

August 18, 2015

Presentation to the New Brunswick Commission on Hydraulic Fracturing

Dear Panel Members:

I serve as a spokesperson and researcher for the New Brunswick Anti-Shale Gas Alliance (NBASGA), on whose behalf I am submitting these comments. NBASGA is an alliance of 22 community groups from across the province, representing both Francophone and Anglophone communities and both rural and urban populations. We, together with non-profit organizations such as the Council of Canadians, and with both of New Brunswick's indigenous groups (Wolastoq and Mi'kmac), have constituted the core of opposition to "**UN**conventional **G**as and **O**il **D**evelopment" in this province. Our shorthand for this industry is the acronym, 'UNGOD'.

***Notes:** Studies use a variety of other acronyms – UOG, UNGDP, UGOD, which you will see in quotes from various studies. They are synonymous.*

*Quotes often contain **bolded** words for emphasis – when I add the emphasis myself, it will be duly noted.*

Our position on shale gas and hydrofracturing is based on the fact that the scientific knowledge in nearly all fields related to UNGOD ranges from the non-existent to the immature.

There is simply too little research and monitoring of the industry to establish the nature and extent of its threats to public health and the environment. There is insufficient data to either craft meaningful regulations or effective mitigation of harm. What the existing science does show is that the industry is associated with many serious threats, and that new problems are continually being discovered.

This is the first of our two founding principles. The second is that the fundamental and existential threats to both health and environment stemming from climate change preclude the development of any new fossil fuel resources. We, therefore also support action to move to a clean energy economy.

As you know, the previous government of New Brunswick made UNGOD the platform on which it centered its recent election campaign, which it lost. Nearly two thirds of voters chose parties that called for a moratorium on UNGOD, and the winning Liberal party has instituted a moratorium on hydraulic fracturing and this commission.

While we are happy for that moratorium and your work on this Commission, we believe that UNGOD poses a threat that should not be left to shifting political winds or ill-defined moratorium conditions. Therefore, we have entered a suit against the Province of New Brunswick, calling for a moratorium until such time that the science can show beyond a reasonable doubt that UNGOD can be done without harm to health, air, water and the climate. We have based our suit on the Charter of Rights guarantee of the Security of the Person. This suit is in progress.

The Recent History of Commissions and Panels

It is worth noting that essentially all states, provinces and countries hosting UNGOD are those where the industry became entrenched before there was much public engagement. In every place where there have been pre-evaluations demanded by an informed citizenry, the industry has been stopped by moratoria or bans. The salient conclusion to be reached from this fact is that it appears that the more one knows about the industry the less likely it is that one will welcome it.

Most recently, the Netherlands, a country highly reliant on natural gas, passed a 5-year moratorium on shale gas development, which included non-renewal of existing gas leases. [1]

In Canada, the provinces of Quebec, Nova Scotia currently have retained and/or strengthened their original moratoria following the completed reports of commissions much like your panel.

The state of Maryland recently enacted a three-year moratorium based on a report conducted by their highly regarded university public health system [2]. But, perhaps, the most thorough review of UNGOD was undertaken by the state of New York [3]. Last year they declared a moratorium based largely on the concerns surrounding public health. This July, they announced the results of a seven-year Summary General

Environmental Impact Statement (SGEIS), upholding that decision with an essentially permanent moratorium.

The conclusions of all these commissions are aptly expressed in the NY SGEIS,

“These studies and expert comments evidence that significant uncertainty remains regarding the level of risk to public health and the environment that would result from permitting high-volume hydraulic fracturing in New York, and regarding the degree of effectiveness of proposed mitigation measures. In fact, the uncertainty regarding the potential significant adverse environmental and public health impacts has been growing over time.” [emphasis mine]

The commissions and panels made use of all the relevant peer-reviewed and expert testimony. Two public health interest groups compiled their own collections of the scientific evidence to be submitted to these panels.

The first is the Compendium [4] including, peer-reviewed science, expert papers and media reports compiled by the Concerned Health Professionals of NY. The other is the universe of peer-reviewed studies [5] collected by Physicians, Scientists and Engineers for Healthy Energy. Both collections are periodically updated on the organizations' websites, and the editions online now are current at least through the first of this year.

We, in turn, submit them to you now as necessary reading for anyone conducting a review. Because of their exhaustive nature, by availing yourself of these resources you will be encompassing all the science and history on the topic.

NBASGA has independently amassed a database of resources during our years of public education and especially in preparation for our lawsuit. Of necessity it duplicates much of what is in the databases just mentioned. Because those sources are comprehensive and also already arranged in specific areas, with explanations of the findings for the non-scientist reader, we will not be submitting the totality of our own, independent research.

We will instead concentrate on the most recent evidence, and that which illustrates the ever-increasing risks and threats of UNGOD, in order to address the specific charges in your mandate. All the studies mentioned are referenced within the text and included at the end of this submission with links to find the documents online. Often there are numerous studies emphasizing the same point, but we may only reference one or two in the interest of brevity and acknowledging the fact that we have furnished you with other resources.

We will address the key areas of the Frame of Reference in an order that makes the most sense for the arguments we are making.

Area 1:

"Clear and credible information about the impacts of hydraulic fracturing on our health, environment and water, allowing us to develop country-leading regulatory regime with sufficient enforcement capabilities."

While the issues surrounding shale gas are broad, interrelated and complex, the bases for a long term moratorium or ban fall into just a few easily understood categories. These include:

- The research that hasn't been done.
- The research that has been done, in the areas of water contamination, air contamination, public health and environmental effects.
- The relationship between shale gas and the central issue of our times - climate change – which is both an existential threat and contributes both directly and indirectly to threats to public health and the environment.

The Research That Hasn't Been Done

Premier Brian Gallant cited The Council of Canadian Academies (CCA) report on shale gas as one of the two reports to be seriously considered by the commission. Its main finding, as expressed in the Executive Summary under 'Limits to Our Knowledge and Understanding' (page xvi) [6], was that there is insufficient scientific research conducted on any aspect of shale gas that would allow one to conclude whether or not it was safe for either the environment or public health.

Under the section 'Monitoring Approaches' (page xviii), they state, "Appropriate environmental monitoring approaches for the anticipated level of shale gas development have not yet been identified. Monitoring programs will have to be adapted to advances in technologies and to the location, scale, and pace of future development."

"The Panel notes that the research needed to support improved science-based decisions concerning cumulative environmental impacts has not yet begun, except in Quebec, and is unlikely to occur without a concerted effort among industry, government, academia, and the public in each of the provinces with significant shale gas potential."

To learn if that situation has changed in the time since the CCA report, we attended a lecture [7] by Dr. John Cherry, the chairperson of the CCA report, and an international expert on contamination hydrology. He stated that there hasn't been any on-going hydrological monitoring of shale wells by independent scientists or governments anywhere in North America. Not one. No government requires monitoring and industry has not permitted independent scientists to conduct their own.

In fact, although the CCA report and any number of academic papers have recommended such monitoring as a necessary first step in any evaluation, until July 2015, no one anywhere has even put together a plan of how meaningful monitoring might be conducted. In July 2015, the state of California mandated such a plan [8], which Dr. Cherry helped design and author. However, the implementation of the plan remains to be seen, as it is comprehensive and will be expensive.

When I asked Dr. Cherry during his address, *'What would be a reasonable amount of time necessary to conduct the appropriate monitoring and research once it was designed and funded,'* he replied, *'A decade.'* Dr. Cherry also reiterated the finding of the CCA report that, because of such a lack of evidence, no current regulatory regimes can be characterized as based on science.

Regulations are largely arbitrary guesswork. We note that in our experience, often-cited industry 'best practices' are largely industry-defined processes that are tied more to cost-effectiveness rather than as a guarantee of health and safety based on science.

And, of course, if regulations are not designed scientifically, how can one guarantee that any mitigation efforts will be effective?

This was also addressed in the CCA report under 'Mitigation Options' (page xviii), "Advanced technologies and practices that now exist could be effective to minimize many impacts, but it is not clear that there are technological solutions to address all of the relevant risks, and it is difficult to judge the efficacy of current regulations because of the lack of scientific monitoring. The research needed to provide the framework for improved science-based decisions concerning cumulative environmental impacts has barely begun."

Note the phrase, "but it is not clear that there are technological solutions to address all of the relevant risks," which refers particularly to the problem the industry has acknowledged and been unable to solve for 50 years: the leaking of cement seals in underground pipes. The report stated that, "The greatest threat to groundwater is the leakage from wells from which even existing best practices cannot assure long-term prevention."

Dr. Maurice Dusseault, also a contributor to the CC report published a book with two colleagues warning that wellbore leakages from bad cementing is responsible for natural gas seeping from 500,000 wellbores (of all kinds) and represents "a threat to environment and public safety" due to groundwater contamination, greenhouse gas emissions and explosion risks wherever methane collects in unvented buildings and spaces. [9]

Ten per cent of all active and suspended gas wells in British Columbia now leak methane. In addition, some hydraulically fractured shale gas wells in that province have become methane super-emitters that spew as much as 2,000 kilograms of methane a year. [10]

The science on this issue is extremely well documented, even by the industry, and we will not cite it here further, but refer you to the Compendium. [4]

The second report cited by Premier Gallant was the recent report by the US Environmental Protection Agency. [11] This once anticipated report was greatly diminished by political interference, self-limitation, and non-cooperation by the industry. It is now in draft status and it is likely to be greatly changed after passing through peer-review, because of its weak conclusions, primarily due to the same the lack of evidence and monitoring noted by the CCA report.

Time and again, in every aspect studied, the report reveals the fact – often openly - that its conclusions are not based on any independent monitoring and are based only on whatever contrived evidence it could find. [12] [13]

Nowhere is this lack of evidence more apparent than in the public health research and medical evaluation of the chemicals used in shale gas.

Years ago, the organization, *'The Endocrine Disruption Exchange,'* catalogued roughly 700 chemicals that are used in the process of hydraulic fracturing, [14] although each individual frack uses only a relative handful, and the mix is different in each frack.

The US EPA recently found essentially the same number by using information reported by industry on the FracFocus website. [15] Of these, a complete survey showed that there is data on only 362 - meaning that there are more than 300 chemicals used by the industry about which we know nothing, and which have never been tested.

The CCA's report mentioned these unknowns prominently. "Information is also required on potentially hazardous chemicals produced down-hole by chemical interactions under high temperature and pressure. This includes information on concentration, mobility, persistence in groundwater and surface water, and bioaccumulation properties, for each chemical on its own and as a mixture. **This represents a major gap in understanding of the potential environmental and human impacts of hydraulic fracturing, and of how to mitigate accidental releases of chemicals or flowback water to the environment.**" [6] (Page 19) (emphasis mine)

Considering that we as a nation require years of extensive testing before certifying a single pharmaceutical chemical for human consumption, it goes against common sense, and any possible ethical standard, that we would expose humans (and animals) to hundreds of unknown substances to be breathed 24 hours a day and consumed in their food and water.

These chemicals affect people and the environment through air as well as water contamination. And once again we find an issue that has been barely studied. In fact, the operations of shale gas wells are so different from conventional gas that many of the standards, and even the methods, of measuring the air pollution from this industry

may be ill-suited to scientific research for establishing regulations or mitigation procedures. [16]

Without any knowledge of the effects of a chemical or how it acts in the environment or in combination with other chemicals, no health studies of any kind can even be designed, let alone implemented.

In conjunction with the necessary testing of these chemicals there must also be both baseline environmental and public health studies and long term, longitudinal studies on the effects on public health. Comprehensive looks at shale gas such as the one from Maryland and another from the Chief Medical Officer of Health for New Brunswick [17], outline an extensive number of baseline studies that must be conducted and questions answered before proceeding with UNGOD.

The CCA report emphasized that, “The paucity of data and evidence of causal links in this area results from the lack of baseline studies, inadequate monitoring, and in some cases non-disclosure agreements may make it challenging to document incidents of contamination.” [Page 137]

In their ‘Final Word,’ the CCA report notes, “The lessons provided by the history of science and technology concerning all major energy sources and many other industrial initiatives show that substantial environmental impacts were typically not anticipated. **What is perhaps more alarming is that where substantial adverse impacts were anticipated, these concerns were dismissed or ignored by those who embraced the expected positive benefits of the economic activities that produced those impacts.**” (emphasis mine)

In summary, the messages from the CCA and EPA reports, public health reviews and government commissions is that it will require years of research and monitoring to establish the science of the hydrofracturing process and its effects before any regulations or mitigation efforts can be said to guarantee, even to a reasonable degree, the safety of public health and the environment.

This by itself is justification for calling for a long term and indefinite moratorium on shale development.

The research that has been done

So, what evidence is available to influence our decisions?

Certainly, anecdotal evidence of the harm from shale development can be found at [The List of the Harmed](#) and [Alberta Voices](#). But much evidence has been hidden from the

public via 'gag orders' included in industry settlements with victims, as noted by the CCA report (page 137)

However, the number of scientific studies is growing and we will summarize them with some detail.

Water

Dr. Cherry categorized the science done so far on shale gas as 'immature science', meaning that all studies on the same topic might have differing findings, or those findings may show 'correlation', but may not meet the tougher standard of 'causation'. That is not a reason for discounting them, but rather means that one must examine them to see where the correlations are strongest, what trends are emerging, and where studies agree.

As mandated by Canadian law in the Canadian Environmental Protection Act of 1999, this is an area for the use of the Precautionary Principle, which states roughly that if you have reasonable evidence that something poses serious threats, you don't have to wait for that evidence to be final and conclusive in order to take preventative measures.

The recent Maryland public health review concluded, "After carefully reviewing the limited evidence from UNGDP impacted areas and current scientific understanding from non-UNGDP related fields, we conclude that there is a **Moderately High Likelihood** that UNGDP's impact on water quality, soil quality and naturally occurring radioactive materials will have a negative impact on public health..." [2]

As many have noted, the EPA report could not characterize the frequency or widespread nature of water contamination, because of "insufficient pre- and post-fracturing data on the quality of drinking water resources; the paucity of long-term systematic studies; the presence of other sources of contamination precluding a definitive link between hydraulic fracturing activities and an impact; and the inaccessibility of some information on hydraulic fracturing activities and potential impacts." [11] (Page 32)

However, on the same page is the one concrete conclusion that it did state:

"Of the potential mechanisms identified in this report, we found specific instances where one or more mechanisms led to impacts on drinking water resources, including contamination of drinking water wells."

This contamination occurred in every category it examined, including "water withdrawals in times of, or in areas with, low water availability; spills of hydraulic fracturing fluids and produced water; fracturing directly into underground drinking water resources; below ground migration of liquids and gases; and inadequate treatment and discharge of wastewater." (Page 32)

This should put to rest the ridiculous industry claim that there has never been a case of water contamination.

The states and provinces hosting the shale industry have reported hundreds of cases of contamination, and industry has settled an unknown number of claims in settlements containing gag orders that deprive the public and scientists of the details. (Again both CCA and EPA noted that this secrecy was a great impediment to researchers.)

When we began our research four years ago, water contamination was everyone's prime worry, and the evidence of this problem continues to grow. [18] [19] After six years of shale development, the state of Pennsylvania just released to the public in 2014 that it had documented 243 cases of well water contamination from shale gas activities. [20] By 2013, Texas reported 532 cases of groundwater contamination. [21] One can examine online the violation records of some jurisdictions such as Pennsylvania and British Columbia to find specific incidences.

Air

While water contamination was the threat that galvanized opposition to shale gas, evolving research points to air contamination as possibly the greatest threat to public health.

The recently concluded Maryland health review found, "Based on our evaluations of the limited but emerging epidemiological evidence from UNGDP impacted areas and air quality measurements as well as epidemiological evidence from other fields, we conclude that there is a **High Likelihood** UNGDP related changes in air quality will have a negative impact on public health..." [2]

This is a higher risk certainty than they found for water contamination.

Many of the known disease-causing chemicals noted in the earlier chemical discussion are airborne (which also affect water, soil, and food when they settle out of the air). Many are also involved in the formation of toxic ground level ozone, which is a well-studied cause of a number of respiratory diseases.

In its statement calling for a shale gas moratorium, the New Brunswick Lung Association listed the myriad ways that shale gas contributes to air pollution and reviewed the research pointing out the potential for new and increased air pollution from the shale industry. It then noted that the Canadian Medical Association predicts that New Brunswick will experience an increase in healthcare costs and lost productivity from \$156 million in 2008, to over \$4 billion in 2031 due to exposure to air pollution. [22]

It is also becoming clearer that this air pollution will affect those living far from shale gas drilling sites, as studies have tracked shale gas emissions travelling downwind for great distances. [23] Likewise, ground-level ozone has long been known to follow winds for hundreds of kilometres.

And new evidence connects shale gas to known problems of air pollution, as in new studies on radon levels in shale gas areas. [24] [25] [26]

Combined with the concerns noted earlier about the inadequacy of current air monitoring protocols and standards [16], air pollution concerns are a top priority for the public health community. Studies have shown that shale gas processes result in periodic spikes of air pollution that conventional monitoring regimes do not take into account or capture. This lack of monitoring capabilities impedes important research, particularly as gas sites are near homes, schools and hospitals, [27] and new studies show that emissions of toxic substances like benzene associated with UNGOD are significantly higher than estimates made by regulators. [28]

Public Health

No matter what vector - air, water, soil or food – brings the chemicals used in the shale gas industry into contact with people, there appears to be a growing number of associated health problems.

Of the 362 fracking chemicals that we do know something about, large percentages are explicitly listed as toxins and/or carcinogens or have been associated by research with problems including cancer, birth defects, brain and neurological disorders, respiratory and kidney diseases, and include endocrine disruptors and mutagens, which control our hormone systems and alter our genes respectively. [14]

Numerous studies have documented the nearly universal complaints of those living near UNGOD: shortness of breath, coughing, chronic fatigue, rashes and skin burning. But recent studies have associated the proximity and density of shale development with the following specific ailments:

- Congenital heart and neural tube defects [29],
- Low-birth weight of infants [30],
- Significant association with increased hospitalization for cardiology and neurology issues [31],
- Cancer – via increased exposure to polycyclic aromatic hydrocarbons [32]
- Endocrine disruptor chemicals.

This last is a relatively new area of medical research. Endocrine disruptors are substances that in miniscule quantities act on the body's hormone system and cause a variety of developmental, immune system and reproductive problems that can then also be passed on genetically.

In their first, 'Scientific Statement, the Endocrine Society stated, "we present the evidence that endocrine disruptors have effects on male and female reproduction, breast development and cancer, prostate cancer, neuroendocrinology, thyroid, metabolism and obesity, and cardiovascular endocrinology. **Results from animal models, human clinical observations, and epidemiological studies converge to implicate EDCs as a significant concern to public health.** [33] (emphasis mine)

The following is from a recent review of the science in this area relative to natural gas:

"We review the scientific literature providing evidence that adult and early life exposure to chemicals associated with UOG (unconventional oil and gas) operations can result in adverse reproductive health and developmental effects in humans. Volatile organic compounds (VOCs) [including benzene, toluene, ethyl benzene, and xylene (BTEX) and formaldehyde] and heavy metals (including arsenic, cadmium and lead) are just a few of the known contributors to reduced air and water quality that pose a threat to human developmental and reproductive health. "

"The developing fetus is particularly sensitive to environmental factors, which include air and water pollution. Research shows that there are critical windows of vulnerability during prenatal and early postnatal development, during which chemical exposures can cause potentially permanent damage to the growing embryo and fetus. **Many of the air and water pollutants found near UOG operation sites are recognized as being developmental and reproductive toxicants; therefore there is a compelling need to increase our knowledge of the potential health consequences for adults, infants, and children from these chemicals through rapid and thorough health research investigation.**" [34] (emphasis mine)

One such newly released study following this line of research found that levels of these chemicals in the **"air near oil and gas development can be orders of magnitude higher than exposures for which we found health effects."** [35] (emphasis mine)

It also found that diseases caused by BTEX occurred at levels that were orders of magnitude lower than the current 'safe' standards set by the EPA, thus multiplying the threat level significantly. There is hardly a better example of how threatening are the risks we have uncovered, and at the same time how many unknown risks may exist. **This is the case against UNGOD in a nutshell.**

Climate Change

While not mentioned explicitly in the Commission's charge to determine the safe development of shale gas, such a determination cannot be made scientifically or ethically without considering the effects of climate change on public health and the environment.

The scientific community is essentially unanimous in concluding that climate change is occurring, that it is largely man-made, and that the burning of fossil fuels is the prime driver. This view is accepted by every national science academy on earth, the United Nations, the International Energy Agency, the World Bank, the International Monetary Fund, the World Health Organization, the insurance industry, the military and intelligence agencies of the world powers, the Pope of the Catholic Church, and virtually every global establishment dealing with the categories of food, water, health, refugees and peace, as the effects of climate change affect every facet of life.

We illustrate this with a simple list of recent articles associated with climate change with certain words bolded just to give a sense of how varied and encompassing are the effects of climate change:

- Extreme Weather Will Be 'New Climate Normal' Without Immediate Action, **Warns World Bank** [36] Other weather stories [37] [38]
- More **infectious diseases** emerging because of climate change [39]
- British Medical Journal, *The Lancet*, says the direct and indirect effects of climate change on health, environment and social order can **overturn all the public health gains of the last 50 years**. [40] Other health stories [41] [42]
- ICE SHEETS: Volume loss from Antarctic ice shelves is **accelerating** [43] Other Antarctic ice melting stories [44] [45]
- **Exceptional** twentieth-century slowdown in Atlantic Ocean overturning circulation - the Gulf stream slowing [46]
- **Historically unprecedented** global glacier decline in the early 21st century [47]
- Projected **deglaciation of western Canada** in the twenty-first century [48] Other glacier melting stories [49]
- Why This New Study On Arctic Permafrost Is So **Scary** [50] - feedback loops accelerate climate change. -
- Climate change effect on ocean plankton – bottom of ocean food chain and supplier of oxygen and absorber of CO₂ for the planet [51]
- Climate Change: **Predicting extinction** in a changing world – mass extinction of species [52] Other story on loss of **marine biodiversity** [53]
- **Unprecedented** 21st century **drought** risk in the American Southwest and Central Plains [54] [55]
- Climate-induced variations in **global wildfire danger** from 1979 to 2013 [56]

- Did Climate Change Help Spark **The Syrian War** [57]
- How the **Pentagon is preparing** for climate change in each part of the world [58]
- **Caribbean** Looks to Paris Climate Summit for Its Very **Survival** [59]
- Effect of warming temperatures on **US wheat yields** [60]
- Temperature **impacts on economic growth** warrant stringent mitigation policy [61]

Perhaps the most concerning studies are those that conclude that climate change is happening much faster than predicted. [62] [63] And this first week of August 2015, James Hansen, one of the first and most accurate predictors of climate change submitted a paper with 17 colleagues saying that the two degree Celsius limit to warming, that the world is using as a guideline, is inadequate. It may allow multi-metre sea level rises within decades, not by 2100 as had been predicted. [64]

New Brunswickers have experienced climate disruption in many ways in recent years. Tropical Storm Arthur went through the heart of New Brunswick in 2014, causing vast damage that shut down the province for nearly two weeks. In 2012, August like temperatures in March melted 60 centimeters of snow in one day causing floods that nearly wiped out the town of Perth-Andover. In 2011, central New Brunswick experienced unheard of December flooding. Rising sea levels have made storm surges an increasing threat to coastal towns.

We now have Lyme disease. Unusual and unpredictable weather patterns such as the polar vortexes have brought us long lasting extreme cold and snow this winter, and currently an unheard of nearly stationary high-pressure system (lasting months) is bringing draught to western Canada and the US. We probably recognize the truth of climate change intuitively, but are simply not aware of how dire our situation may be.

The consensus opinion among scientists and world institutions is that in order to have any chance of preserving a livable climate, two-thirds of the known fossil fuel reserves in the world cannot be burned. [65] [66]

Of the fossil fuels, natural gas, when burned, produces the least amount of carbon dioxide (CO₂) – a global warming gas. Proponents of gas have thus stated that gas should then be the fossil fuel of choice until we can get off them completely.

Unfortunately, this simplistic view has been found to have serious flaws. The first is that adding any new source of fossil fuel, regardless of how clean burning, also adds more CO₂ to the atmosphere. The idea is not to add any new sources of CO₂.

Secondly, shale gas is in a category known as ‘unconventional’ fossil fuels. This means that ordinary means of production are not able to access the fuel, and extraordinary methods must be employed. In the case of shale gas this requires thousands of truck

trips carrying water, wastewater, fracking chemicals and sand to each well pad. More truck trips are required to get rid of the wastewater. Huge amounts of diesel fuel and gasoline must be burned.

The enormous pressure necessary to fracture the shale in each 'frack' also requires thousands of horsepower of diesel engines. These processes are repeated multiple times, as each well can be repeatedly fracked.

Each shale gas well can be several kilometres longer than a traditional well, once again requiring the burning of more fossil fuel during drilling. The special sand used in fracking requires its own new mining industry, which produces its own large share of carbon emissions

So while gas burns 'cleaner' than other fossil fuel, its development requires burning much more fossil fuel than conventional methods, diminishing its clean burning advantage.

However, any advantage disappears completely due to the fact that the natural gas (methane) escaping into the atmosphere without being burned is a global warming gas roughly 84 times more potent than CO₂ over a 20 year period (and roughly 20 times more potent over 100 years).

There have been contradictory studies about how much methane is leaked into the atmosphere, with industry estimates and EPA showing smaller amounts, while many varied measuring techniques showed much, sometimes very much more methane leakage.

This week one of the patent holders of the instrument for measuring methane emissions that is used by the EPA and by many of the studies showing lower emissions, released a new study. [67] The paper pointed out that the measuring device had been misused, and that the levels reported by previous studies using it may actually be orders of magnitude higher, which better aligns with the competing studies. So while much of the research must be redone, it appears very likely that methane leaks at a rate that would make its effect on global warming worse than that of burning coal.

Fossil fuels cannot be used to solve the problems that fossil fuels cause. [68]

While not mentioned directly in your mandate, climate change is inseparable from the charge to judge whether shale gas is an activity that can be done without harm to the population. Clearly it cannot.

Area 2

“a plan that mitigates the impacts on our public infrastructure and that addresses issues such as waste water disposal.”

Wastewater

Wastewater disposal is also a problem that has yet to be solved. There are no good solutions, only those that may be less bad than others.

Treating wastewater via wastewater plants has proven to be less than effective as shown by studies you will find in the Compendium, and specialized plants and treatment are expensive. Two new studies raise health and environmental issues from wastewater that is spilled into groundwater or even treated and discharged into waterways from specialized plans. [69] [70]

One concludes that, “Bromide, iodide, and ammonium in surface waters can impact stream ecosystems and promote the formation of toxic brominated-, iodinated-, and nitrogen disinfection byproducts during chlorination at downstream drinking water treatment plants. **Our findings indicate that discharge and accidental spills of OGW (oil and gas wastewater) to waterways pose risks to both human health and the environment.**” (emphasis mine)

And even where regulations require wastewater to be ‘contained in pipelines,’ its safe disposal cannot be guaranteed, as evidenced by this example of a three million gallon pipeline spill. [71]

Such spills can have dire and drastic environmental consequences on forests [72] and waterways [73], affecting ecosystems, economies and land use, as well as posing threats to human health. In fact, failure to manage wastewater is a widespread and enduring aspect of UNGOD, as seen in recent studies. [74] [75] [76]

Illegal dumping of wastewater takes place regardless of regulations and is extremely dangerous, because no one except California requires public disclosure or wastewater testing for hazardous chemicals, and California has found the wastewater to be a ‘toxic stew’. [77]

Of course, the most widely used method of wastewater disposal has been the use of deep injection wells. However, this practice has been strongly tied to earthquakes, first

in Arkansas and now in places like Texas [78], Oklahoma [79], British Columbia [80], and Kansas [81]. Earthquakes caused by fracking itself, known to occur in British Columbia

and Great Britain have now occurred in Ohio [82] and Alberta [83] [84] with some experts saying they are more likely to occur in Canada [85].

There was great controversy caused locally last year when fracking wastewater from Nova Scotia was slated to be disposed of in Dieppe, New Brunswick. It exposed the facts that the contents of wastewater are not routinely disclosed or even known, and that tests for the presence of some of the more exotic chemicals do not exist or are very expensive and involve the use of distant laboratories.

It also showed the reluctance of two provincial governments to be forthcoming about the topic. This is a pattern that is all too common. As an example, both the current government and the previous government of New Brunswick have been unable or unwilling to inform the public about what happened to the wastewater created during Corridor's fracking activities in New Brunswick last year.

The fracking by Corridor was suggested by the pro-shale forces and the previous government to be a solution to the problem of wastewater, as it used propane rather than freshwater as the main fluid. This does not eliminate wastewater, as the 'produced' water pulled out of the ground can still be substantial, but it does greatly decrease the amount.

It still requires the use of chemicals and comes with its own problems of handling propane in large quantities, and it is more expensive. In any case, it was used in less than one percent of fracking, and the company using the technology went bankrupt last year. [86] Industry reports this year show that the technology so far has been disappointing and expensive. [87]

Although recycling of wastewater has decreased the amount of fresh water used and the amount of wastewater, this too is expensive – impurities have to be removed before reusing – and the continued recycling concentrates the toxins and radioactivity in the water, making it that much harder to dispose of at the end.

As we said at the beginning, there are no good methods of wastewater disposal, only those less bad. Which is why the industry continues to put most of it in injection wells, despite the risks.

Infrastructure

It appears evident that no matter how much governments receive from the industry to compensate for its road and bridge infrastructure impacts, it isn't enough. Costs to

repair damages routinely are substantially more than revenues. [88] [89] In times like the present, when the price of gas is low, fewer royalties, taxes and impact fees are collected, but the destruction of the roads remains the same. This situation will be exacerbated in New Brunswick, because of the high proportion of roads and bridges we have in comparison to our small population.

There are also ancillary costs that industry does not pay for, such as the losses and damages that occur in local areas due to delays, vehicle damage, injuries and death [90], which can even impact the cost and delivery of emergency services. [91]

Tourism, agriculture [92] [93] and fisheries and the infrastructure to support them have also suffered in places hosting shale gas. This is especially a concern in New Brunswick. Unlike Canada's western provinces, where the industry is largely in unpopulated areas, shale areas here are in places of rural populations, tourist destinations, agricultural areas and commercial fishing waterways.

Perhaps, the most lasting infrastructure impact will be the industrialization of the rural landscape. The deforesting of large areas and the segmentation of ecosystems due to well pads, roads, pipelines, compressor stations and parking areas will continue long after the industry has gone. So will the after-effects of the alteration of the landscape on the large scale this industry requires. One must remember that a shale gas industry must grow or die an early death, because of its high depletion rates and high costs. [93] [94] Thousands and even tens of thousands of wells are not unusual in a mature shale gas play.

Area 3

“a process in place to respect our obligations under the duty to consult with First Nations.”

While we are allied with First Nations in our opposition, we do not in any way want to appear to speak for them. They have treaty rights that are unique to their situation.

International law has developed the FPIC standard for consultations with indigenous people over mineral claims and other issues. Consultations must be Free, Prior, and Informed leading to Consent.

Without even considering other aspects of this process, one can say that, as there is currently not enough science on which to have an 'Informed' consultation, the rest of the process is premature and certainly cannot lead to Consent.

What we claim in our suit is that the same standard must apply to **all citizens** when the government wants to promote an activity that threatens the Security of the Person

under the Charter of Rights. The threats to clean air, water and public health posed by shale gas clearly fall into that category. Government must, therefore, create a methodology for all constituents affected by the proposed activity.

Area 4

'a social license in place.'

The concept of social license is not yet clearly defined legally; however, one can point out what it isn't.

It can't be granted without going through the FPIC process. Thus, there can be no social license without consent, and there can be no consent without FPIC, and there can be no FPIC without the required information that does not yet exist.

Because the Charter of Rights grants the Security of the Person to have clean air and water, those rights cannot be disposed of by commissions, or executive orders, or parliamentary votes, or a majority of voters in a referendum. As long as a reasonable threat to any citizen exists, social license cannot be granted.

It is a basic civil right and would take a constitutional change or Supreme Court decision to change. Environmental justice and climate change justice are the civil rights issues of our time.

In the confirmed absence of serious threat, then, perhaps social license could be granted by any of the above methods.

Area 5

'and a mechanism in place to ensure that benefits are maximized for New Brunswickers, including the development of a proper royalty structure.'

This area is so open to interpretation that it is difficult to even address. Are the benefits to New Brunswickers maximized if the government receives royalties and some jobs are created for workers for a few years, but the same amount of money is lost to increased health care costs and long term damage to the environment on which we are dependent?

Is a temporary boost in revenue a good trade for global climate change and the myriad costs it will bring?

Isn't our indulgence in cost-benefit calculations over an industry that threatens our very existence an exercise in absurdity?

So we will spend little time here beyond noting how shale gas fails even in a normal accounting.

It is a typical boom-bust enterprise, and in the case of shale gas, its quick depletion rate means the boom will not last long. As Canadian petro geologist David Hughes showed in his two unique and comprehensive investigations into shale gas, shale plays peak in roughly five years. [94] [95] After the flurry of drilling, the numbers of workers plummet, the infrastructure built to support them is abandoned, and the industry will leave the area in worse economic straits than it was before. A few people will make money, but most of the profits will leave the province. This classic economic cycle is well documented historically, and currently, in shale areas.

Legacy costs and environmental damages will outlast the industry's presence. Alberta's number of abandoned wells has quadrupled in the last year. [96] At the current rate of reclamation, it will take 20 years to dismantle just this year's supply. It's an expensive process, costing a minimum of \$10,000 and millions in special cases.

As explained in a CBC interview [97], "Industry is not doing as well, and it's due to the low commodity prices, low price of oil, low price of gas and declining production," Payne said. "Declining reservoirs [are] catching some of the companies and they're not able to survive."

When a company walks away from a well, it is capped off, but thousands of metres of tubing remain underground and can still transport remaining oil or gas to the surface. **"There is often some level of contamination with these older sites, and the costs really escalate quickly,"** said Jason Unger of Edmonton's Environmental Law Centre.

Unger's report notes that, over time, abandoned wells become more prone to failures that can lead to ground and surface water contamination, and threats to plants and animals in the area. The report also points to the economic costs of leaving a site abandoned for years. **"Once production has ceased from a well, the land effectively remains sterilized from other uses,"** the report states.

These current troubles stem from the business case for the industry, which itself is flawed. The Energy Information Agency's Third Quarter 2014 Financial Report (US agency that tracks financial and production data) stated that, "industry balance sheets have not shown a profit from the actual sale of gas."

In the financial magazine 'The *Economist*,' Michael Cohen of Barclays bank, states, "The industry's weak balance sheet is also a vulnerability. Most firms invest more cash than they earn, making up the difference by issuing bonds. Total debt for listed American exploration and production firms has almost doubled since 2009 to \$260 billion, according to *Bloomberg (Businessweek)*; it now makes up 17% of all America's junk

bonds. In 2013, more than a quarter of all shale investment was done by firms with dodgy balance sheets (having debt of more than three times gross operating profits).”

Moody’s and Standard & Poor rate roughly 75% of the bonds issued by shale exploration and development companies as below investment grade, or ‘junk’ status.

With the cost of producing gas continuing to be greater than the price for which it is sold, the industry currently exists on massive borrowing and the sale of junk-status bonds. It is already contracting due to the current world economic status, the over-supply of gas and likely future restrictions due to climate change concerns.

Plans for exports have been hit by a reduction in demand, as China has signed a long term contract to buy gas from Russia, and Iran, the second largest gas producer in the world, will most likely soon be released from sanctions that kept it from selling gas to Europe. These other sources of gas are conventional and much cheaper to produce than shale gas. Shale’s future does not look bright.

In addition to any sources noted here, we suggest that you simply Google, 'shale gas bubble.'

Because of this, getting the industry to pay a royalty rate that would justify its existence in New Brunswick is extremely unlikely.

And shale gas often doesn’t deliver on its economic promises of jobs and prosperity. Actual numbers of jobs created are well below the hype that precedes development. **[98]** Numerous studies have shown that oil and gas development provides fewer jobs than any other energy related industry, and compared to clean energy and energy efficiency, far fewer. **[99]** **[100]** **[101]** Energy efficiency has even been promoted as a key to economic growth in the Maritimes and Canada in a report commissioned by the Canadian Government. **[102]**

Jurisdictions hosting shale gas trail the economic performance of their neighbors who are not dependent on the Industry. Deborah Rogers tracked the economic performance of 32 counties in the four major shale gas areas in the US. Using *U.S. Bureau of Labor Statistics* data for 2006 – 2010, Rogers showed that of those 32 counties:

- 26 counties (80%) were below their state’s average for retail sales;
- 30 counties (94%) were below their state’s average for median income; and
- 29 counties (90%) had weekly wages below the national average. **[103]**

A much better path to jobs and prosperity for New Brunswick is a clean energy economy. Massachusetts began its Clean Energy Industry program at the same time

that fracking started in Pennsylvania. Since then it has created roughly 3 times the number of jobs, even though it has one half the population of Pennsylvania. The number of jobs continues to grow, while since 2013, shale jobs in Pennsylvania have decreased. The jobs exist throughout the states geography and in all economic classes, as opposed to shale's concentration in drilling areas and lower level manual labor and service jobs. [104] [105]

Conclusions

In addressing the scientific basis for the safe development we have shown that the current state of scientific monitoring does not allow for any conclusions to be drawn about its safety or threats to public health and environment.

From a total lack of monitoring of fracking operations for water and air contamination to the use of hundreds of chemicals whose properties are unknown, shale gas is an unknown quantity. To proceed with it is to run a live, unethical medical experiment on unwilling citizens who won't know what is happening to them.

This alone is enough to seriously question shale gas development.

Regulations are arbitrary, not based on science, and give only an illusion of safety. In any case they are regularly disregarded by industry as records of thousands of violations illustrate. An analysis of Pennsylvania's oil and gas industry over a four-year period found that the top offenders of regulations—averaging more than one environmental violation every day—represented a wide range of companies from Fortune 500 companies like Cabot Oil, to mom-and-pop operators, to firms like Chevron. [106]

This lack of science alone is cause for a long term, 10-year minimum moratorium to do the necessary research.

We have also shown that the science, while incomplete and demanding much follow-up research, associates shale gas with a myriad of public health and environmental threats.

To put it in perspective, Dr. Anthony Ingraffea, expert on hydrofracking, [107] made this statement referencing about a new scientific panel's report on the fracking in the Delaware River Basin. [108]

"In 2007 when Delaware Riverkeeper first became an advocate for preserving that watershed from shale gas development, there were only six (6) peer-reviewed science, engineering, and public health publications on the actual impacts of shale gas development worldwide. Today, 6 years later, there are over 580 such publications, and that number increases daily.

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www.noshalegasnb.ca

shaleinfo.nb@gmail.com

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Alarming, about 80% of those have been published since January 1, 2013 and over 50% in just the past year and a half: **where it has occurred, shale gas development has been done largely in ignorance of its impacts. A review of those 580 publications in the key categories of impacts to human health, to air, and to water reveals that 94% find harmful impacts to human health, 69% find harmful impacts on water quality, and 88% find harmful impacts to air quality."**

This alone, in light of the Precautionary Principle, and the fact that over 300 hundred chemicals used in fracking are known toxins/carcinogens, is more than enough to call for a long term moratorium.

We have shown that climate change is the most serious challenge facing human kind and that it is inconsistent with the development of new, especially unconventional, fossil fuels.

This alone is enough to ban shale gas development.

As stated at the beginning of this presentation, every panel that has examined the scientific evidence has come to the same conclusions, varying only in the length of time of the moratorium or ban they recommended.

To decide otherwise would require an extensive amount of evidence pointing the other way. We do not believe such evidence exists. Attempts by industry to put together supporting science have been feeble and heavily criticized by objective parties [109].

We have also given you our comments on the questions concerned with process, but they are essentially moot, as any consultation process cannot proceed until the science is done and results provided to all parties.

We thank you for your time and consideration. If we can provide additional help in any way, please let us know.

Sincerely,

Jim Emberger, Spokesperson for NBASGA
shaleinfo.nb@gmail.com

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