

Comments from Concerned Health Professionals of New York



on the



Maryland Marcellus Shale Public Health Study

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As members of Concerned Health Professionals of New York, we appreciate the opportunity to comment on the “Detailed Scoping Report: Potential Public Health Impacts of Natural Gas Development and Production in the Marcellus Shale in Western Maryland,” and provide background on the health impacts of shale gas drilling development (commonly known as “fracking”). Like others, we recognize the drive to pursue such development, yet we have serious concerns about fracking’s environmental and public health hazards, especially when the process is considered in a comprehensive life-cycle fashion.

You may be aware that the medical community in NY State has been actively working on this issue for the past three years¹. Our request has been that NY State order a comprehensive Health Impact Assessment^{2 3} which would include all the risks, including the costs of lives shortened or otherwise negatively impacted by gas development activities. That has not been done.

Our first major concern is that Maryland is not giving itself adequate time and resources to assess whether fracking can be conducted safely. Apparently, a final report on fracking is due on August 1, 2014, while regulations came out last year without the benefit of the report or any of its recommended studies. The scope of work for the report was issued publicly on Dec. 24, 2013, and the public has been given only 30 days to comment.

We strongly urge that the public comment period be extended by a minimum of an additional 60 days.

¹ <http://concernedhealthny.org/timeline/>

² <http://concernedhealthny.org/call-for-a-comprehensive-health-impact-assessment/>

³ <http://concernedhealthny.org/letters-to-governor-cuomo/>

The health study described in the Detailed Scoping Report is supposed to be completed in June, 2014. We believe that this time frame is inadequate to conduct even a sharply truncated preliminary public health study of fracking. Moreover, the announced budget of \$150,000 does not provide adequate funding for qualified consultants to plan and conduct a thorough analysis.

Similarly, while we applaud the inclusion of public comment sessions in western Maryland, we believe that a small-scale study based on the idea that fracking will only happen in these western parts of the state is inadequate to guide the entire state. This concern is heightened now that evidence suggests there may be commercially attractive shale deposits in other parts of the state. In addition, we feel that a great deal of education and outreach is often needed in order to ground meaningful public participation.

Of greatest concern is the tendency of the Detailed Scoping Report to address specific issues such as collecting baseline data, as though a decision to proceed with fracking has already been made, rather than raising the question of whether enough evidence of safety exists to justify a decision to go forward. A decision to permit fracking activities imposes all its risks and hazards not only on those choosing to participate but also on individuals and communities that do not see potential benefits that are worth the risks to their health and livelihoods. This becomes an issue of environmental justice, when, as in Maryland, rural communities with lower median incomes are proposed as the site for industrialized activities such as fracking.

In addition to these general concerns about the process of Maryland's review, we offer the following additional comments about the Detailed Scoping Report:

1) in several places in the scoping document, the proposed health study is called a health impact assessment (HIA); an HIA has been defined by the National Academies of Science, and we strongly recommend that the term HIA be reserved for the rigorous, comprehensive, deliberative, open, transparent and participatory process envisioned by the National Academies. We also strongly recommend that Maryland – along with New York – conduct a rigorous HIA prior to any decision to proceed with shale gas drilling activities;

2) although not well-attended, the stakeholder input appears to have been valued by the organizers, and the comments taken under advisement; however, many stakeholder concerns and recommendations were not including in the Detailed Scoping Report, some of which we concur with, and include below;

3) in several places the term HVHF (High Volume Horizontal Fracturing) is used, rather than terms that clearly include the entire process of shale gas development; the entire process should be evaluated, and described as such;

4) the study will look at the following potential stressors and factors (pg 19 has the outline of the study): air pollution, water contamination, noise, public safety, social determinants of health, baseline health and environment, mixed and cumulative exposures, population health and

vulnerable groups, and data gaps; notably missing is specific attention to radioactive materials disturbed during drilling;

5) we note that the following will not be covered: economic health impacts, climate change impacts or occupational impacts (although secondary impacts associated with the economics and workers will be included); reasons for not studying climate change impacts were given as 1) that “whether HVHF will contribute to additional climate change more than other readily available alternatives is highly debated,” a statement which is dismissive of both accumulating data on methane emissions as well as sustainable energy alternatives, and 2) that it is “beyond the limited resources of this project”;

6) we have not seen a scoping for the economic impacts study, which will be done separately by Towson College, but we suggest that the study be designed to evaluate both short-term and long-term impacts;

7) costs of health impacts as an economic liability, both short and long-term, do not appear to be part of this study; these need to be identified and quantified; for example, there are numbers available for costs of air pollution (in general, not related to shale gas drilling and fracking because that has not been done as yet) and such costs should be considered;

8) neurological diseases should be included in the Baseline Health Assessment because headaches, tremors, twitches, cognitive impairment and other neurological and psychological manifestations have been observed by some of us in areas where gas drilling operations are occurring and in development (in the Detailed Scoping Report the focus is noted to be only on asthma and COPD, CV diseases and cancer);

9) the Detailed Scoping Report notes that a baseline health survey will not be done due to budgetary constraints, and instead will rely on available data: if fracking goes forward, the absence of baseline data collection and monitoring will leave injured populations, along with researchers and clinicians, in a poor position to document the causal role of fracking activities;

10) baseline health data should include school and employment illness histories, including number of days absent due to illness, and basic demographic information from birth and birth defects registries. Ideally, in any area to be subjected to fracking activities, school and work health records would be supplemented by simple physical examination parameters such as home or office pulmonary function testing and laboratory tests such as complete blood counts and basic blood chemistries.

11) at a minimum, baseline methane testing should be conducted (see <http://catskillcitizens.org/learnmore/Damascus-Baseline-Report-FINAL.pdf> and <http://www.damascuscitizensforsustainability.org/2012/11/damascus-baseline/>)

While we understand that the final report will not recommend for or against shale gas development, it apparently will attempt to estimate the impacts of the policy options so that the policy makers can draw their conclusions. As one of the first “statewide” health studies conducted prior to fracking of Marcellus shale reserves, this study may potentially be widely referenced. We therefore strongly suggest that it include all the information on health impacts that is available—case studies, peer-reviewed literature, media reports and presentations by members of the medical and scientific community who research this issue.

Thus far, there are relatively few references on health impacts of gas development presented on the study site (<http://www.marcellushealth.org/resources.html>). In our comments below, we include additional references, and invite you to also access our resources (at www.concernedhealthny.org), as well as those available at another site administered by our colleagues, Physicians, Scientists and Engineers for Health Energy (www.psehealthyenergy.org).

Shale gas development does cause adverse health impacts. Due to a well-orchestrated set of exemptions, this industry received from key federal public health laws⁴, these health issues are difficult to study empirically and have only come to light relatively recently. As a corollary, there is no mechanism in place to monitor or track the overall impacts from gas drilling operations, including the economic costs.

Reports of ill health from people impacted by fracking are coming to us, despite the lack of involvement from federal and state public health and environmental agencies. Compilations of complaints from people living in areas along pipelines and near fracking sites and compressor stations have been generated by activists (List of the Harmed⁵) and surveys have been conducted that document a high incidence of the types of symptoms predicted by the nature of the exposures predicted for fracking activities (Earthworks’ Survey of Health Impacts and Southwest Pennsylvania Environmental Health Services)⁶. A Health Impact Assessment⁷ started in Battlement Mesa, Colorado showed that air pollution was significant. That Assessment was never completed because it was blocked by industry during the second draft.

Despite obstacles at the state and federal levels, including lack of adequate funding for research⁸, and lack of the health profession’s inclusion on key decision-making committees⁹, reports of adverse health impacts are now appearing in the peer-reviewed literature.

⁴ <http://www.ewg.org/research/free-pass-oil-and-gas/oil-and-gas-industry-exemptions>

⁵ <http://pennsylvaniaallianceforcleanwaterandair.wordpress.com/the-list/>

⁶ Steinzor, N, et al., Investigating Links Between Shale Gas Impacts and Health through a Community Survey Project in Pennsylvania, New Solutions, Vol. 23(1) 55-83 (May 2013). Access at: <http://www.earthworksaction.org/files/publications/SteinzorSubraSumiShaleGasHealthImpacts2013.pdf>

⁷ Witter R, et al, Battlement Mesa HIA 2011 <http://www.garfield-county.com/environmental-health/battlement-mesa-health-impact-assessment-draft2.aspx>

⁸ Bernard Goldstein, January 2014 op-ed: When it comes to the public health implications of gas drilling, Pa. has its head in the shale

Air pollution

In October 2011, George Thurston of NYU addressed Congress regarding the health impacts of air pollution: “The human evidence includes impacts revealed by epidemiologic studies, natural experiments and controlled chamber exposures, all showing consistent associations between air pollution and increases in adverse health impacts across a wide range of human health outcomes, including illness and death.”¹⁰

The effects of ozone and its association with premature death appear to be very well documented and should no longer be considered questionable. Anenberg et al. (2010) estimated a global mortality from anthropogenic ozone to be 0.7 million respiratory mortalities per year which equates to 6.3 million years of lost life annually. PM_{2.5} is related to 3.5 million cardiopulmonary deaths and 220,000 deaths from lung cancer annually.¹¹ According to a 2013 study, aggressive measures designed to reduce greenhouse gas emissions could prevent as many as 3 million premature deaths annually by 2100.¹² According to the results, aggressive cuts in greenhouse gas emissions could prevent 300,000-700,000 premature deaths annually by 2030; 800,000-1.8 million by 2050; and between 1.4 million and 3 million by 2100. The authors estimate significant cost benefits as a consequence of the GHG reductions.

The main source of the compounds that cause air pollution (ozone, particulate matter, nitrogen oxides, Volatile Organic Compounds, formaldehyde and polycyclic aromatic hydrocarbons) is from fossil fuels.

Given the enormous scale of proposed gas development throughout the nation, and particularly in the Marcellus Shale, there will be a large increase in all these substances in our air, and the health impacts will increase as well.

More recently, there have been observations and studies specific to air pollution from gas development.

[http://www.pennlive.com/opinion/index.ssf/2014/01/when it comes to the public health implications of gas drilling pa has its head in the shale.html](http://www.pennlive.com/opinion/index.ssf/2014/01/when_it_comes_to_the_public_health_implications_of_gas_drilling_pa_has_its_head_in_the_shale.html)

⁹ Goldstein et al., 2012. Missing from the Table: Role of the Environmental Public Health Community in Governmental Advisory Commissions Related to Marcellus Shale Drilling. *Environ Health Perspect*; DOI:10.1289/ehp.1104594. Access at <http://ehp.niehs.nih.gov/1104594/>

¹⁰ Thurston, G.D., Statement of Professor George D. Thurston to the Subcommittee on Energy and the Environment of the United States House of Representatives Committee on Science Space and Technology, Re: the science of air pollution health effects and the role of Casac in EPA standard setting, (October 4, 2011). Access at

http://science.house.gov/sites/republicans.science.house.gov/files/documents/hearings/100411_Thurston.pdf

¹¹ Anenberg, SC et al., 2010. An Estimate of the Global Burden of Anthropogenic Ozone and Fine Particulate Matter on Premature Human Mortality Using Atmospheric Modeling. *Environmental Health Perspectives*. 118:9 1189-1195

¹² Lamarque et al., 2013. Co-benefits of mitigating global greenhouse gas emissions for future air quality and human health. *Nature Climate Change* 3, 885–889 (2013) doi:10.1038/nclimate2009

One of the first papers that found air pollution from gas drilling presenting significant risk to human health was from Colorado, the Battlement Mesa Health Impact Assessment.¹³

In a follow-up to that study, MacKenzie found that residents living less than ½ mile from wells were at greater risk for health effects from gas development than residents living more than ½ mile from wells. Subchronic exposures to air pollutants presented the greatest potential for illness, with benzene as the major contributor to the risk.¹⁴

A study by Dr. Theo Colborn and colleagues in 2013 tested air before and after the start of drilling and fracking operations. Once drilling operations started, 44 air pollutants were detected at a house located about 1 kilometer away from a well pad.¹⁵

A report from a federal agency, the National Oceanographic and Atmospheric Administration, discussed a study in Utah where high ozone levels were present during the winter, an anomalous situation. Because ozone precursor pollutants are emitted in large quantities by the region's oil and natural gas drillers, the regulators concluded that they were the main contributors to the toxic emissions. High concentrations of ozone can trigger asthma attacks and inflame conditions for people with bronchitis, emphysema and other respiratory ailments.¹⁶

Children are especially vulnerable because their lungs continue to grow and enlarge until about age 18. In addition, they breathe faster and are closer to the ground.¹⁷ The result of chronic ozone exposure can be brittle lungs, like those of an elderly adult.

Total air pollution in an area of Texas which is heavily drilled, is more than double all the auto and truck exhaust. That area has seen a recent increase in the incidence of asthma to 25%, compared to half that in other Texas cities.¹⁸

The World Health Organization has now classified diesel exhaust as a definite human carcinogen (Group 1), raising additional concerns for gas field workers and other vulnerable groups exposed to diesel exhaust.¹⁹

In the study from the University of California at Irvine²⁰, researchers working in the Alberta gas and oil fields (called the Industrial Heartland) found that, “based on a 13-year record (1994-

¹³ Witter R, et al., Battlement Mesa HIA 2011 <http://www.garfield-county.com/environmental-health/battlement-mesa-health-impact-assessment-draft2.aspx>

¹⁴ McKenzie LM, et al., Human Health Risk Assessment of Air Emissions from Development of Unconventional Natural Gas Resources 2012 <http://www.ncbi.nlm.nih.gov/pubmed/22444058>

¹⁵ Colborn T, et al., An Exploratory Study of Air Quality near Natural Gas Operations 2012 <http://endocrinedisruption.org/chemicals-in-natural-gas-operations/air-pollution>

¹⁶ NOAA ozone study <http://www.eenews.net/public/Landletter/2011/04/21/1>

¹⁷ World Health Organization http://www.who.int/ceh/capacity/Children_are_not_little_adults.pdf

¹⁸ Fort Worth Natural Gas Air Quality Study Final Report 2011

http://fortworthtexas.gov/uploadedFiles/Gas_Wells/AirQualityStudy_final.pdf

¹⁹ IARC: Diesel Exhaust Carcinogenic 2012 http://www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213_E.pdf

2006) at the county level, the incidence of male hematopoietic cancers (leukemia and non-Hodgkin lymphoma) was higher in communities closest to the Industrial Heartland compared to neighboring counties. While a causal association between these cancers and exposure to industrial emissions cannot be confirmed, this pattern and the elevated VOC levels warrant actions to reduce emissions of known carcinogens, including benzene and 1,3-butadiene.” In this paper, the authors do not claim a causal link; however, there is strong enough evidence to take precautions, such as reducing the VOC emissions and limiting exposure. They also state that it is “important and responsible to improve health surveillance and VOC exposure measurements, to utilize epidemiological studies that can better link environmental factors to disease, and to reduce exposures to pollutants that might plausibly be related to adverse health impacts.”

At the end of 2013, a report by the University of Pittsburgh School of Public Health documented significantly increased air pollutant levels associated with adverse health statistics in Southwest Pennsylvania²¹ where shale gas extraction and other infrastructure are under accelerated development.

Children are particularly affected in adverse ways by environmental toxins. Air pollution has also been shown to be associated with birth problems, neurodevelopmental disorders, lower IQ in babies born to mothers with polycyclic aromatic hydrocarbon exposure during pregnancy and learning disorders in exposed children.

Low birth weight infants and prematurity present a major and increasing problem. From the pediatric literature it is known that this group is susceptible to a host of problems including respiratory complications and developmental disorders, such as cerebral palsy and autism. There is substantial evidence that gestational age is affected by environmental exposures.

Perera, et al. of Columbia University (2003)²² studied air-born polycyclic aromatic hydrocarbons (PAHs) using the personal air of the pregnant mother. They found a significant association with Low Birth Weight as well as lower head circumference. Edwards, et al. (2010)²³ used the same methodology in Poland and found that high exposures to PAHs in utero resulted in a 4 point lower IQ at age 5, which is consistent with the findings in New York.

²⁰ Simpson I et al, Air quality in the Industrial Heartland of Alberta, Canada and potential impacts on human health 2013 <http://concernedhealthny.org/wp-content/uploads/2013/07/Simpson2013-AE-in-press.pdf>

²¹ Univ of Pittsburgh 2013 http://www.heinz.org/UserFiles/Library/PRETA_HAPS.pdf

²² Perera FP, et al., 2003 Effects of Transplacental Exposure to Environmental Pollutants on Birth Outcomes In a Multiethnic Population. *Environmental Health Perspectives* 111:2 201-205

²³ Edwards SC, et al., 2010 Prenatal Exposure to Airborn Polycyclic Aromatic Hydrocarbons and Children’s Intelligence at 5 years of age in a Prospective Cohort Study in Poland. *Environmental Health Perspectives* 118:9 1326-1331

A study in 2010 compared residential proximity to a freeway with the incidence of autism, and found that for those living within 300 meters of the freeway during the third trimester, the odds ratio of being born with autism was more than twice as great as controls.²⁴

Elaine Hill, a PhD candidate in the Department of Applied Economics and Management at Cornell University, has studied birth outcomes (birth weight, gestational age at birth, low birth weight and premature birth) in two states, Pennsylvania (Hill, 2012)²⁵ and Colorado (Hill 2013)²⁶. To define exposure, she used detailed vital statistics and mother's residential address to define proximity to drilling activity. Using a difference-in-differences approach (before and after and close versus less-close), her papers compare health at birth of infants born to residences within 1 km of the wellhead versus 1.5 km to identify the impact of drilling. She found that proximity to wells reduces birth weight and gestational length on average and increases the prevalence of low birth weight and premature birth.

Building on Hill's preliminary study, Currie and her colleagues, including Katherine Meckel of Columbia University, and John Deutch and Michael Greenstone of the Massachusetts Institute of Technology, looked at Pennsylvania birth records from 2004 to 2011 to assess the health of infants born within a 2.5-kilometer radius of natural-gas fracking sites. According to the report, "(t)hey found that proximity to fracking increased the likelihood of low birth weight by more than half, from about 5.6 percent to more than 9 percent. The chances of a low Apgar score, a summary measure of the health of newborn children, roughly doubled, to more than 5 percent." (Bloomberg report of the study at the American Economic Association conference in January 2014).²⁷

Although the evidence is just emerging for an association between air pollution and low birth weight, birth defects and neurodevelopmental problems, there is clearly an overall trend of association with some pollutants at some points during pregnancy. These findings clearly demonstrate the need for additional studies as the public health implications of increasing the numbers of premature and low birth weight babies, as well as children with autism and birth defects, are enormous. In addition to the public health problems, there is the cost to the government and the taxpayer. A child disabled because of environmental exposure is not only a tragedy for the family, but a significant cost outlay for the state.

²⁴ Volk, HE, et al. (2011) Residential Proximity to Freeways and Autism in the CHARGE study. *Environmental Health Perspectives* 19(6):873-7.

²⁵ Hill, E, PhD Candidate, Unconventional Natural Gas Development and Infant Health: Evidence from Pennsylvania, (July 2012) Work in Progress available at <http://dyson.cornell.edu/research/researchpdf/wp/2012/Cornell-Dyson-wp1212.pdf>

²⁶ Hill, E, PhD Candidate, The Impact of Oil and Gas Extraction on Infant Health In Colorado, Job Market Paper (Oct. 2013) preliminary draft available at <https://sites.google.com/site/elainehill/research>

²⁷ Bloomberg news report, Study Shows Fracking Is Bad for Babies, by Mark Whitehouse, January 4, 2014. Access at <http://www.bloomberg.com/news/2014-01-04/study-shows-fracking-is-bad-for-babies.html>

In 2011 Sheffield & Landrigan wrote that “(c)limate change is increasing the global burden of disease and in the year 2000 was responsible for > 150,000 deaths worldwide. Of this disease burden, 88% fell upon children. Heat-related health effects for which research is emerging include diminished school performance, increased rates of pregnancy complications, and renal effects. Stark variation in these outcomes is evident by geographic region and socioeconomic status, and these impacts will exacerbate health disparities. Prevention strategies to reduce health impacts of climate change include reduction of greenhouse gas emissions and adaptation through multiple public health interventions.”²⁸

Landrigan and Goldman²⁹ and Trasande and Liu³⁰ in 2011 also published papers on the health impacts of air pollution; they have also monetized the health impacts of air pollution on children, not referring specifically to gas development.

Since health impacts from other sources of air pollution have been monetized, it should be possible to do the same for pollution from gas development. This needs urgent attention.

Water contamination

Besides the air pollution associated with fossil fuels and with gas development in particular, there is growing evidence in peer-reviewed literature from multiple sources that water has become contaminated when gas drilling occurs nearby.

In a 2011 paper on methane migration, Jackson, et al.³¹ found evidence that aquifers overlying the Marcellus shale formations have explosive levels of methane contamination in drinking water and this was associated with shale gas extraction. A study a year later further documented methane migration.³²

In the July 2013 paper on brine migration, 141 drinking water wells were analyzed across Pennsylvania. They detected thermogenic methane in 82% of drinking water samples, with the highest concentrations in homes less than 1 km from natural gas wells. Methane is a problem for humans when it displaces oxygen and breathing becomes difficult. People in Pennsylvania have lost consciousness in their homes. In other cases methane accumulated in the home has caused explosions.³³

²⁸ Sheffield, P. and Landrigan, P., Global Climate Change and Children’s Health: Threats and Strategies for Prevention, *Environ Health Perspect* 119:291–298 (2011). doi:10.1289/ehp.1002233

²⁹ Landrigan, P. and Goldman, L., Children’s Vulnerability To Toxic Chemicals: A Challenge And Opportunity To Strengthen Health And Environmental Policy. *Health Aff* (May 2011). doi:10.1377/hlthaff.2011.0151

³⁰ Trasande, L. and Liu, Y., Reducing The Staggering Costs Of Environmental Disease In Children, Estimated At \$76.6 Billion In 2008, *Health Aff* (May 2011), doi:10.1377/hlthaff.2010.1239

³¹ 2011 Duke study <http://www.biology.duke.edu/jackson/pnas2011.html>

³² 2012 Duke and CalStatePolytech <http://www.pnas.org/content/early/2012/07/03/1121181109.full.pdf>

³³ Increased stray gas abundance in water wells near Marcellus shale gas wells—2013 Duke, U of Rochester, Cal State Polytechnic and Max Planck Institute <http://www.pnas.org/content/110/28/11250.full.pdf>

Authors from the University of Texas, in a 2013 paper, determined that arsenic, selenium, strontium, barium, and total dissolved solids (TDS) reached their highest concentrations in water coming from areas in close proximity to natural gas wells.³⁴ Arsenic causes bronchitis, gastroenteritis, skin changes, neuropathy, various cancers, and death. Excessive selenium causes growth retardation, hair and skin changes, and neurological disturbances. Strontium accumulates in bones and can weaken them, and the effects are worse on children's bones. The signs of barium toxicity include low blood potassium, cardiac arrhythmias, respiratory failure, gastrointestinal dysfunction, paralysis, muscle twitching, and elevated blood pressure.

Michelle Bamberger and Robert Oswald researched several cases where chemicals associated with drilling were implicated in negative health outcomes.³⁵ They focused mostly on animals because animals are the sentinels of disease in humans due to the fact that their reproductive cycles and their lives are shorter. Their study illustrates several plausible links between gas drilling and negative health effects.

Two cases provided inadvertent control experiments since herds of cows were kept in different pastures. In brief, cows exposed to gas drilling chemicals had significantly more illness, deaths, stillbirths and congenital malformations.

Two other cases involved deaths and congenital malformations of companion animals and one of the implicated routes of exposure was waste spreading on roads, which the animals either drank or licked off their paws; in the other case, exposure was from an aerated impoundment of waste. In addition, their water had turned after drilling but they had continued to use it.

In one of the homes studied, a child became ill with fatigue, confusion, abdominal pain and back pain. After several animals in the household had died, the doctor became suspicious of toxins, and testing revealed arsenic in the child. The family then stopped drinking the water (despite results which showed the well water was safe), and the child eventually recovered, having lost a year of school. In these cases, there were 25 wells within two miles of the homes, and there was also the aerated impoundment, and two compressor stations within a mile. While checking for other toxins in these two homes, random urine tests on family members revealed phenol, a metabolite of benzene; symptoms observed by families in both homes included extreme fatigue, headaches, nosebleeds, rashes, and sensory deficits (smell and hearing). Were it not for the deaths of the animals, the human health effects would not have been found.

The US Environmental Protection Agency (EPA) has studied several cases of water contamination—in Texas, Dimock Pennsylvania and Pavillion Wyoming. These studies have not been concluded: when the evidence pointed to contamination, EPA retreated under industry

³⁴ Schug, 2013. *Environ. Sci. Technol.*, 2013, 47 (17), pp 10032–10040
DOI: 10.1021/es4011724 <http://pubs.acs.org/doi/abs/10.1021/es4011724>

³⁵ Bamberger and Oswald—2012 *New Solutions*
http://www.psehealthyenergy.org/Impacts_of_Gas_Drilling_on_Human_and_Animal_Health

and political pressure.³⁶ Based on accumulating evidence from all these sources, we believe the threat of contamination to water extends far beyond municipal and private wells. Indeed, fracturing may impact surrounding aquifers to distances that have not yet been clearly defined but may stretch over 1/2 mile from the fracturing site; with disposal of tracking waste materials included in consideration, there is no theoretical limit to the range of potential contamination.

Of serious concern are the hundreds of chemicals used in gas exploration and production that are not disclosed and that include many extremely toxic chemicals. Dr. Theo Colborn³⁷ has written about these chemicals, which include benzene (a known carcinogen), ethylbenzene, toluene (causes miscarriages, placenta previa), xylene, diesel (recently classified by WHO as a carcinogen), naphthalene (a neurotoxin and carcinogen), polynuclear aromatic hydrocarbons (carcinogens), formaldehyde (known carcinogen), 2-Butoxyethanol (hemopoietic dyscrasias; carcinogenesis). 2-BE is the active component of Corexit which was used as a dispersant in the Exxon Valdez and BP Gulf disasters; it is used in all phases of gas extraction.

Additional information about some of these chemicals follows. Benzene primarily affects the central nervous system (CNS) and the hematopoietic system, resulting in anemia and leukemia. Acute benzene toxicity is characterized by CNS depression. Symptoms may progress from light-headedness, headache, and euphoria to respiratory depression, apnea, coma, and death. Benzene concentrations of about 20,000 ppm are fatal to humans within 5 to 10 minutes. With gas drilling, subchronic exposures to benzene are the most likely to occur, and this was documented in the recent Colorado study by MacKenzie; some of the health problems that might be encountered are rather non-specific, like fever, blood disorders, fatigue, and anorexia.

Regarding toluene, evidence suggests that the risk for pregnancy problems, as well as developmental delays and neurobehavioral difficulties, is higher for the children of women who were exposed to high concentrations of organic solvents during pregnancy than for those who have not.³⁸

Xylene exposure can occur via inhalation, ingestion, eye or skin contact. The main effect of inhaling xylene vapor is depression of the central nervous system, with symptoms such as headache, dizziness, nausea and vomiting. The effects can begin to occur with exposure to air levels of about 100 ppm. Long-term exposure may lead to headaches, irritability, depression, insomnia, agitation, extreme tiredness, tremors, impaired concentration and short-term memory. Levels of 200 ppm or greater can irritate the lungs, causing chest pain and shortness of breath.³⁹

³⁶ <http://www.propublica.org/article/epas-abandoned-wyoming-fracking-study-one-retreat-of-many>

³⁷ <http://endocrinedisruption.org/assets/media/documents/cP02591Colborn20021022coalbedmethane2-BEcomments.pdf>

³⁸ Hannigan JH and Bowen SE., 2010 Reproductive toxicology and teratology of abused toluene <http://www.ncbi.nlm.nih.gov/pubmed/20377315>

³⁹ Kandyala, R., et al., 2010. Xylene: An overview of its health hazards and preventive measures <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2996004/>

Dr. Theo Colborn has also studied the endocrine disrupting chemicals associated with gas development.⁴⁰ A University of Missouri School of Medicine study released in December 2013 linked fracking with dangerous hormone-disrupting chemicals in the water near gas drilling sites, including the Colorado River.⁴¹

Silicosis

Large quantities of silica sand are used during the hydraulic fracturing process, and it is mined primarily in Minnesota and Wisconsin, where local residents are concerned about their air. In the course of transport, silica dust is released into the air, causing a hazard to those employees involved in handling silica sand. Silicosis is an incurable but preventable lung disease. In addition to being an occupational lung carcinogen, inhaled silica dust causes chronic obstructive pulmonary disease (COPD), chronic renal disease and various autoimmune diseases. Individuals with silicosis are known to be at higher risk of tuberculosis. These illnesses can impact the community in which the workers live.

The Occupational Safety and Health Administration has proposed rules to limit crystalline silica, which would prevent nearly 700 deaths a year.⁴² No health agency has looked silica's potential impacts on the residents living near fracking sites.

Waste

The waste generated by this industry is enormous, and it is hazardous, even when not deemed so due to legal exemptions.^{43 44} Fracking waste contains radioactive brines and gases.^{45 46} It is exempt from federal oversight.⁴⁷

It has been documented that disposal in underground injection wells can and has caused earthquakes,^{48 49 50 51} which have impacted the foundations and cracked walls in some homes.

⁴⁰ Colborn, T., et al., 2011. Natural Gas Operations from a Public Health Perspective. Human and Ecological Risk Assessment: an International Journal <http://endocrinedisruption.org/chemicals-in-natural-gas-operations/journal-article>

⁴¹ Nagel et al, 2013. Estrogen and Androgen Receptor Activities of Hydraulic Fracturing Chemicals and Surface and Ground Water in a Drilling-Dense Region. DOI: <http://dx.doi.org/10.1210/en.2013-1697>

⁴² http://www.osha.gov/dts/hazardalerts/hydraulic_frac_hazard_alert.html

⁴³ http://www.shalegas.energy.gov/resources/060211_earthworks_petroleumexemptions.pdf

⁴⁴ <http://www.dcbureau.org/201308148881/natural-resources-news-service/new-york-imports-pennsylvanias-radioactive-fracking-waste-despite-falsified-water-tests.html#more-8881>

⁴⁵ <http://www.grassrootsinfo.org/pdf/radioactivewaste.pdf>

⁴⁶ <http://www.grassrootsinfo.org/pdf/whitereport.pdf>

⁴⁷ <http://www.epa.gov/osw/nonhaz/industrial/special/oil/oil-gas.pdf>

⁴⁸ Katie M. Keranen, Heather M. Savage, and Geoffrey A. Abers et al., "Potentially Induced Earthquakes in Oklahoma, USA: Links between Wastewater Injection and the 2011 Mw 5.7 Earthquake Sequence," *Geology*, vol. 41, no. 3 (March 26, 2013)

⁴⁹ <http://geology.gsapubs.org/content/early/2013/03/26/G34045.1.abstract>

⁵⁰ <http://www.ldeo.columbia.edu/news-events/wastewater-injection-spurred-biggest-earthquake-yet-says-study>

Radioactivity

There are additional risks due to the radioactive nature of the Marcellus shale, in particular, which have not been adequately studied. We do know that radium and radon are elevated in the Marcellus shale region at baseline, and generally wherever shale gas is extracted. Radon is a leading and preventable cause of lung cancer.^{52 53} Paschoa, in *Radiological Impact due to Oil and Gas Extraction*, 2003, wrote that "...gaseous radon (²²²Rn) is concentrated in ethane and propane fractions due to the fact that the boiling point of radon lies between those of propane and ethane. Elevated Rn activity concentration values have been measured at several processing plant sites...It is well known today that the radiological impact of the oil and gas-extracting and processing industry is non-negligible. Two steps should be taken to improve the current situation in most oil-producing countries: 1. establish a common basis for the international regulation of TENORM in the oil and gas industry, taking into proper account the natural radioactive background with its spatial and temporal variations, for example the EURATOM BSS; and 2. improve the international database on extraction and production processes in the oil and gas industries, for example in the framework of a co-ordinated research project under the auspices of a well-recognised international organisation..."⁵⁴ Steinhäusler has written that workers and those living nearby are at risk from exposure to radioactive materials.⁵⁵ ATSDR lists stoves and furnaces as a source of radon.⁵⁶

These are some examples of a growing but already significant body of scientific evidence showing harms to public health from gas development.

Despite this evidence, the monetary costs associated with the health impacts—premature death, birth defects, prematurity of birth, cancer, autism, learning disabilities and other problems—have not yet been entered into any published economic analysis of fracking.

⁵¹ <http://stateimpact.npr.org/texas/tag/earthquake>

⁵² National Academy of Sciences, *Health Effects of Exposure to Radon: BEIR VI*, NATIONAL ACADEMY PRESS, Washington, D.C. 1999 <http://www.nap.edu/catalog/5499.html>

⁵³ <http://www.epa.gov/radon/pubs/citguide.html>

⁵⁴ Paschoa, A, *Radiological Impact due to Oil and Gas Extraction*, report in *BUSINESS BRIEFING: EXPLORATION & PRODUCTION 2003*

⁵⁵ Steinhäusler, F, *RADIOLOGICAL IMPACT ON MAN AND THE ENVIRONMENT FROM THE OIL AND GAS INDUSTRY: RISK ASSESSMENT FOR THE CRITICAL GROUP*, Published in *M.K. Zaidi and I. Mustafaev (eds.), Radiation Safety Problems in the Caspian Region*, 129-134.

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⁵⁶ <http://www.atsdr.cdc.gov/csem/csem.asp?csem=8&po=5>

We appreciate this opportunity to comment on the Detailed Scoping Report: Potential Public Health Impacts of Natural Gas Development and Production in the Marcellus Shale in Western Maryland proposed public health study. Please feel free to contact us.

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