The Fugitive Gas Emissions Team

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Policy Paper





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Insights into alternative policies in regulating fugitive gas emissions

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Abstract

Despite the implementation of several environmental policies by federal and provincial governments intended to minimize the impact and mitigate the long-term effects of GHG emissions, regulations to account for GHG emissions are still in the preliminary stages. In addition, the lack of accurate baseline information on methane emissions and the costs required for compliance make most of the current policies ineffective. Currently, there are four potential alternatives being discussed to regulate methane emissions: market-based policies; technology-based standards policies; performance standard policies; and voluntary approaches. However, this paper proposes an alternative approach, which has not been discussed in the literature. Based on literature review, successful policies and regulations will depend on the capacity to accurately monitor and quantify GHG emissions. A series of studies and government reports have demonstrated the success of the forestry industry's third-party certification process in Canada. Thus, we suggest that research regarding a demand-based policy, combined with a voluntary approach, should be explored for this specific case. This approach could lead to an effective long-term reduction of greenhouse gas emissions from the oil and gas sector in Canada. Based on this alternative approach, both public and private resources could be used for campaigns aiming to educate consumers about the costs of adopting sustainable management practices and the importance of consuming energy from certified suppliers.

1.0 Policy Issue

A necessary condition to successfully regulate greenhouse gas (GHG) emissions is the capacity to monitor and quantify the emissions before and after the regulations are in place. This task is especially challenging during the development of unconventional hydrocarbon resources, as intentional and unintentional releases of gas happen throughout each stage of the value chain (Ma, Sobernheim, and Garzon 2016).

The release of natural gas is of great concern as methane, the main component of natural gas, has greater global warming potential than carbon dioxide (Myhre et al. 2013). Thus, the climate benefits of using natural gas as the bridge fuel towards a future less dependent on hydrocarbons only holds true if fugitive release of methane is minimized before combustion (Alvarez et al. 2012). Above all, the social costs or negative externalities associated with methane emissions are currently not being internalized by the industry.

In Canada, while the federal and provincial governments have made it part of their environmental policies to target methane emissions reductions, regulations to address and account for these emissions are still in the drafting stages at both levels of government. The efficacy of these policies in reducing methane emissions is subject to the type of policy that is adopted, considering that some solutions impose higher costs to the industry, which could erode potential benefits that natural gas holds over alternative fossil fuels.

2.0 Background and Current Status

2.1 Evolution of unconventional production

Compared to conventional oil and gas reservoirs, which are typically developed using vertical wellbores and do not require constant stimulation treatments, unconventional reservoirs are tight subsurface hydrocarbon resources with low permeability or high viscosity and cannot be economically developed with extraction technologies used for conventional reservoirs (Ma, Sobernheim, and Garzon 2016).

These tight geological formations include oil and gas shales, heavy oil and gas sands, coalbed methane, and gas hydrates. The extraction of these resources requires more wells being drilled on

an ongoing basis as low permeability causes rapidly declining production rates (Chimowitz et al. 2015). Further, this extraction also requires new technologies like horizontal drilling and hydraulic fracturing to stimulate the production of the resource at a continuous rate within the same play to maintain economic and commercial viability (Ma, Sobernheim, and Garzon 2016).

While horizontal drilling and hydraulic fracturing have been used as techniques for hydrocarbon extraction in the past, it wasn't until the mid 2000s when the increase in demand for natural gas in the United States, and the resulting increase in prices, made shale gas production economically viable. In December of 2005, natural gas prices peaked at $15.38 per MBtu while imports grew 41% between 1995 and 2007 (Ratner et al. 2015).

2.2 Climate Impact

The increasing global pressure to reduce GHG started to challenge the growth of extracting hydrocarbons from unconventional reservoirs. It is estimated that the oil and gas sector is responsible for the largest contribution to greenhouse gas emissions in Canada (Johnson et al. 2017).

The amount of GHG emissions per unit of energy output varies when different fossil fuels are burned. The Energy Information Administration (EIA) reports that natural gas, when burned, emits the lowest amount of CO_2 compared to any other types of fossil fuel (U.S. Energy Information Administration 2017).

However, GHG emissions happen throughout the value chain of the different fossil fuels, not just when they are burned, i.e., natural gas is sometimes intentionally released and used during fracturing, production, and distribution. There are also unintentional fugitive gas emissions via leaks in the equipment used throughout the process (ICF International 2014).

Some emissions may be the result of deterioration of geochemically unstable cement, leading to a weak or broken well seal which allows gas to escape and migrate. This is the case for between 1 and 3% of unconventional well leaks. Fugitive gas may migrate all the way to surface via these wellbore conduits, or they may begin migrating laterally along adjacent formations. This lateral

migration can result in either emissions to surface or contact with groundwater (Steelman et al. 2017) (Figure 1).

Intentional and unintentional releases of gas are of great concern as methane, the main component of natural gas, has 25 times the global warming potential of carbon dioxide over a 100 year period (Myhre et al. 2013). Alvarez et al (2012) estimate that the natural gas climate benefit over coal or diesel is eroded when more than 2.7 or 0.8 percent, respectively, of the natural gas produced is emitted before it is used.

Some literature indicates that approximately 0.6-7.7% of methane emissions produced during the lifetime of a fossil fuel well occur during activities that take place either at the well site (known as "upstream") or during processing (known as "midstream"). Approximately 0.07-10% of methane emissions occur during transportation, storage, and distribution activities (known as "downstream") (Caulton et al. 2014). Other literature states that there are detectable levels of methane being emitted from approximately 47% of active wells in northeastern BC (Johnson et al. 2017).

3.0 Key Considerations

To address some of the concerns around fossil fuel burning, governments have implemented policies to minimize the impact and mitigate the long-term effects of GHG emissions. These policies include emission caps, feed-in-tariff programs, and market-based solutions such as taxes or tradable permits (McKitrick 2016).

There is great uncertainty regarding the accuracy of inventory levels of methane emissions in Canada. Inventory levels of GHG are reported in the Environment and Climate Change Canada's National Inventory Report (NIR). The inventories in this report are only fully updated approximately every five years and the estimates during interim years are calculated based on projections from the baseline data. Further, unreported and fugitive sources of emissions magnify the inaccuracy of the official inventory levels. A recent airborne survey performed in BC indicated that actual emissions may be much higher than what is being reported by industry or estimated by the government (Johnson et al. 2017).

Bottom-up inventory and top-down apportionment are two commonly used approaches in estimating emissions. There is currently no industry consensus as to which measurement technique would yield the most accurate emission estimates. Literature suggests that top-down measurements can be much higher than bottom-up estimates (Johnson et al. 2017; Caulton et al. 2014). Furthermore, natural gas of different types (thermogenic/biogenic) and maturity levels have different $\delta^{13}C_{CH4}$ (isotopic composition of methane) signatures, so $\delta^{13}C_{CH4}$ measurement data can be used to discriminate the origin of CH_4 emissions. Lopez et al. (2017) presented an improved CH_4 source attribution method through continuously measuring $\delta^{13}C_{CH4}$ in the plume of anthropogenic CH_4 sources using a mobile analytical system to differentiate biogenic from thermogenic methane (Lopez et al. 2017).

4.0 Policy Options

4.1 Current policy status

In Canada, the federal Ministry of Environmental and Climate Change is responsible for regulations and policies on environmental issues. In 2016, the department presented its plan to meet Canada's emissions reduction targets, while minimizing the impact to the economy, through its Pan-Canadian Framework on Clean Growth and Climate Change (Government of Canada 2016). In this plan, the federal government laid out its commitment to reducing methane emissions from the oil and gas sector to 40 to 45% below 2012 levels by 2025.

At the provincial level, the Alberta Government has explored and put in place numerous strategies to meet emissions reduction targets (Government of Alberta 2008, 2007). The latest of the series of plans and strategies is called the Climate Leadership Plan (Government of Alberta 2015). Here the provincial government commits to reducing methane emissions from oil and gas operations by 45% by 2025. The Alberta Energy Regulator is currently working with industry participants, technology groups, and members from government and environmental nongovernment organizations to develop regulations to meet these targets.

4.2 Policy Categories

Munnings et al (2017) found abatement costs are heterogeneous across subsectors and the costs greatly vary depending on the geography, geology, and hydrology of the production and

distribution areas. Thus, provincial and federal regulations need to consider the implications of their policies as these could impose higher costs than benefits.

The alternatives to regulate methane emissions could be categorized into four different groups: market-based policies; technology standards; performance standards; and voluntary and demand side approaches.

4.2.1 Market-based policies

Market-based policies such as tradable permits allow emitters to decide how much they can afford to emit based on the number of tradable credits, or emissions rates, assigned to them by the regulator. If firms decide to emit above their assigned rates, they must purchase credits from other firms that emit below those rates and account them for compliance.

Another effective market-based policy is the use of taxes on emissions. Here, the regulator must make assumptions about the emission factors, activity factors, and tax firms based on the estimated emissions each firm produces.

The lack of accurate inventory data on methane emissions, especially from fugitive sources, would make market-based policies ineffective and could impose costs with negligible impact on actual methane emissions.

4.2.2 Technology-based standards policies

For these types of policies, the regulator makes assumptions regarding the technologies available to reduce emissions and prescribes technical solutions that the industry must adhere to. While these policies do not require an accurate inventory of current emissions, the enforcement and monitoring required for compliance could impose significant administrative costs on the regulators. Furthermore, this solution could prevent firms from adopting technology advancements that could yield better results than the imposed regulated solution.

4.2.3 Performance standard policies

For this policy, initial emissions need to be measured to establish a baseline; then the emitter decides how to best decrease their emissions below this baseline. Compared to technology

standards, performance standards allow more flexibility for the emitters to choose a solution that best fits their constraints to reach their emission reduction targets. These policies still require a more accurate method to measure baseline emissions and the use of public resources for enforcement and monitoring, but may provide incentives for innovation.

A subset of these types of policies could be procedural or operational standards. This may include leak detection and repair programs or norms that the industry needs to comply with.

4.2.4 Voluntary approaches

Voluntary approaches to report and reduce methane emissions are self-explanatory. Emitters pre-emptively decide to adopt technologies or processes that can minimize the amount of methane emissions resulting from their different industrial activities. Programs like the Natural Gas STAR spearheaded (NSTAR 2016) by the Environmental Protection Agency (EPA) in the US have been around since the mid-nineties. The success of these approaches is debatable as no third-party verification of emission reductions is done before or after companies adopt these voluntary approaches, and without baseline information it is difficult to attribute successful emission reductions to specific companies or initiatives.

A policy which has not been explored in the literature is a combination of voluntary approaches with demand side public campaigns, whereby public funds are used to educate consumers regarding the social costs associated with energy consumption to trigger bottom-up (grassroots) movements to elicit suppliers to adopt and implement technologies and processes that minimize emissions throughout the energy value chain. This idea is explored in more detail in the following section.

5.0 Policy Alternative

Given the success that the forestry industry in Canada has achieved in demonstrating and promoting sustainability of forest management practices (Gibson MacDonald and Zezulka 2015), the authors of this paper advocate for future research to be done regarding the implementation of a similar approach in the oil and gas industry. We argue that instead of using public funds to monitor and enforce certification on market participants, resources could be used in public communication campaigns educating consumers about the hidden costs associated with energy

use, and the importance of buying and consuming energy from suppliers who are certified with sustainable management practices; i.e., allow companies to voluntarily obtain a certification while actively educating the public that certified companies are a better choice.

The main drawback of the voluntary approach to reduce emissions is the lack of accountability. No third-party verification process exists to guarantee that voluntary initiatives are having an impact on methane emissions. Thus, the social costs associated with the negative externalities remain uncompensated.

A third-party certification process, like those adopted by the forestry industry in Canada (Canadian Council of Forest Ministers 2014), could address the lack of accountability of voluntary approaches. This would incur few administrative costs for the regulator. While companies could choose not to pursue a certification, a more environmentally conscious energy consumer base could trigger a shift towards energy sustainable management practices across the industry.

6.0 Conclusions

The increasing global pressure to reduce GHG has led federal and provincial governments to implement policies to minimize the impact and mitigate the long-term effects of GHG emissions. Despite the implementation of environmental policies to reduce methane emissions, regulations to account for GHG emission are still in the drafting stages.

To meet Canada's emissions reduction targets, the Alberta Government is currently collaboratively working with industry, technology groups, government members, and environmental nongovernment organizations to implement new provincial regulations. There are four potential alternatives to regulate methane emissions: market-based policies; technology-based standards policies; performance standard policies; and voluntary and demand side policies. The capacity to accurately monitor and quantify GHG emissions is a necessary condition to achieve successful regulation. Thus, the lack of accurate baseline information on methane emissions and the enforcement and monitoring required for compliance would make most of these policies ineffective.

Based on a series of studies showing the recent success of the forestry industry's third-party certification process in Canada, the implementation of a combined voluntary and demand-based policy approach could lead to an effective long-term reduction of greenhouse gas emissions from the oil and gas sector in Canada. To the best of our knowledge, this approach has not been discussed in the literature and more research exploring this alternative is needed to assess its viability. Both public and private resources could be used for campaigns to educate consumers about the costs of adopting sustainable management practices and the importance of consuming energy from certified suppliers. Furthermore, one of the major advantages of adopting this approach is that no additional administrative costs are imposed on the regulator, other than funding public awareness campaigns. Following the same pattern observed in the forestry industry during the last few decades, more environmentally conscious consumers would induce industry to adopt more sustainable management practices and, consequently, minimize emissions. Furthermore, one of the major advantages of adopting this approach is that no additional administrative costs are imposed on the regulator, other than funding public awareness campaigns.

7.0 Figures

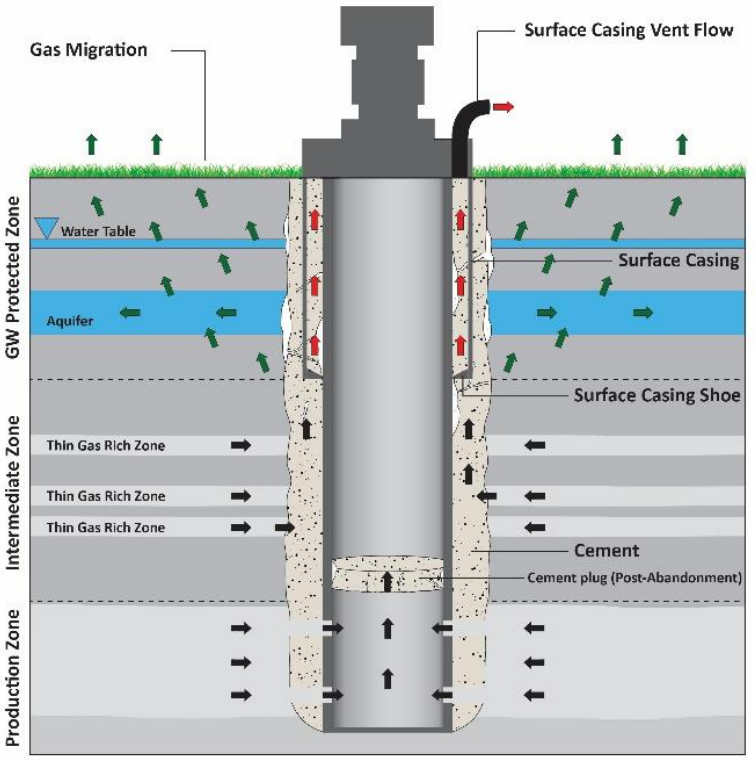

Figure 1: Pathways for fugitive gas emissions

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