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E. Christopher Abruzzo
Secretary, Pennsylvania Department of Environmental Protection
Rachel Carson State Office Building
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Harrisburg, PA 17101

Via e-mail and hard copy cabruzzo@pa.gov

Dear Secretary Abruzzo

I am writing in regard to decisions that your office will be making about unconventional natural gas extraction (UGE). Some of these decisions may relate specifically to children, such as decisions about setbacks between UGE sites and schools. Other decisions may relate to UGE in a broader sense. As a physician with significant expertise in environmental health*, I want to point out that there is no information in the medical or public health literature to indicate that UGE can be implemented with a minimum of risk to human health.

In this very new area of research, there are very few articles in the public or peer-reviewed literature that do indicate that there are health problems and there are a number of other pieces of data that suggest that UGE is fraught with negative health outcomes. Elaine Hill at Cornell University compared pregnancy outcomes from a group of mothers who lived in proximity to active wells to outcomes in mothers who lived near wells currently under permit but not yet developed. The results showed an association between shale gas development and incidence of low birth weight and small for gestational age (25% and 18% increased risk).[1]

McKenzie and colleagues looked at the relationship between proximity and density of gas wells to maternal address and birth defects, preterm birth and fetal growth.[2] Two approximately even exposure groups were formed for births in rural Colorado between 1996 and 2009: zero wells within ten miles and one or more wells within ten miles. For women residing with one or more wells within ten miles, women were then categorized into three groups of increasing number of wells within ten miles. Women in the highest exposure group, with greater than 125 wells per mile, had an elevated risk of births with congenital heart disease (CHD) and neural tube defects (NTD). A risk for both CHD and NTD increased with increasing number of wells. The authors cited chemicals such as benzene, solvents and air pollutants as previously established associations between maternal exposure and CHDs and NTDs.

It is also very clear that there are adverse mental health outcomes associated with UGE in addition to the physical health problems noted above. A community study by Ferrar and colleagues found that the predominant stressor of citizens impacted by shale gas drilling in Pennsylvania was a concern for their health.[3] The majority of persons interviewed felt that their health concerns were largely ignored and the most common health complaint of community members was stress. Noise can also be a source of stress for residents near UGE activities. Well pad operations, when set up, are industrial facilities often running 24 hours a day near homes, schools and public areas, creating unhealthy noise levels for the

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surrounding area. Although noise is a part of our daily life, with typical conversations occurring at sounds levels between 55-60 decibels (dbA), annoyance to noise can begin to occur at sound levels around 55 dbA, school performance begins to decline at 70 dbA, and sleep is disturbed at anywhere from 35-60 dbA. For well pads, noise levels have been shown to be 89-90 dbA at 50 feet from the pad, 60-68 dbA at 500 feet and 63-54 dbA at 1,000 feet from the pad.[4] Stressors may also include odors, such as from the rotten egg smell of hydrogen sulfide released by unconventional gas extraction operations.

In addition to individual health, UGE activities can impact population health and create community wide changes. A health impact assessment done in Battlement Mesa, CO found that unconventional gas extraction activities create community-wide impacts, including an increased transient worker population and a decreased use of public outdoor areas. The assessment also found increased crime rates and rates of sexually transmitted infections (STIs) and although crime rates and STIs cannot be directly correlated with UGE activities, they are none the less real community changes that coincided with the introduction of UGE. Other identified health impacts include: increased traffic accidents, decreased use of outdoor space and reduced physical activity, increased stress, a decline of social cohesion and strain on community resources, such as healthcare and housing, due to an influx of workers.[5]

Although research is limited on the health impacts of UGE, there are real pathways of exposure, such as through air and water, from UGE activities to human populations. Air pollution occurs during every stage of UGE. In an analysis of all chemicals used in UGE processes, 37% were found to be volatile and therefore able to aerosolize. Of these volatile chemicals, 81% were found to have adverse effects on the brain and central nervous system.[6] Aerosolized chemicals have the ability to be inhaled and be absorbed directly into the bloodstream, bypassing the body's detoxifying mechanisms of the liver. Diesel engines and generators, another source of air pollution, are widely used in UGE and a number of federal agencies and international bodies classify diesel exhaust as "carcinogenic to humans,"[7] as "reasonably anticipated to be a human carcinogen,"[8] or as "likely to be carcinogenic to humans."[9]

Water pollution has been documented in association with UGE.[10] While this research focuses on contamination with methane, it is reasonable to think that components of hydraulic fracturing fluids and normally occurring underground toxic substances travel with the methane. Data collected by the Minority Staff of the Committee on Energy and Commerce of the US House of Representatives in 2011, based on data submitted by the 14 leading oil and gas service companies, revealed the use of more than 2,500 hydraulic fracturing products containing 750 chemicals and other components.[11] From the limited information available, it is evident that many of the substances used in hydraulic fracturing fluid are toxic, including some which are known carcinogens. Wastewater, such as the flowback and produced water, can contain a large number of naturally occurring toxic chemicals in addition to the chemicals added to make the hydraulic fracturing fluid. Naturally occurring toxic chemicals may include radioactive material, salts, salts of manganese, chlorides, sodium bromides and heavy metals such as lead and arsenic. Radionuclides shown to be present in natural gas wastes include: radon, 226radium and 228radium and radionuclides of potassium, strontium, lead, thallium, bismuth and thorium. Radium in flow-back and produced water often incorporates into solids formed during wastewater treatment, thereby producing low level radioactive waste. [12, 13]

In protecting children from environmental health hazards, it is essential to recognize that for many reasons children may be more exposed to environmental health hazards than adults in the same location. Moreover, children may have different outcomes than adults similarly exposed. For example, children breathe more air and drink more water per unit of body weight than adults do, Therefore, if the air or water are contaminated, the children will receive a higher dose than the adults. Children also live longer than adults. While that may seem self-evident, it is important in the environmental context because many outcomes of environmental exposures occur years after the exposure. If the delay between exposure and outcome is, for example, 40 years or more, as it may well be in terms of some of the chronic lung diseases of adulthood, if a 60 year old adult is exposed, s/he may not live long enough to develop the adverse outcome. A child, however, will, in all likelihood, live long enough to experience that adverse outcome.

In summary, neither the industry, nor government agencies, nor other researchers have ever documented that UCG can be performed in a manner that minimizes risks to human health. There is now some evidence that these risks that many have been concerned about for a number of years are real risks. There is also much data to indicate that there are a number of toxic chemicals used or derived from the process, known or plausible routes of exposure of those chemicals to humans; and therefore, reason to place extreme limits on UGE. When and if industry can present the following information, it would then be reasonable to expect your agency and the communities which may become involved in UGE to make decisions on whether or not to proceed with UGE: 1) disclosing complete information of the composition of all materials used to make hydraulic fracturing fluid, 2) studying and disclosing information about all air contaminants released from well pads and the extent of their expected dispersion, 3) studying and disclosing information about mechanisms of water contamination and dispersion of contaminants in ground and surface waters, and 4) studying and disclosing information on the extent to which air and water pollution can reasonably be expected to be minimized. While this type of research should not be carried out by industry, it certainly should be funded by industry. Industry profits from UGE; and industry should bear the responsibility for determining how it can be done in the safest manner possible. Then, and only then, can regulatory and public health agencies and communities make reasonable decisions about whether or not UGE should proceed.

If you or your staff have any questions, I be happy to try to provide answers.

Sincerely

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* Jerome A. Paulson, MD, is a Professor of Pediatrics at the George Washington University School of Medicine & Health Sciences and Professor of Environmental & Occupational Health at the GW Milken Institute School of Public Health. He is also the Director of the Mid-Atlantic Center for Children's Health and the Environment (MACCHE) based at the Children's National Health System. Dr Paulson has helped organize and was a presenter on a panel on Unconventional Gas Extraction at the 2011 American Public Health Association national meeting; and helped organize and was the lead-off speaker at the 2012 conference on the Public Health Aspects of Shale Gas Extraction jointly sponsored by Physicians, Scientists and Engineers for Healthy Energy and MACCHE. He was an invited panelist at the May 2012 meeting on unconventional gas extraction organized by the George Washington University School of Public Health and the Agency for Toxic Substances & Disease Registry; and on the planning committee for a meeting on data collection related to water and air toxics exposures from unconventional gas extraction that was jointly sponsored by the Natural Resources Defense Council, the Harvard Center for Environmental Health and MACCHE in December 2013.

MACCHE (www.childrensnational.org/MACCHE) is one of 10 Pediatric Environmental Health Specialty Units (PEHSUs) (www.pehsu.net) in the US. MACCHE serves Federal Region 3; i.e., Pennsylvania, Maryland, Delaware, West Virginia, Virginia and the District of Columbia. It is funded by a grant from the Association of Occupational and Environmental Clinics (AOEC) (www.aoec.org) which receives its funding for this project from the Agency for Toxic Substances & Disease Registry (ATSDR) of the CDC and from the EPA. MACCHE receives no corporate funding. The two basic functions of MACCHE, and the other PEHSUs, are to provide education to health professionals and others about environmental issues that impact on the health of children and to answer questions from the public that are related to children, health and the environment. MACCHE has been receiving inquiries about the potential health impacts of unconventional natural gas extraction for at least the last 7 years.

While MACCHE is indirectly funded by ATSDR and the EPA, the opinions expressed in this letter do not represent the policy of either organization and have not been reviewed by either organization.

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