Electrification of the Horn River Basin

PURPOSE

The Horn River Basin contains significant natural gas reserves that are considered economically viable. However, in a business as usual world its production would result in large amounts of vented carbon dioxide.

An opportunity exists to develop the Horn River Basin in a way that obtains the economic value, while minimizing the greenhouse gas impact.

OVERVIEW

The Challenge

The Horn River Basin (HRB) region is north of Fort Nelson. It is a region with significant natural gas reserves; however, the reserves are entrained in shale (called shale gas) and require new, unconventional, means to extract the natural gas. BC Hydro understands that the economics for HRB development are challenging relative to other sources of natural gas in the world, but that industry continues to advance the HRB's development with the expectation that it will be economically developed.

Industry producers currently have plans to install new natural gas processing capacity at a site approximately 90 km northeast of Fort Nelson, along with a raw natural gas gathering network through the HRB region.

Raw natural gas from the HRB has a very high level of associated carbon dioxide (CO_2); this is a unique characteristic relative to most other natural gas fields. Approximately 12% of the raw natural gas stream is CO_2 (formation CO_2), of which 10% is stripped off in processing and vented. By itself, this formation CO_2 would make up nearly 10% of B.C.'s climate change target of 46 megatonnes (MT) in 2020 based on BC Hydro's mid scenario of natural gas production.[1] Additionally, in a business as usual world, industry would utilize natural gas work sources (natural gas drives and heat raising) which, when combined with the formation CO_2, would result in an overall impact on the 2020 Greenhouse Gas Reduction Target Act target of 14%, with an expected range 6% to 23%, depending on the level of HRB development.

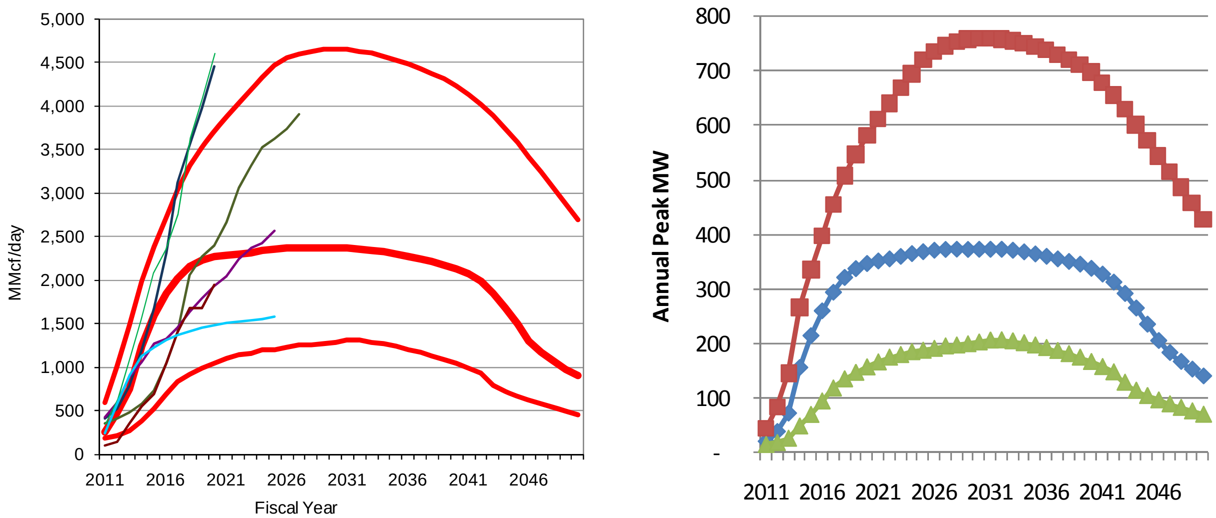
Carbon sequestration, through carbon capture and storage (CCS) and/or enhanced oil recovery are being considered by industry and government as a means of mitigating the effect of the formation CO_2. Sequestration is currently not a viable solution for the combustion CO_2.

Individually, or in combination, electrification and carbon sequestration could be used to significantly reduce the amount of greenhouse gas (GHG) that is vented. The challenge is to find ways that the HRB can be developed while mitigating the effects of GHG production.

[1] Greenhouse Gas Reduction Target Act sets a Provincial target of 46 MT for 2020. This was described in the Greenhouse Gas Price Forecast paper presented at the IRP TAP Meeting #2.

Current estimates of the amount of natural gas that could be economically developed from the HRB are presented in Figure 1 (left side). This figure contains BC Hydro's three scenarios of HRB natural gas production (high, mid and low), along with available forecasts from industry and experts in the field. BC Hydro's mid scenario identifies a peak production of 2,400 million cubic feet per day (MMSCF/day), with a total recovered amount of 30 trillion cubic feet over a 50-year period. At the right of Figure 1 is the estimate of the annual peak load work requirements to extract, process, compress and ship the natural gas, while also implementing CCS.[2]

Figure 1: HRB Natural Gas Production and the Work in Peak Annual MW Required to Produce It



Type and Location of Work Loads in HRB

The natural gas processing plants are expected to be relatively centralized, with current plans for new processing capacity to be developed at a location 90 km northeast of Fort Nelson. Approximately 25% to 40% of the total work energy is expected to be located at the processing plants, and would include the CCS compression load if it is implemented. All heat requirements would also be at these locations; the heat requirement could be partially or totally supplied with natural gas-fired co-generation (electricity and heat production) located at the processing plants.

Almost all of the remaining 60% to 75% of the work load is expected to be compression load at raw gas treatment stations spread through the HRB.

If the HRB were to be electrified, a new transmission line would be required from the BC Hydro system to the processing plants, along with a network of sub-transmission lines from processing plants to the raw gas treatment stations.

[2] This is the total amount of work required irrespective of source. Even if electrification was to occur, it is not expected that BC Hydro would be expected to, or could, serve that entire load; some would remain self-supplied.

Nearest Electrical Source

The Fort Nelson region is in the far northeast of B.C. BC Hydro serves customers in the region with electricity generated at its Fort Nelson Generating Station (FNG), with backup service from Alberta; there is no direct electrical connection to BC Hydro's integrated system. BC Hydro is normally exporting electricity to Alberta from FNG, resulting in BC Hydro operating FNG whenever it is available, while purchasing very little electricity from Alberta through the course of a year.

The transmission and generation infrastructure is currently being upgraded to support up to approximately 75 MW of load in the Fort Nelson region. This supply will be provided by the upgraded 75 MW FNG, along with 75 MW of backup service from Alberta.

With the plans currently being implemented, this relatively confined region has sufficient electricity supply available to meet the forecast load for many years. However, there is not sufficient capacity available in the Fort Nelson region to also reliably serve the potential HRB load.

Available Options

Broadly speaking, there are three available options to providing the required work energy necessary for HRB natural gas to be developed:

- Industry self-supply: Continue a business as usual strategy
- Local BC Hydro service: Supply the HRB with new gas-fired generation developed or acquired by BC Hydro
- Interconnected BC Hydro service: Interconnect the Fort Nelson and HRB regions with the BC Hydro integrated system with a new transmission line (the northeast transmission line) and supply the work energy with clean or renewable electricity

The options of Fort Nelson and HRB remaining isolated from the interconnected system, while relying on clean, intermittent resources and/or additional supply from Alberta have been discarded for a combination of technical, jurisdictional and economic reasons.

Preliminary Findings

1. The HRB is approximately 500 km from BC Hydro's closest point of supply (Peace region) that could serve it. A double circuit 287 kV line appears to meet the combined Fort Nelson and HRB regions. In addition some 150 to 250 km of sub-transmission could be required to fully electrify the raw gas treatment stations. The combined transmission cost would be in the order of $1.5 to $2.0 billion.
2. Given the distances, industry would self-supply in a business as usual world. However, the cost differential between electricity service and self-supply is relatively small. Industry is increasingly considering electricity service instead of self-supply as the expectations for mandated GHG reductions increases. To date, BC Hydro has no formal requests for service to the HRB, but there are indications that some producers would electrify if service was available.

3. If natural gas continues to be the source of work energy for the HRB, industry self-supply with cogeneration would be more efficient than utility-based combined cycle gas-fired generation; direct drive gas compressors would be less efficient.
4. Approximately 65% to 70% of the GHG that would be produced in the HRB could be mitigated with carbon sequestration of the formation CO_2 if fully implemented; and 10% to 15% could be mitigated with electrification with clean or renewable electricity sources. It does not appear economically viable to eliminate the remaining 15% to 20% of vented CO_2.
5. Initial estimates of the cost of electrifying the HRB, including the cost of the clean or renewable electricity, when measured on a CO_2 abatement $/tonne basis (i.e., incremental cost of supply divided by the incremental reduction in CO_2 produced over the life of the HRB) fall within the range of GHG offset cost forecasts.

Policy Considerations

The Clean Energy Act requires that BC Hydro submit an integrated resource plan that describes how BC Hydro will respond to the energy objectives including the following:

1. Meet a 93% clean or renewable electricity target in Section 2 (c),
2. Reduce B.C. GHG emissions in Section 2 (g); and
3. Encourage fuel switching from one energy source to another that decreases GHG in B.C. in Section 2 (h).

Portfolio Analysis[3]

Scenarios will be tested that include (1) no HRB electrification; (2) electrification with moderate penetration (45% to 50% served by BC Hydro); and (3) very heavy electrification (85% to 90% served by BC Hydro).

Questions that would be analyzed include:

1. What amount of CO_2 is produced from the region under the various scenarios being tested?
2. What is the cost impact of using electrification as a tool for GHG reduction in the HRB?
3. What effect would BC Hydro serving the HRB have on its ability to meet its 93% clean or renewable electricity target?
4. Are there any additional benefits that could be obtained if the northeast transmission line was developed (e.g., would it provide access to additional clean or renewable electricity resources that could not otherwise be accessible)[4]?

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[3] Linked to the “IRP Portfolio Analysis” paper and the “Electrification Sensitivities” paper provided at the IRP TAC Meeting #2.

[4] Linked to the “Transmission Planning: Cluster Analysis” paper provided at the IRP TAC Meeting #2.