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New Brunswick Lung Association Position Statement
on Shale Gas Development in New Brunswick
June 2019

Position Statement:

The New Brunswick Lung Association supports a precautionary approach to development of unconventional natural gas deposits in New Brunswick. This includes supporting a moratorium on the development, and production of unconventional natural gas until:

- The provincial government implements the recommendations of New Brunswick's Chief Medical Officer of Health

- The outcomes of implementation of the above recommendations indicate that hydraulic fracturing can be conducted in a way that does not negatively impact the health, well-being, social economic status and right of enjoyment of property of people living in New Brunswick

- A third-party independent agency provides a full-life-cycle comprehensive and realistic cost/ benefit analysis of the expected revenues and all costs to New Brunswickers that can be used to make a decision to proceed, or not, with Shale Gas development.

Background on Shale Gas with a Focus on Respiratory Health:

Drilling for shale gas entails injecting fluid underground to open pre-existing fractures in the shale formation to coax out the natural gas. This type of natural gas extraction uses directional or horizontal drilling with laterals up to two miles in length, unlike conventional, vertically drilled gas wells. And unlike traditional forms of natural gas extraction, the unconventional methods used for shale formations require large volumes of fluid to extract gas from many existing fractures (Hays and Law, 2012).

The process of unconventional natural gas development is typically divided into two phases: well development and production (EPA, 2010a; US DOE, 2009). Well development involves pad preparation, well drilling, and well completion. The well completion process has three primary stages: 1) concrete well plugs are installed in wells to separate fracturing stages and then drilled out to release gas for production); 2) hydraulic fracturing ("fracking": the high pressure injection of water, chemicals, and propants into the drilled well to release the natural gas); and 3) flowback, the return of fracking and geologic fluids, liquid hydrocarbons and natural gas to the surface (EPA, 2010a; US DOE, 2009). Once development is complete, the "salable" gas is collected, processed, and distributed. While methane is the primary constituent of natural gas, it contains many other chemicals, including alkanes, benzene, and other aromatic hydrocarbons (TERC, 2009).

Approximately a million or more gallons of fluid containing chemicals are injected underground during the hydraulic fracturing stage (Colborn et al. 2011). As with drilling, chemicals are used in hydraulic fracturing fluids for many purposes such as friction reducers, biocides and corrosion inhibitors (Colborn et al., 2011; Hays and Law, 2012).

Shale gas extraction uses clustered, multi-well pads to further extend the area of extraction, thereby accessing as much of the resource as possible under leasing and capital constraints. There can be up to 30 wells on one pad. Hydraulic fracturing takes place over 2 to 5 days and may be repeated 10 or more times on the same well over the course of the potential 25- to 40-year lifetime of a well (Colborn et al., 2012; Bamberger and Oswald, 2012).

From the first day the drill bit is inserted into the ground until the well is completed, toxic materials are introduced into the borehole and returned to the surface along with produced water and other extraction liquids.

In hydraulic fracturing fluids, chemical substances other than water make up approximately 0.5 to 1 percent of the total volume, but, the very large volume used require correspondingly large volumes of a variety of compounds. Some of these compounds are reported to the public and some are not. The quantities and proportions of these chemicals are largely considered trade secrets. In addition to these chemicals, naturally occurring toxicants such as heavy metals, volatile organics and radioactive compounds are mobilized during gas extraction and are released into the air (Bamberger and Oswald, 2012; Colborn et al. 2012).

As shown by ambient air studies in Colorado, Texas, and Wyoming, the natural gas development process results in direct and fugitive air emissions of a complex mixture of pollutants from the natural gas resource itself as well as diesel engines, tanks containing produced water, and on site materials used in production, such as drilling muds and fracking fluids (CDPHE, 2009; Frazier, 2009; Walther, 2011; Zielinska et al., 2011). The specific contribution of each of these potential sources has yet to be ascertained and pollutants such as petroleum hydrocarbons are likely to be emitted from several of these sources. This complex mixture of chemicals and resultant secondary air pollutants, such as ozone, can be transported to nearby residences and population centers (Walther, 2011; GCPH, 2010).

Drilling chemicals and fracturing fluids used in various steps of the drilling process can be highly toxic and include known carcinogens (e.g. benzene, butoxyethanol, boric acid, methanol) (Hays and Law, 2012). The materials extracted from underground can be equally or more toxic than the hydraulic fracturing fluid and include radioactive material (radium-226, radon-222 and uranium-238), arsenic, lead, strontium, barium, benzene, chromium and 4-nitroquinoline-1-oxide. Before wastewater is removed from a drilling site, it is often stored in large impoundments where the volume is decreased by evaporation. This increases the concentration of some toxic substances in the impoundment (salts, heavy metals) and introduces volatile organics such as benzene and toluene to the atmosphere (Bamberger and Oswald, 2012).

Colborn et al. (2011) compiled a list of products and chemicals used in natural gas operations, searched the literature for their health effects and categorized them according to standard toxicological categories. They found that more than 75% of the chemicals used can affect the skin, the eyes and other sensory organs, the respiratory system, the gastrointestinal system and the liver. This represents effects that would likely be expressed upon immediate exposure such as eye and skin irritation, nausea and/or vomiting, asthma, coughing, sore throat, flu-like symptoms, tingling, dizziness, headaches, weakness, fainting, numbness in extremities and convulsions.

Approximately, 37% of the chemicals are volatile and can become airborne. All of the 22 chemicals used in the drilling fluids are associated with respiratory effects (Colborn et al., 2011).

Multiple studies on inhalation exposure to petroleum hydrocarbons in occupational settings as well as residences near refineries, oil spills and petrol stations indicate an increased risk of eye irritation and headaches, asthma symptoms, acute childhood leukemia, acute myelogenous leukemia, and multiple myeloma (Glass et al., 2003; Kirkeleit et al., 2008; Brosselin et al., 2009; Kim et al., 2009; White et al., 2009). Many of the petroleum hydrocarbons observed in these studies are present in and around natural gas development sites (TERC, 2009). Some, such as benzene, ethylbenzene, toluene, and xylene (BTEX) have robust exposure and toxicity knowledge bases, while toxicity information for others, such as heptane, octane, and diethylbenzene, is more limited. Assessments in Colorado have concluded that ambient benzene levels demonstrate an increased potential risk of developing cancer as well as chronic and acute non-cancer health effects in areas of Garfield County Colorado where natural gas development is the only major industry other than agriculture (CDPHE, 2007; Coons and Walker, 2008;CDPHE, 2010).

Health effects associated with benzene include acute and chronic nonlymphocytic leukemia, acute myeloid leukemia, chronic lymphocytic leukemia, anemia, and other blood disorders and immunological effects. (ATSDR 2007a). In addition, maternal exposure to ambient levels of benzene recently has been associated with an increase in birth prevalence of neural tube defects (Lupo, 2011). Health effects of xylene exposure include eye, nose, and throat irritation, difficulty in breathing, impaired lung function, and nervous system impairment (ATSDR, 2007b). In addition, inhalation of xylenes, benzene, and alkanes can adversely affect the nervous system (Carpenter et al., 1978; Nilsen et al., 1988; Galvin et al., 1999; ATSDR, 2007a; ATSDR, 2007b).
In addition to the land and water contamination issues, at each stage of production and delivery, tons of toxic volatile compounds (VOCs), other hydrocarbons and fugitive

natural gases (methane), can escape and mix with nitrogen oxides (NO_x) from the exhaust of diesel-fueled, mobile and stationary equipment to produce ground-level ozone. Ground-level ozone can burn the deep alveolar tissue in the lungs causing it to age prematurely (CPDHE, 2007; URS, 2008; US Congress Office of Technology Assessment, 1989).

Based on fluid transportation and other well pad activities (e.g. construction, equipment), a total of 3,950 heavy and light-duty truck trips are required for each horizontal well, given that each well can be hydraulically “fracked” multiple times during its productive life (Hays and Law 2012). Fine diesel particulate matter as well as nitrogen oxides and VOCs are emitted into the atmosphere during transportation, posing additional concerns for public health.

Ozone combined with particulate matter less than 2.5 microns in diameter produces smog which has been demonstrated to be harmful to humans as measured by emergency room admissions during periods of elevations (Peng et al. 2009).

Subchronic exposures to air pollutants during well completion activities present the greatest potential for health effects (McKenzie et al., 2012). The most susceptible to air pollutants produced by natural gas development are those over 65 and those with pre-existing respiratory and cardiovascular problems such as asthma, congestive heart failure or chronic obstructive pulmonary disease (COPD) (Islam et al., 2007, Tager et al., 2005, Triche et al., 2006; Canadian Medical Association, 2008). Even at moderate levels, chronic exposure to air pollution harms long-term health especially for children, older adults, people suffering from chronic lung or heart disease and active young adults who spend time outdoors (Health and Environment Canada, 2011; Gauderman et al., 2002; Miller et al., 2007; Pope et al. 2002). Acute exposure to pollutants during smog episodes increases the incidence and severity of asthma attacks, flare-ups of COPD, heart attacks and strokes (Slaughter et al., 2003; D’Ippoliti et al., 2003; Hong et al., 2002; Desqueyroux et al., 2002).
According to the Canadian Medical Association (2008), air pollution currently causes the deaths of 21 000 Canadians every year, as well as 92 000 emergency department visits and 620 000 doctor’s office visits. In New Brunswick, this translates to 400 deaths, 4 300 emergency department visits and 24 000 doctor’s office visits.

The health and economic damages of air pollution on the health of Canadians is significant and will become more so over time. These damages are experienced by all Canadians, either directly due to reduced personal health and quality of life, or through the impaired health of family members and friends or through increased costs of our national healthcare system. As well, air pollution is affecting the overall productivity of the Canadian economy through absenteeism and poorer health of the workforce.
The economic costs of air pollution will top $8 billion and by 2031, these costs will have accumulated to over $250 billion nationally. In New Brunswick, this means an increase from $156 million in 2008, to over $4 billion in 2031 due to lost productivity and healthcare costs from exposure to air pollution (Canadian Medical Association, 2008).

Given that there exists only a handful of peer-reviewed scientific publications on the public health dimensions of natural gas development and hydraulic fracturing, more research is needed for the public health risks of shale gas development to be adequately assessed.

The risks associated with shale gas extraction are substantial and the level of magnitude at which it is carried out is unprecedented. To provide context, in Pennsylvania alone 5,364 wells have been drilled since 2007, a number expected to rise to over 100,000 within the next few decades. Regardless of the strength of regulation and safe practice, accidents will occur and water and air will become contaminated (Hays and Law, 2012).

While no energy production method is completely benign, the large-scale development of shale gas resources and their potential impacts on human health and world climate call for precaution. Potential exposure pathways must be further investigated, and epidemiologic research is needed to quantify short- and long-term risks to human populations in New Brunswick.

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