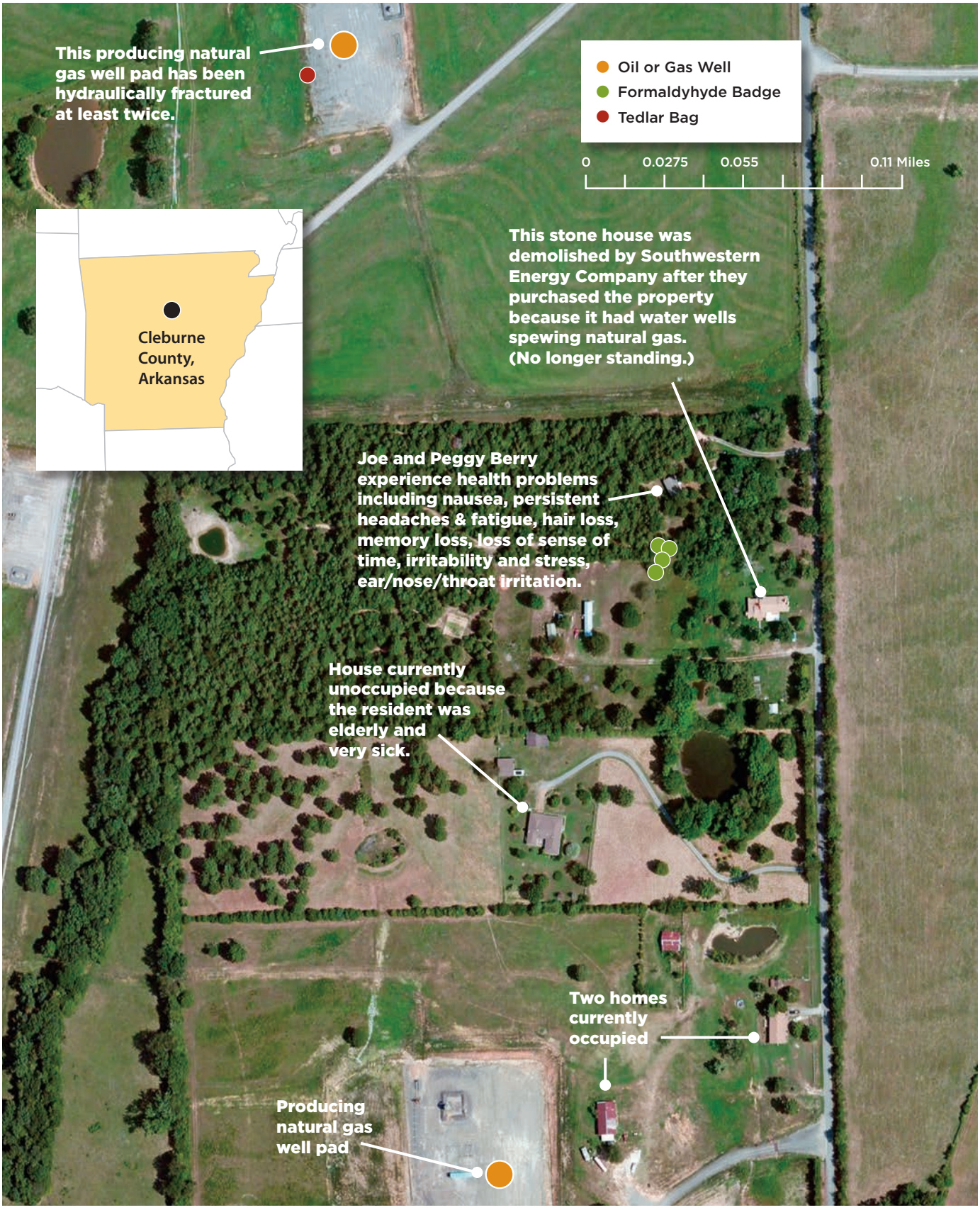
"I still go to the park when I can," she said, "but it's not the same. The feeling of being totally immersed in nature is gone. Now I just feel lucky that the well didn't blow out or have a major spill. But what about the next well they drill? I don't want to think about it."

Emily Lane's sister-in-law, April Lane, also of Greenbrier, echoed the sense of loss of the quiet, small town she grew up in.

CONTINUED ON PAGE 22

FIGURE 8

Bucket Brigade Air Samples from Cleburne County, Arkansas



Oil and gas development sites are often situated very close to homes, schools and other places where people live, work and learn. In Cleburne County, Arkansas, residences are in close proximity to drilling pads and locations of some of the air sample "grabs" that showed high chemical readings.

"Everyday life there has changed," she said. "Trucks fill every open space where gravel has been laid. Metal buildings blanket the landscape and every back road I take is filled with gas wells and pipelines and compressor stations, pumping out God only knows what, on a daily basis.

"We have a son, Lincoln, who is five. Every Sunday on our drive to church I think about the gas companies and then I think about Lincoln. I have made it my life's work to try to protect and provide a future for him and all of the residents, workers, and landowners that I care about in our hometowns. We cannot waste any more time taking this lying down.

"It is nearly impossible to understand," she continued, "what it is like to fall ill and be deathly sick each day when they start fracking and other production activities on your land, until you get sick. It is hard to comprehend the helplessness that you feel when your water has been tainted, your children are having nosebleeds and you are passing out in your home from the fumes, until it happens. These are not fairy tales or horror stories. They are real."

COLORADO

In 2011, Rod Brueske and his wife invested their family savings to restore a small farmstead on the outskirts of Longmont, a Boulder County town about 40 miles north of Denver. They had a vision of raising their own chickens and vegetables to feed themselves and sell at local farmers' markets.

But in January 2012, their dream was shattered when Encana Corp. built a drill pad across the street—a "five pack," with five gas wells on one site. Heavy truck traffic invaded the peace and quiet of the rural community, rattling their house and shaking their children awake at night.

As operations continued, Brueske noticed the flaring from the well pads. During the flaring, his wife and children experienced headaches, sore throats, a metallic taste in their mouths and gastrointestinal illness. Worried for his family's health, Brueske reported the problems to the state.

In Erie, Colorado, oil and gas development sites are spread throughout neighborhoods, near schools and playgrounds.

© Elizabeth Crowe

FIGURE 9

Bucket Brigade Air Samples from Boulder and Weld Counties, Colorado

Oil and gas development sites are often situated very close to homes, schools and other places where people live, work and learn. In Boulder and Weld Counties, Colorado, residences are in close proximity to drilling pads and locations of some of the air sample "grabs" that showed high chemical readings.

Months later, he heard a hissing from the well pad. He immediately reported this to the Colorado Oil & Gas Conservation Commission. The agency was dismissive. A later inspection by state regulators revealed that a well on the property was out of compliance and pumping pollution into the air. The Colorado Department of Public Health and the Environment fined the company $53,000 for this incident, a significant reduction from what could have been assessed. Brueske wonders how many other wells in the state might be leaking. There are fewer than 20 investigators to oversee more than 52,000 active wells in the state.[19]

THERE ARE FEWER THAN 20 investigators to oversee more than 52,000 wells in the state.

In Erie, 11 miles south of Longmont, at the time of the Bucket Brigade training in July 2012, there were 58 well pads within a two-mile radius of Red Hawk Elementary School. The majority of those well pads have multiple wells on them.

"I was riding my bike and it felt like these chemicals just hit me in the face," said Andrea Roy, an Erie resident who was active in the Bucket Brigade. "I don't know how else to describe it. My eyes started watering, my nose was burning, my throat was burning."

Said Jen Palazzolo, who moved to Boulder to escape drilling operations in Erie, "I feel very violated as a parent. You think you picked the right town and the right school only to find out that this industry is in your town bringing in only God knows what because they don't tell you."

Kathleen Ford, also a former Erie resident, knows the feeling. "We bought our place nine years ago thinking that we'd raise a family and my kids would walk across the street to the school and everything would be great," she said. "Thinking about having to give up that dream, of being in our dream community where we take bike rides at night, where my kids go to the library and the community center a lot and where we feel a real sense of community—I feel really, really sad about having to leave."

OHIO

On St. Patrick's Day in 2011, residents of Youngstown, Ohio, were shaken by the first earthquake in the area's history (according to the Ohio Department of Natural Resources or ODNR), measuring 2.2 on the Richter scale. John Williams remembers thinking: "What the heck was that?"

"It was a wakeup call," he said. "We all knew Youngstown as a safe, nice place to live. Now fracking had arrived."

Over the next few months there were five more earthquakes, and the epicenter was a deep injection gas well on Ohio Works Drive. Some residents began to investigate, put two and two together, and deduced that the injection well was the cause of the earthquakes. But state regulators repeatedly denied any connection.

"A group of us decided to protest," said Williams. They marched to the convention center, where the Chamber of Commerce was organizing a conference to tout the economic advantages of fracking and other production activities to Youngstown, which has a 48% poverty rate, the highest in the United States.

WITH THE STATE GOVERNMENT reducing renewable energy incentives, fossil fuels, global warming, and clean energy are emerging among this year's gubernatorial election issues.

By the time nine earthquakes had been recorded and the ODNR continued to deny any connection with fracking and other production activities, Williams said the public outcry could no longer be dismissed. Following a public meeting with the ODNR at the convention center, Gov. John S. Kasich suspended operations at the Ohio Works Drive well. A few days later, on New Year's Eve 2011, a magnitude 4.0 earthquake hit, damaging many homes and business. But, said Williams, it solidified residents' opposition into the Frackfree Mahoning Valley movement.

© Sandra Sleight-Brennan

Ohio residents speak out on health and environmental impacts from waste injection wells.

Meanwhile, in the southeastern corner of the state, near the West Virginia border, communities are under assault from injection wells for the disposal of waste fluids from fracking and other production activities.

In 2013, Ohio injected 687 million gallons of frack waste,[20] laden with radioactive material and heavy metals,[21] more than half from out of state. Despite the mounting intensity of protests against the dumping, Athens County recently became home to two of Ohio's largest injection wells on the same site, which can receive up to 231,000 gallons of waste a day. Before the waste is injected into the ground it is stored in tanks, which may be off-gasing toxic and radioactive compounds into a nearby neighborhood 24 hours a day.

Ohio residents have seen lowered property values; increased air, soil, and water pollution; reduced physical and mental health; and damage to local food and clean-energy economies. Accidents, explosions, earthquakes and intentional dumping in Ohio are weekly news but have not slowed down the industry. New pipelines have affected dairies and orchards that sell to local customers and restaurants. One local organic farm atop a toxic waste injection field has permanently shut down operations.

"I live in and love this community. The oil and gas industry is destroying our communities, aided by laws and regulations that favor industrial profit over local economies and human health and well-being. This government-supported industry is poisoning the air, water and food we rely on. It is destroying our community," said Athens County Fracking Action Network member, Heather Cantino. "We will keep fighting for our right to be healthy and safe and to protect the land and communities we love."

Resistance to the industrial invasion is on the rise. As of May 2014, there are over 50 organizations in Ohio fighting fracking and other production activities and its associated processes. With the state government reducing renewable energy incentives, fossil fuels, global warming, and clean energy are emerging among this year's gubernatorial election issues. Small businesses, ordinary Ohioans, and faith-based groups are calling for a switch from fossil fuels to renewables.

PENNSYLVANIA

The impacts of fracking and other production activities are not limited to physical health effects. The introduction of large-scale industrial activity into what were formerly quiet rural communities can also cause profound psychological and social problems.

Amy Payne, 33, was born and raised in Susquehanna County, PA, and lived there her entire life. In 2010, a gas company began building a drilling pad 1,200 feet from the home she, her husband and two boys lived in. At first her worries were about construction noise and whether her children were safe from the heavy truck traffic down her dirt road. A year later, a drill rig, the first of five, went up. In late 2011, she learned that a compressor station would be built at the same site.

"I could not in good conscience let my children breathe in the toxins and pollutants that would be released from this kind of facility," Payne said. "I knew I had to get my family away from the health risks that they were sure to be exposed to. Even if the water is safe for now, the air they would be breathing would compromise their health. . . . It seems a never-ending process once the industry gets started. The risks keep expanding and growing."

"When reviewing the health risks associated with this industry," she continued, "we need to consider the physical, psychological and social effects. I myself felt the effects of anxiety and stress. I had these unusual pains in my chest, so I went to the doctor and had tests done. The tests showed that I was healthy, and the chest pains were unexplained. After we moved away from the area, and I distanced myself from the situation, I stopped having the pains. I believe it was all stress related. I was dealing with a real threat every day, and could not defend my children against it, until we moved."

© Frank Finan

Gas well flare next to a family home in Brooklyn, Pennsylvania.

Rebecca Roter, a property owner in Susquehanna, recalled what her home was like before a Williams compressor station and a Cabot Oil & Gas well pad were built nearby.

"We used to walk up to the Newton Hill Cemetery, a leisurely walk on our country road," Roter said. During construction of a well pad and compressor station, our road was turned into an industrial highway with as many as 2,000 vehicles a day. When the compressor temporarily shut down after an explosion and fire, she said, "my daughter and I wanted to retrace our memories and do those things we had not done in over a year since the compressor and well pad were installed off our road. So we parked along our neighbors' cornfield, and sat in their field looking at the beautiful starry sky down the valley.

"We savored the respite from traffic and noise and enjoyed the sounds of a beautiful country evening. Then we saw a truck drive up to our parked car. It slowed down to pass it, then turned around and slowly went back down the hill. It was Cabot security. We suddenly felt scared."

As mother and daughter drove toward home, two cars followed closely, then blocked their way after crossing over a double yellow line on a state road. A man came to the driver's door and accused them of trespassing.

"I told him he had no right to stop us in the middle of a road, that he was a thug and that we were not trespassing," Roter said. "He insisted we were on Cabot property. I told him he was dead wrong, we were not on the well pad property; we were on our neighbors' field with permission."

The security guard threatened to call the state police and both private security vehicles followed the Roters to their home.

"I was furious, alarmed and shocked," Roter said, "but we did go home. We sat on our porch, feeling unsettled, angry, saddened, confused as to how drastically living on our hill has changed."

© Deb Thomas

Sampling on McMullan Ranch, near Deaver, WY.

© Denny Larson

Deb Thomas at the Crosby drill pad near her Wyoming home.

WYOMING

In 2006, a blowout at a Windsor Energy gas well in the rural community of Clark, WY, spewed eight million cubic feet of methane, vaporized drilling fluids and condensates into the air. The Wyoming Department of Environmental Quality (DEQ) later estimated that more than 250 tons of toxic pollutants were released.

Windsor Energy didn't alert residents for hours, and the DEQ wasn't notified until receiving a phone call from an evacuated resident. Twenty-five families were forced to evacuate their homes for three days while the Clark volunteer fire department tried to keep people out of the area. There was no explosion or fire, but resident Jim Sonderman said: "We were told afterward that if a spark had gone off, the whole valley would have gone up."

Today, more than 100 monitoring wells and 25 drinking water wells in the area are tested to identify and assess the toxic groundwater plumes that contaminated wells and aquifers. Because no air monitors were in place, residents, workers and emergency responders will never know what their real exposures from the blowout were. Residents report headaches, rashes, asthma episodes, extended kidney infections, kidney stones, urinary tract bleeding, colitis, diarrhea and other intestinal problems.

About 50 miles to the east, Genie and Doug McMullan are concerned for their own health and the health of their livestock. Not long after buying their ranch near the town of Deaver, they discovered a bog of oil from old, leaky pipelines connecting the oil wells on their property. They suspect that the pipes were corroded by the deadly gas hydrogen sulfide, which is released during the ongoing development.

"We noticed right away the air quality was poor, but we didn't know it was (hydrogen sulfide)," said Genie. The toxic gas hurts her lungs and makes her sleepy and dizzy.

About 100 miles south, the Lockers' farm near Pavillion, WY, is surrounded by gas wells, production pads and compressor stations. The Lockers live with bloody noses, respiratory problems, loss of smell and taste, cancers, neuropathy and cognitive difficulties.

"At times, going to work, there were big clouds of emissions I had to drive through," said Rhonda Locker. "I could see it coming from one of the wells. I now have a lot of trouble breathing. I never had that before."

"Since Rhonda got sick, I've thought about leaving every day," Jeff Locker said. "I wonder if it's killing her to stay here. But where do we go? We can't sell our land for what it's worth." (The Fremont County Board of Equalization has devalued property in the Pavillion area by 50 percent because of the impacts of oil and gas development.)

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

Clean energy from sources like this wind farm in Colorado generate electricity without toxic emissions that could harm public health.

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The monitoring data and personal stories in this report clearly show there is justifiable reason for concern with oil and gas development in the United States. Although the sampling results varied from state to state, taken together they show that oil and gas operations pose a serious threat to public health that no community should have to endure.

We believe lawmakers and regulators should take a precautionary approach to the health risks associated with oil and gas drilling and development. Where harm has already occurred, how can it mitigated and further harm be avoided? Where fracking and other production activities have not yet taken place, how should decisions be made to prevent harm to public health and the environment? For states touched by the fracking boom as well as the nation, what measures will ensure that a clean and safe energy policy safeguards the health of communities?

We recommend:

- Where oil and gas development is already happening, state agencies must put in place more robust monitoring protocols and practices. Community monitoring can be a powerful tool for assessing potential risks, and it should inform the action of regulators to better protect public health.
- Companies that produce fossil fuels must fully and publicly disclose the compounds used in fracking and other production activities. Regulators, public health officials, workers and citizens cannot properly safeguard public health if they are kept in the dark about chemicals in their communities. Federal policies that shield corporations from disclosing "confidential business information" should be shifted to support citizens' right to know. Health care providers should be free to inform patients of the health risks of chemicals used in their communities.

- State and federal agencies must use a precautionary approach when permitting oil and gas development operations. Based on the current body of knowledge on health risks of exposure to chemicals used in fracking and other production activities, regulators should exercise their authority to protect public health. When data is inconclusive, regulators should err on the side of protection of health.
- Utilities, businesses and governments must invest in common-sense energy efficiency measures and clean, renewable energy development to meet our nation's energy needs. Conserving energy is more economical, and safer than producing more fossil fuels. Clean, renewable sources like solar and wind provide more stable utility rates for wholesale and retail consumers with far fewer environmental and health risks, and generate more jobs than the fossil fuel economy. State and federal regulators must work together to protect public health at each stage of energy development. And, community members directly affected by oil and gas development should be directly involved in decision making at each stage.

BOX 2
Speaking Up: A Business Perspective

As fracking has rapidly expanded, business leaders are increasingly concerned that its unchecked use is harming public health, degrading water, air and soil, and worsening climate change. It is also blocking development of clean energy and imposing additional tax burdens. Like every extractive industry, fracking and other oil and gas production activities are creating short-term economic gain for some, but causing long-term damage by displacing existing businesses and disrupting communities.

Fracking impacts all other businesses, since all taxpayers have to shoulder costs for the heavy use of roads, increased demand for public services and cleanup of contamination. It is particularly damaging to businesses that depend on a clean natural environment, such as tourism, agriculture, food and beverage production, real estate, hunting, fishing and other outdoor recreation.

While natural gas produced by fracking *might* lower fuel bills today, it increases the cost of doing business through decreased employee productivity, traffic impacts and decreasing property values. In farm regions, additional pressures on businesses include competition for water and land resources. And, employees who develop illnesses as a result of exposure to chemicals used in oil and gas development, or whose children or other family members become ill, cost businesses more money in lost-work days and health care expenses.

Because of these health hazards and other cost concerns, small businesses are playing a critical role in revealing the threats of fracking and other production activities and further dependence on fossil fuels, and in transitioning to a sustainable economy.

For example, in April 2014, 27 business leaders in New York filed a brief in the state's highest court defending home rule in support of the right of towns to ban hydraulic fracturing from within municipal borders. Approximately 1,500 New York business leaders have signed on to a letter to Gov. Andrew Cuomo calling for a statewide ban on unconventional gas development. In addition, 250 chefs, producers and other food professionals have signed onto a separate letter to the Governor for a statewide ban.

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Solar panels on the Village Bakery in Athens, Ohio show its commitment to clean energy solutions.

In Athens, Ohio, 26 businesses (and counting) have signed on to an amicus brief for a case in Munroe Falls in which in which a city is fighting to win back its rights. They note that it is unfair for the oil and gas industry to be exempt from established zoning laws, written to keep all commercial activity in its proper place to preserve the health, value, and character of a community. Businesses are investing time and money to drive the secure, clean energy economy forward. Leading by example, business shows its commitment to these values, winning loyal customers as a bonus.

— Hilary Baum and Laura Neiderhofer
American Sustainable Business Council
http://asbcouncil.org

APPENDIX A
STATE AGENCY AIR MONITORING PROTOCOLS

TABLE 3

Five-State Survey of Air Quality Monitoring Protocols for Unconventional Oil and Gas Operations

Agency (year)	Target Compounds	Sampling Equipment	Sample Sites	Duration	Representative Findings
ADEQ (2011)	VOCs (total) NO, NO_2	PID (fixed) PID (handheld)	4 compressor stations 6 drilling sites 3 well sites (fracking) 1 upwind	1 d (4–6 hrs.)	• VOCs "almost always below or near detection limits" • VOCs at drilling sites elevated (ave. 38–678 ppb; max. 350–5,321 ppb) • NO/NO^2 rarely exceed detection limits
CDPHE (2012)	NMOCs (78) Methane	Canister	1 well pad (Erie)	3 wks.	• Detects = 42 of 78 compounds in >75% of samples • Benzene "well within EPA's acceptable cancer risk range" • Acute and chronic HQs "well below" 1
CDPHE (2009)	NMOCs (78) VOCs $PM_{2.5}$	Canister PID (handheld) Filter (hand-held)	8 wells (4 drilling, 4 completion)	1 day	• Total NMOC ave. 273–8,761ppb at 8 sites • Total VOC ave. 6–3,023ppb at 8 sites • $PM_{2.5}$ ave. 7.3–16.7 mg/m^3 at 8 sites
CDPHE, GCPHD (2007)	VOCs (43) PM_{10}	Canister Filter	14 sites 7 sites	24 mos.	• Detects = 15 of 43 compounds • Benzene ave. 28.2mg/m^3, max 180 mg/m^3 (grab) • Toluene ave. 91.4mg/m^3, max 540 mg/m^3 (grab)
CDPHE (2003–2012)	NMOCs Carbonyls	Canister	5 sites (2003) 6 sites (2006) 3+ sites (2012)	2 mos.	• Methane ave. 2,535 ppb (Platteville) vs. (1,780 ppb Denver) • Top NMOCs in Platteville = ethane, propane, butane • Benzene, toluene higher in Platteville
CDPHE (2002)	VOCs (42) SO^2 NO, NO^2	Canister Continuous	2 well sites 1 residential 1 active flare 2 up-, down-valley 1 background	1 mo.	• Detects = 6 of 42 VOCs • Benzene in 6 of 20 (2.2–6.5mg/m^3) • Toluene in 18 of 20 (1.5–17 mg/m^3)
ODNR (2013)	VOCs (69) VOCs $PM_{10}/PM_{2.5}$ H_2S CO	Canister GC/MS Filter	1 well site 1 remote site	12 mos.	• Ongoing; gathering background data • Detects include BTEX, alkanes (e.g., ethane, hexane), methane • Second site planned near processing plant
DEP (2010)	VOCs (48) Alkanes Leak detection	Canister OP-FTIR GC/MS FLIR	2 compressor stations 1 condensate tank 1 wastewater impoundment 1 compressor station 1 background	5 wks.	• Detects include methane, ethane, propane, benzene (max. 758ppb) • No conc.'s "that would likely trigger air-related health issues" • Fugitive gas stream emissions
DEP (2011)	VOCs (48) Alkanes Leak detection	Canister OP-FTIR GC/MS FLIR	2 compressor stations 1 completed well 1 well site (fracking) 1 well (tanks, separator) 1 background	4 wks.	• Detects include BTEX (benzene max. 400 ppb), methylbenzenes • No conc.'s "that would likely trigger air-related health issues" • Fugitive emissions from condensate tanks, piping

TABLE 3

Five-State Survey of Air Quality Monitoring Protocols for Unconventional Oil and Gas Operations (continued)

Agency (year)	Target Compounds	Sampling Equipment	Sample Sites	Duration	Representative Findings
DEP (2011)	VOCs (48) Alkanes	Canister OP-FTIR GC/MS	2 compressor stations 1 well site (flaring) 1 well site (drilling) 1 background	4 wks.	• Detects include benzene (max. 400 ppb), toluene, ethylbenzene • Natural gas constituent detects near compressor stations • Conc.'s "do not indicate a potential for major air-related health issues"
DEP (2012)	Criteria VOCs/HAPs Methane H_2S	"Full suite"	1 gas processing 2 large compressor stations 1 background	12 mos.	• Ongoing
WDEQ (2012)	Ozone Methane NMHCs NO, NO^2 PM_{10}	Continuous Triggered canister	Special-purpose monitoring in areas of natural gas development (e.g., Boulder, Juel Spring, Moxa, South Daniel, Wamsutter)	Ongoing	• WDEQ also has 3 mobile monitors w/"full suite of equipment" • Placed downwind for one year (e.g., Pavillion, Big Piney) • All monitors attain NAAQS w/exception of Boulder (ozone)

BTEX = benzene, toluene, ethylbenzene, and xylenes; FLIR = forward looking infrared; GC/MS = gas chromatography-mass spectrometry; HAP = hazardous air pollutant; NAAQS = National Ambient Air Quality Standards; NMHC = non-methane hydrocarbon; NMOC = non-methane organic compound; OP-FTIR = open-path Fourier transform infrared; PID = photoionization detector; VOC = volatile organic compound.

Agency Acronyms

ADEQ Arkansas Department of Environmental Quality

CDPHE Colorado Department of Public Health and Environment,

GCPHD Garfield County Public Health Department

ODNR Ohio Department of Natural Resources

DEP Pennsylvania Department of Environmental Protection

WDEQ Wyoming Department of Environmental Quality

APPENDIX B
AGENCIES AND POLICIES REGULATING OIL AND GAS PRODUCTION

AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY (ATSDR)
ATSDR's focus is on the public health impacts of hazardous substances. The agency is Congressionally mandated to carry out public health assessments and consultations.

ARMY CORPS OF ENGINEERS
The Corps addresses issues regarding the impact of wetlands, under the Clean Water Act, the law regulating discharges to waters of the U.S.

BUREAU OF INDIAN AFFAIRS (BIA)
Part of the mission of the BIA is to oversee leasing of Native American land for oil and gas development.

BUREAU OF LAND MANAGEMENT (BLM)
This agency manages the leasing of federal oil and gas, under laws such as the Mineral Leasing Act, Federal Land Policy and Management Act; and conducts Environmental Analysis under the National Environmental Policy Act.

ENVIRONMENTAL PROTECTION AGENCY (EPA)
EPA has authority and oversight of several laws relevant to oil and gas development, and is tasked with protection of public health and the environment. Laws under the EPA's jurisdiction include:

- ***Air impacts:*** Clean Air Act—hazardous air pollutants; new source performance standards; greenhouse gases.
- ***Water impacts:*** Safe Drinking Water Act in regard to waste in injection wells; hydraulic fracturing with diesel; Clean Water Act regarding storm run-off.
- ***Waste disposal:*** Resource Conservation and Recovery Act—or RCRA—for non-exploration and production wastes.
- ***Hazardous wastes:*** Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) when there are chemical spills and releases.
- ***Toxic substance reporting:*** Ensuring that companies follow the Emergency Planning and Community Right to Know Act, and provide information to the Toxic Release Inventory

OCCUPATIONAL HEALTH & SAFETY ADMINISTRATION
OSHA is an agency enforcing standards on priority impacts to worker health/safety, following the Occupational Health and Safety Act.

NATIONAL TRUST FOR HISTORIC PRESERVATION
The Trust is concerned with protection of cultural resources, including from the impacts of pollution, following the National Historic Preservation Act.

U.S. FISH & WILDLIFE SERVICE
This agency is primarily responsible for oversight of the Endangered Species Act, and is concerned with impacts from pollution to the air, water and land on a wide range of sources.

U.S. FOREST SERVICE (USFS)
USFS deals with impacts to National Forest lands. The agency follows regulations in the National Forest Management Act.

U.S. NATIONAL PARK SERVICE
This agency's mission includes preserving and protecting National Parks/Refuges from pollution.

ENDNOTES

1 Throughout this report the term hydraulic fracturing, or fracking and other production activities, applies to activities at wells, production pads, compressor stations, tank farms, processing stations and wastewater pools.

2 EPA identifies cancer risk levels and estimates exposures that could cause cancer in one out of 10,000 people exposed, one out of 100,000 people exposed, and one out of one million exposed. ATSDR sets Minimal Risk Levels (MRL), defined as exposures that are "likely to be without appreciable risk of adverse non-cancer health effects."

3 Acute Exposure Guideline Level 3: ". . . the airborne concentration of a substance above which it is predicted that the general population . . . could experience life-threatening health effects or death."

4 See the U.S. Energy Information Administration (EIA) Natural Gas Weekly Update at *http://www.eia.gov/naturalgas/weekly/archive/2014/10_02/index.cfm*

5 U.S. Energy Information Administration (EIA) Summary of the Number of Producting Gas Wells in the U.S. *http://www.eia.gov/dnav/ng/ng_prod_wells_s1_a.htm*

6 *Prudent Development—Realizing the Potential of North America's Abundant Natural Gas and Oil Reserves.* National Petroleum Council, September 2011. *http://www.npc.org/prudent_Development-Topic_papers/2-29_Hydro_Frack_Technology_paper.pdf*

7 U.S. EIA Short-Term Energy Outlook bulletin, September 2014. *http://www.eia.gov/forecasts/steo/pdf/steo_full.pdf*

8 For example: Colborn T, Kwiatkowski C, Schultz K, and Bachran M. 2011. Natural gas operations from a public health perspective. Hum Ecol Risk Assess, 17(5):1039-56. *press.endocrine.org/doi/abs/10.1210/en.2013-1697.* Also see the "Compendium of Scientific, Medical and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction)" published by Concerned Health Professionals of New York, July 2014. *http://concernedhealthny.org/compendium*

9 For example: *http://www.earthworksaction.org/voices/detail/dish_texas_health_survey#.VEffgIfD471.* Also, *http://www.earthworksaction.org/voices/detail/pavillion_wyoming_health_survey#.VEfgcYfD471.* And, Rabinowitz P et al. "Proximity to Natural Gas Wells and Reported Health Status: Results of a Household Survey in Washington County, Pennsylvania." *Environmental Health Perspectives,* September 2014. *http://dx.doi.org/10.1289/ehp.1307732.* Community health surveys can be valuable in presenting personal health experiences, that can spur additional research and precautionary action to avoid harm to our health.

10 See U.S. EIA's "Today in Energy" chemical manufacturing briefs at: *http://www.eia.gov/consumption/manufacturing/briefs/chemical*

11 The Precautionary Principle can be found at: *http://sehn.org/precautionary-principle*

12 The Principles of Environmental Justice can be found at: *http://www.ejnet.org/ej/principles.html*

13 EPA method TO-15 and ATDSR method D 5504-08. *http://www.epa.gov/ttnamti1/airtox.html*

14 EPA Method TO-11A. *http://www.epa.gov/ttnamti1/airtox.html*

15 EPA methods TO-14 and TO-15. *http://www.epa.gov/ttnamti1/airtox.html*

16 ATSDR sets three risk levels for most chemicals: acute (short term), intermediate (medium term), and chronic (long term). The levels define exposures that are "likely to be without appreciable risk of adverse non-cancer health effects." The EPA's IRIS program identifies cancer risk levels and estimates exposures that could cause cancer in one out of 10,000 people exposed, one out of 100,000 people exposed, and one out of one million exposed.

17 Colborn T, Kwiatkowski C, Schultz K, and Bachran M. 2011. Natural gas operations from a public health perspective. Hum Ecol Risk Assess, 17(5):1039–56. *press.endocrine.org/doi/abs/10.1210/en.2013-1697*

18 The U.S. Geological Service would soon identify some earthquakes as "induced seismic activity" triggered by injection wells. *http://www.usgs.gov/blogs/features/usgs_top_story/man-made-earthquakes*

19 See news stories such as: *http://www.kunc.org/post/inspector-shortage-colorado-oil-fields-sparks-concerns* for coverage on well inspector shortages, and the report from the Government Accountability Office titled "Updated Guidance, Increased Coordination, and Comprehensive Data Could Improve BLM's Management and Oversight." GAO 14–238. May 5, 2014.

20 Based on a compilation of well injection data provided to the Buckeye Forest Council, by the Ohio Department of Natural Resources on February 13, 2014.

21 Based on research including from the U.S. Geological Survey: Rowan, E.L., Engle, M.A., Kirby, C.S., and Kraemer, T.F. "Radium content of oil- and gas-field produced waters in the northern Appalachian Basin (USA)—Summary and discussion of data." U.S. Geological Survey Scientific Investigations Report. 2011–5135, 31 p. *http://pubs.usgs.gov/sir/2011/5135*

WARNING SIGNS

Toxic Air Pollution Identified at Oil and Gas Development Sites

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The United States' oil and gas boom has transformed hundreds of communities across the country—from rural areas and small towns to suburbs and cities—into industrial production zones. Oil and gas companies are using new techniques such as hydraulic fracturing to extract deposits wherever they can be reached, even if those places are in the backyards of homes, near schools or places of worship, or on farmland. Oil and gas production uses hundreds of toxic chemicals that are emitted directly or escape into the air, exposing residents and workers.

In 2012, grassroots organizations from six states joined together with national support organizations to monitor their communities' air for toxic chemicals from oil and gas development sites. The air monitoring data, outlined in this report, is a warning sign that public health is being threatened in these communities, and likely in other places where oil and gas activities are underway.

Impacted communities are demanding swift action from state and federal regulatory agencies, legislators and the industry itself in order to protect families, communities and the air and water on which we depend.