FRACKING: New Report on Environmental Impact of Shale Gas Extraction Released

Shale gas is natural gas that's tightly locked within low permeability sedimentary rock. It's already being extracted in AB and BC. And substantial recoverable reserves may exist in NB, NS, QC and elsewhere in Canada. New technology has made accessing shale gas reserves increasingly possible and more economically feasible. Depending on factors such as future natural gas prices and government regulations, further development of Canadian shale gas resources could span many decades and involve the drilling of tens of thousands of hydraulically fractured horizontal wells, i.e., 'fracking.' But the rapid expansion of shale gas development has happened without a corresponding investment in monitoring and research addressing its impacts on the environment. So a new study by The Council of Canadian Academies looked at the environmental impacts of extracting this gas. Here's an overview of its findings.

KEY ENVIRONMENTAL IMPACTS

The Council assembled a panel of experts to address the state of knowledge of potential environmental impacts from the exploration, extraction and development of Canada's shale gas resources as well as the state of knowledge of associated mitigation options. The panel focused on the environmental impacts in two key areas:

Water

The panel raised concerns that accidental surface releases of fracturing chemicals and wastewater, and changes in hydrology and water infiltration caused by new infrastructure, may affect shallow groundwater and surface water resources. There's also a risk to potable groundwater from the upward migration of natural gas and saline waters from leaky well casings, natural fractures in the rock, old abandoned wells and permeable faults. These pathways may allow for migration of gases and possibly saline fluids over long time periods, with a potentially substantial cumulative impact on aquifer water quality.

The panel did note that risks from surface activities will likely be minimal if proper precautionary management practices are followed. But not enough is known about the fate of the chemicals in the 'flowback water' (that is, the water used in a single hydraulic fracturing treatment that returns up the well to the surface after stimulation) to understand potential impacts to the environment and human health or to develop appropriate remediation. Monitoring, assessment and mitigation of impacts from upward migration are more difficult than for surface activities.

However, the greatest threat to groundwater is gas leakage from wells for which even existing best practices can't assure long-term prevention, said the panel. The impacts of well leakage is site specific due to variability in several factors. And these potential impacts aren't being systematically monitored, predictions remain unreliable and approaches for effective and consistent monitoring must be developed.

In addition, flowback, is a potentially hazardous waste because it typically contains hydrocarbons including variable amounts of benzene and other aromatics, fracturing chemicals and potentially hazardous constituents leached from the shale (such as salts, metals, metalloids and natural radioactive constituents). Although flowback water is now commonly re-used in later fracturing treatments, some eventually remains, which poses technical challenges for treatment where deep wastewater injection for disposal may not be feasible, such as in eastern Canada.

GHG Emissions

To the extent that natural gas extracted from shale replaces oil and coal in energy use, particularly in electricity generation, it may reduce the environmental impact of fossil fuels. But whether fracking will actually reduce GHG emissions and slow climate change will depend on several variables, including which energy sources it displaces and the volume of methane emissions from gas leakage at the wellhead and in the distribution system. The panel noted that experts disagree about these issues. Some conclude that downstream GHG benefits may be offset by upstream leakage as well as the risk that shale gas will undercut the markets for lower carbon alternatives and foster lock-in to high carbon infrastructure. Others argue that shale gas could provide a bridge to a low-carbon future. And fields that produce gas with high carbon dioxide content could become important additional sources of carbon dioxide emissions unless those emissions are captured and used for enhanced oil recovery or are sequestered in saline aquifers.

Other Impacts

The study also considered other environmental impacts, including those affecting:

Land. Large-scale shale gas development will have both local and dispersed land effects. So the assessment of the environmental effects of shale gas development can’t focus on a single well or well pad, but must also consider regional and cumulative effects. Shale gas development requires extensive infrastructure that includes roads, well pads, compressor stations, pipeline rights-of-way and staging areas. Although the use of multi-well pads and longer horizontal laterals reduces the environmental impact compared to individual well sites, the cumulative effects of the large number of wells and related infrastructure required to develop the resource still impose substantial impacts on communities and ecosystems. In addition, the performance of the infrastructure, operations and closure procedures will require monitoring for potential fluid migration over long time scales to assess impacts. Because the degree of future land reclamation from shale gas development is uncertain, consideration should be given to the risks and financial liability that arise. Land impacts may include deforestation, the destruction and fragmentation of wildlife habitat and adverse effects on existing land uses such as agriculture and tourism. It’s difficult to estimate these impacts without information on the location, pace and scale of future shale gas development.

Air contaminants. The emission of air pollutants from fracking is similar to conventional gas, but higher per unit of gas produced because of the greater effort required. These pollutants include diesel-use emissions, hydrocarbons, volatile organic compounds (such as benzene) and particulate matter. The main regional air emission issue is the generation of ozone, which could adversely affect air quality.

Seismic events. Although hydraulic fracturing operations can cause minor earthquakes, most of the earthquakes that have been felt by the public have been caused not by the fracking itself, but by wastewater re-injection. Most experts believe the risk of fracking causing earthquakes to be low. Seismic monitoring during operations can diminish this risk further. The risk from the injection of waste fluids is greater but still low and can be minimized through careful site selection, monitoring and management.

Human health and social impacts. The health and social impacts of fracking haven’t been well studied. Although shale gas development will provide varied economic benefits, it may also adversely affect water and air quality and community well-being due to the rapid growth of extraction industry in rural and semi-rural areas. Potential community impacts include health and safety issues related to truck traffic and the sudden influx of a large transient workforce. Psychosocial impacts on individuals and on the communities have been reported related to physical stressors, such as noise, and perceived lack of trustworthiness of the industry and government. If shale gas development expands, risks to quality of life and well-being in some communities may become significant due to the combination of diverse factors related to land use, water quality, air quality and loss of rural serenity, among others. These factors are particularly relevant to the ability of Aboriginal peoples to maintain their traditional way of life. In fact, several First Nations have expressed concerns about the possible impacts of fracking on their quality of life and their rights.

The panel stated that managing the environmental impacts of large-scale shale gas development will require not only the knowledge provided by characterizing water and ecological systems prior to development and environmental monitoring, but also a robust management framework that includes five distinct elements:

- Technologies to develop and produce shale gas. Equipment and products must be adequately designed, installed in compliance with specifications and tested and maintained for reliability;
- Management systems to control the risks to the environment and public health. The safety management of equipment and processes associated with the development and operation of shale gas sites must be comprehensive and rigorous;
- An effective regulatory system. Rules to govern the

development of shale gas must be based on appropriate science-driven, outcome-based regulations with strong performance monitoring, inspection and enforcement;

- Regional planning. To address cumulative impacts, drilling and development plans must reflect local and regional environmental conditions, including existing land uses and environmental risks. Some areas may not be suitable for development with current technology, while others may require specific management measures; and
- Engagement of local citizens and stakeholders. Public engagement is necessary not only to inform local residents of development, but also to receive their input on what values need to be protected, reflect their concerns and earn their trust. Environmental data should be transparent and available to all stakeholders.

BOTTOM LINE

The panel concluded that there may be some negative impacts of shale gas development that can't be eliminated and the scientific basis for identifying areas that are particularly vulnerable hasn't been established. The shale gas industry has made progress over the past decade in reducing water use by recycling, reducing land disruption by concentrating more wells at each drilling site, reducing the volumes of the toxic chemicals it uses and reducing methane emissions during well completions. Other impacts, however, such as cumulative effects on land, fugitive GHG emissions and groundwater contamination, are more problematic.

The Canadian regulatory framework governing shale gas development is evolving and remains untested. It's difficult to judge the efficacy of current regulations because of the lack of scientific monitoring. Existing technologies and practices could be effective to minimize many impacts, but it's unclear that there are technological solutions to address *all* of the relevant risks. And the research needed to provide the framework for improved science-based decisions on cumulative environmental impacts has barely begun. Because shale gas development is at an early stage in Canada, there’s still an opportunity to implement management measures, including environmental surveillance, that’ll reduce or avoid some of the potential negative environmental impacts and permit adaptive approaches to management.

INSIDER **SOURCE**

‘Environmental Impacts of Shale Gas Extraction in Canada,’ The Council of Canadian Academies, 2014.