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Shale Gas and Climate Targets: Can They Be Reconciled?

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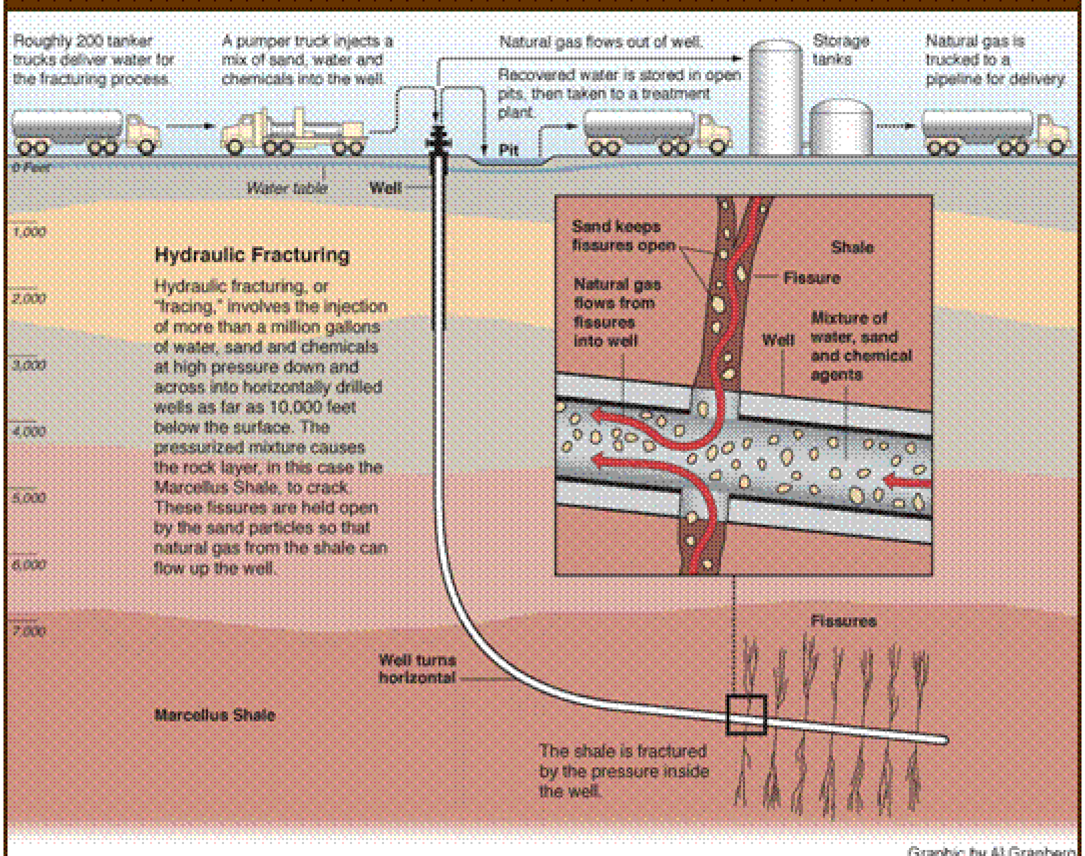
Issue

The B.C. government seeks to reduce provincial greenhouse gas (GHG) emissions 33% below their 2007 level by 2020. By 2050, it has committed to emissions that are 80% below their 2007 level. While pursuing these GHG emission targets, the government continues to promote the exploitation of highly valuable provincial natural gas resources in spite of the challenges this strategy creates for its GHG objectives.

In recent years, natural gas exploration and development have spread beyond traditional gas resources into promising unconventional deposits. Largely through new drilling technologies that have dramatically lowered recovery cost, previously uneconomic resources like shale gas are beginning to be exploited and these hold considerable development potential. While conventional gas can be extracted relatively easily using vertical drilling methods, natural gas in shale deposits flows poorly and requires new advances in horizontal drilling and rock fracturing to improve gas extraction rates. Hydraulic fracturing uses a water, sand, and chemical mixture pumped under high pressure to open up cracks in the shale and allow gas to be drawn out.

Shale Gas Extraction Method

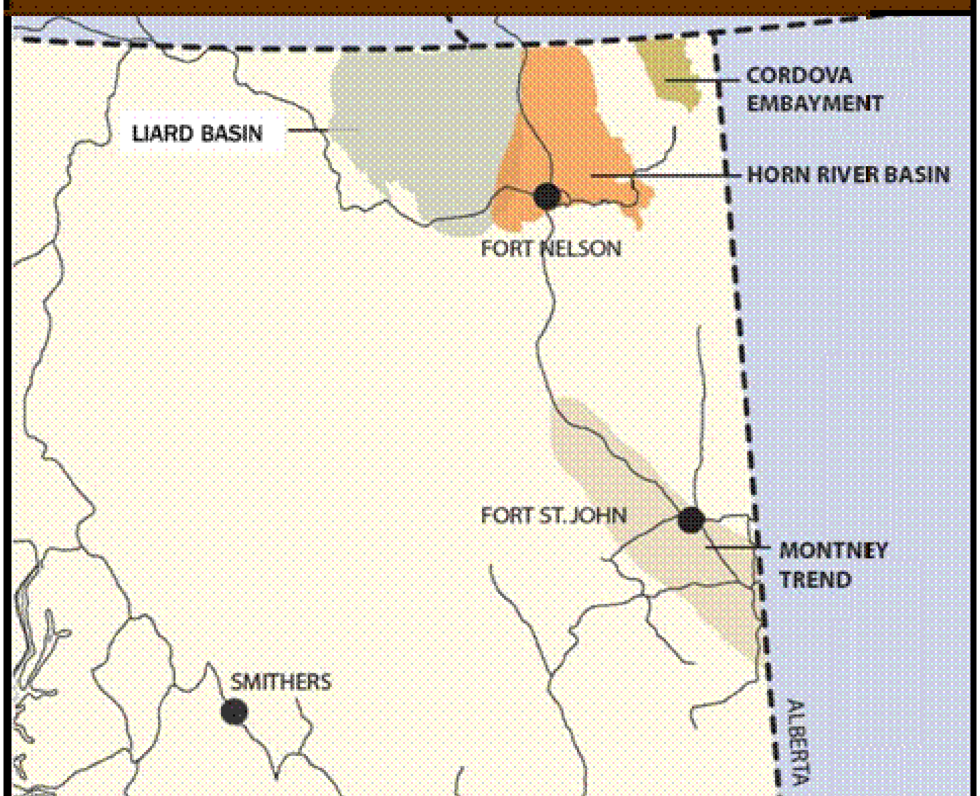


Source: ProPublica, http://www.propublica.org/special/hydraulic-fracturing

Shale gas development in northeast B.C., particularly in the Horn River Basin near Fort Nelson, could become a major economic driver for the province. The shale gas industry could develop this resource of trillions of cubic feet of natural gas, resulting in substantial royalties for the provincial government over many decades. However, this gas is associated with high concentrations of CO2, which is normally vented to the atmosphere as the gas is processed to market standards.

While the expansion of B.C.'s natural gas industry is associated with several sources of GHG emissions, including methane leaks from pipelines and CO2 emissions from combustion at processing plants, the venting of excess CO2 from the raw resource poses a unique set of concerns. First, this is potentially a very large source of GHG emissions, which on its own could play a key role in thwarting the provincial government's climate policy objectives. Second, because industry must incur the cost of CO2 separation as part of the production process of shale gas, the prospects for CO2 capture and storage are quite favourable compared to other sources of GHG emissions.

B.C. Shale Gas Development Areas



Source: British Columbia Natural Gas Petroleum
Yours to Explore 2010, B.C. MEMPR

In this paper, we therefore focus on the particular issue of CO2 venting from large-scale shale gas development and policy responses that could improve B.C.'s ability to achieve its GHG emissions reduction targets.

Analysis

Raw natural gas extracted from shale in the Horn River Basin contains approximately 11-12% CO2, considerably higher than the average content of only 2-4.5% for B.C.'s conventional natural gas reservoirs (NEB, 2009b; CAPP, 2004; CAPP, 2010). Typically, commercial gas sold to market customers can contain no more than 2% CO2 to ensure adequate heating value and for pipeline restrictions. When excess CO2 is removed at natural gas processing facilities, it is usually vented to the atmosphere.

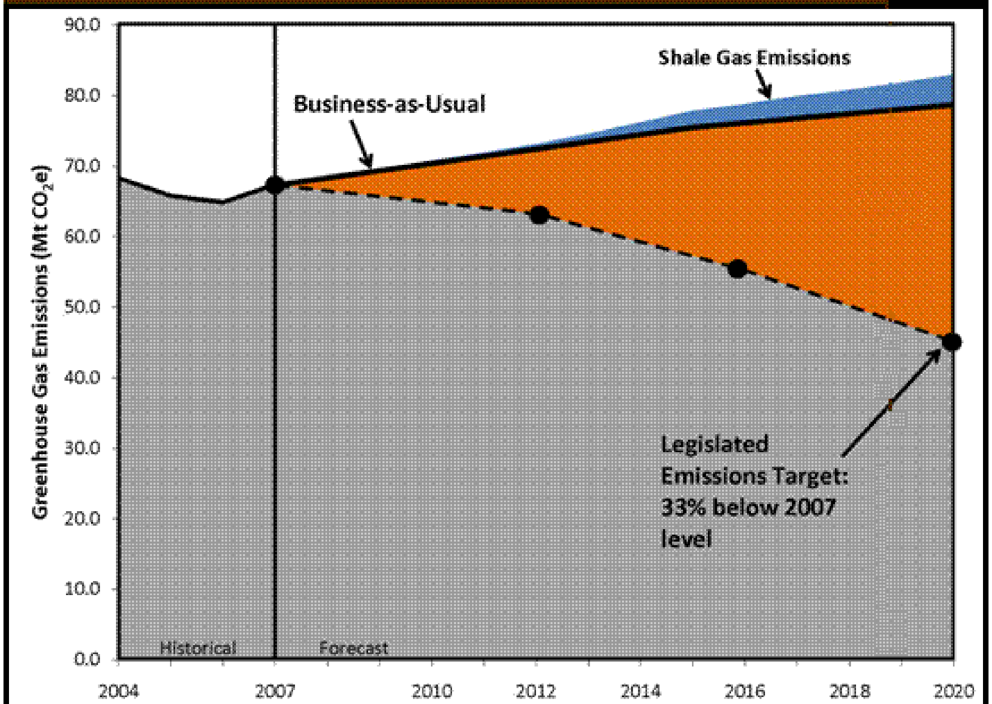
This venting of CO2 could become a significant issue when one considers that estimates of shale gas in the Horn River Basin range from 144 to 1000 Tcf (trillion cubic feet). Recoverability estimates are currently at 75 to 200 Tcf, although this could increase in future with maturing extraction technologies. By 2015, potential development of shale gas in the Horn River Basin is forecast to be 1 Bcf/day (billion cubic feet per day) and by 2020 this would increase to 2 Bcf/day (CAPP, 2010a; CAPP, 2010b). This level of shale gas production is substantial considering that during 2008 all natural gas extraction combined in B.C. was 3 Bcf/day (BC MEMPR, 2010).

Natural gas processing plants also have significant emissions from in-plant fuels combustion. We have decided not to pursue this issue in this paper because we are not contesting the development of a natural gas industry in B.C. Such an industry may for a time contribute to continental reductions in GHG emissions if the gas is used almost entirely to supplant coal in electricity generation and/or gasoline in vehicles. But long run simulations indicate that if North America is to reach emissions reductions of 80% and more by mid-century, then almost all fossil fuel use will need to involve conversion to electricity and hydrogen with 90% capture and storage of all carbon in the fuels (Jaccard, 2006; Stern, 2006; IPCC, 2007).

Results

To assess the implications of shale gas development for B.C.'s climate targets, we generated a forecast of GHG emissions from vented shale gas formation CO2. We assume that 10% of the CO2 content is removed from the shale gas to prepare it for commercial sale and use the most recent publicly available CAPP forecast of production in the Horn River Basin (CAPP, 2010b). A simple calculation was used to convert 10% of the forecast production volume into GHG emissions. While the magnitude and pace of shale gas development in B.C. is uncertain, there is a realistic chance that exploitation of this resource will reach the production levels indicated above, under current market conditions and in the absence of government constraints. Accordingly, vented GHG emissions could reach a level of 4.3 Mt/yr in 2020.

Provincial Emissions, Current Policies, and Shale Gas Forecast



Source: B.C. Climate Action Plan and model simulation by authors

This potential rise in emissions from shale gas will make it extremely difficult for B.C. to achieve its CO2 reduction targets. For the province to meet its legislated emissions reduction of 33% below 2007 levels (45 Mt CO2e/yr) by 2020, it must reduce total provincial emissions by 33.6 Mt/yr from the business-as-usual estimate of their likely 2020 levels[1]. However, our forecast shows that shale gas development would increase provincial emissions by almost 10% relative to where they should be in 2020 under the legislated emissions target.

The Spectra Energy Fort Nelson natural gas processing plant and the proposed EnCana Cabin plant will be the two largest point-sources of emissions in the province with processing capacities of 790 and 800 Mcf/day (million cubic feet per day), respectively. The EnCana Cabin processing plant alone will emit 2.2 Mt/yr at full capacity, which represents 6.5% of the required emission reductions from business-as-usual (BC EAO, 2009).

If B.C. is to achieve its GHG emission target while pursuing shale gas development, it will need to reduce emissions throughout the economy by almost 50% from where they would otherwise have been in 2020 as its population, building stock, industrial sector, and number of vehicles grow over the next decade. Even without the increase in emissions that would occur with shale gas development, analyses by the government suggest that the 2020 target will be extremely difficult to achieve. The provincial government's Climate Action Plan details emission reduction policies, such as the carbon tax, clean-electricity generation requirements, clean transportation initiatives, new building codes, and increased efforts in energy efficiency. But all of these policies in concert are projected to achieve only 73% of the reductions needed to meet the mandatory climate target and do not account for the rapid growth of shale gas development (BC MoE, 2008).

1 While the business-as-usual estimate is based on quantitative data included in the Climate Action Plan, it does not include emission reduction measures from the Plan. Significant development of shale gas resources is not included in the BAU estimate (BC MoE, 2008).

In this situation, the broad options for the government are: (1) abandon its GHG reduction target, (2) ban shale gas development completely, or (3) restrict shale gas development so that it is no more GHG-intensive than the conventional natural gas industry. This latter option requires industry to adopt carbon capture and storage (CCS) technologies at natural gas processing facilities to capture CO2. CCS implemented at facilities like the EnCana Cabin and Spectra Energy Fort Nelson plants would capture 85-95% of CO2 emissions that would otherwise be vented to the atmosphere when making shale gas marketable (IPCC, 2005). The CO2 could then be injected into deep saline aquifers or depleted oil reservoirs for permanent storage.

While CCS mostly involves technologies that have been commercially used for decades, there is some uncertainty about its cost at full-scale applications for capturing and sequestering CO2 from the fossil fuel industry. However, the cost of separating CO2 from raw shale gas is unavoidable in order to produce market-ready gas and industry is already applying technologies at commercial scale for this purpose.

Thus, the only additional cost of CCS for industry in this case is the cost of CO2 transport and geological injection. As a comparison, in the North Sea the Norwegian energy company Statoil operates the Snøvhit and Sleipner gas fields, each equipped with CCS. Sleipner has been in continual operation for over a decade. Natural gas at these fields contains 5-9% CO2, which must be reduced to a maximum concentration of 2.5% before it can be exported to the European market. Snøvhit and Sleipner annually sequester 700,000 and one million tonnes of CO2, respectively.

In issuing its 2009 environmental approval certificate for the EnCana Cabin natural gas processing plant in northeast B.C., the provincial Environmental Assessment Office purported to consider cumulative effects when making its decision. Yet, as the quote from the assessment report illustrates, the discussion of cumulative effects seems to focus only on the incremental effects of the EnCana project. It does not provide a numerical estimate of the effect of approving a series of similar projects one-at-a-time, which collectively match the magnitude of the resource available for exploitation[2].

Under the title, Cumulative Impact Analysis for Carbon Emissions (Section 5.2.3.), the EnCana Cabin plant environmental assessment certificate decision says:

> "The EAO recognizes that the impacts of carbon emissions must be considered at a global level, and that there are limited means available at present to accurately measure the impact of a single point source of carbon emissions at a regional or global scale. The impact of the proposed Project relative to other global sources is difficult to assess, and, therefore, it is difficult to come to a determination of global cumulative impacts with any degree of certainty. However, it is reasonable to consider, given the magnitude of carbon emissions associated with the proposed Project, that there would be cumulative impacts with other emitters in the regional and global context."

Note that the decision discusses the difficulty of determining the impact of the proposed project relative to other global sources. But such a determination would be an incremental analysis rather than a cumulative analysis. Cumulative analysis would instead focus on estimating similar projects within B.C.'s jurisdiction that are likely to seek development approval in future and thus to estimate the cumulative effects of all such projects.

2 In the federal Cumulative Effects Assessment Practitioner's Guide, cumulative effects are defined as "changes to the environment that are caused by an action in combination with other past, present and future human actions." (CEAA, 1999).

Cumulative impact analysis should estimate the aggregate effect of B.C. approving a set of projects similar to the EnCana Cabin plant that, in total, represent the likely extent of resource development. We therefore assess here the likely cumulative effect of a number of similar projects that collectively exploit a significant amount of B.C.'s shale gas resource potential. Our analysis shows that the cumulative effect would make it even more difficult for B.C. to achieve its GHG emissions reduction target for 2020.

Policy Recommendations

Canadian federal and provincial governments have a consistent history (starting in 1988) of promising to achieve GHG emissions targets for future years (2000, 2005, 2010) that they subsequently failed to meet, usually by a wide margin. In fact, no Canadian government has realized its GHG reduction targets, in spite of strong promises that these would be achieved. In the case of B.C.'s current target for 2020, the potential development of shale gas makes it likely that this province will sustain the Canadian tradition of failing to meet GHG emissions reduction targets. If, however, the government is serious about achieving its target, then our analysis suggests that it needs to either ban shale gas development in B.C. or only allow such development if it includes CCS to prevent CO2 venting. Even in this latter case, it is likely to be difficult to achieve B.C.'s GHG emissions reduction targets.

We therefore recommend the following:

1. The B.C. government should immediately amend the EnCana Cabin plant Environmental Assessment Certificate approval and require that this project, as well as all future natural gas projects processing shale gas (including the retrofit or expansion of existing plants), include CO2 capture and storage to ensure that any vented emissions are comparable per unit of commercial gas produced to those generated by a plant processing natural gas that has a low CO2 content (0-2%) in its raw state.

2. The B.C. government should establish a competitive bidding process for gas industries to apply for government funding to assist in the first development of shale gas with CCS. The lowest bid per unit of CO2e sequestered will receive a subsidy offer from the government for that project (with the size of the subsidy to be determined through negotiation to cover some but not all of the additional costs). Funds for the subsidy could be provided from natural gas royalty revenues or from a portion of carbon tax proceeds as the carbon tax should soon be applied to combustion emissions from natural gas processing facilities. Subsequent projects might receive different levels of subsidy based on the merits of their designs and a continuation of a competitive bidding process.

3. The B.C. government should conduct a thorough analysis of its evolving natural gas industry and the implications for its GHG targets. In particular, it needs to extend the preliminary analysis of this paper to examine options for preventing CO2 venting and for reduction of methane leaks from pipelines and emissions from processing facilities. Policies to be explored include carbon taxes, subsidies, regulations and, if necessary, moratoriums.

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