The Oil Drum: Canada
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Predictions for Canada's Natural Gas Production

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Canadian natural gas is important in a number of ways: It provides 17% of total US NG consumption and today contributes roughly 11% [see calc at bottom] of the energy content in a barrel of tar sands oil (which will only increase with in-situ recovery growth). By no means (conventional or unconventional), can Canada be considered to have lots of natural gas, yet, we produce more than our fair share. Accurately predicting Canadian NG supply is, of course, important for all the usual North American energy security reasons and, among others: It would be nice to know if Canadians will have NG for things other than tar sands and exports to the US. Half of all Canadian homes are heated primarily by natural gas and about 6% of Canada's electricity sector relies on natural gas, a lot of which is used as peak electricity generation.

It's well known that Canadian conventional gas peaked around 2001, but according to a continuing trends prediction case from the National Energy Board, it doesn't appear as if unconventional gas will be playing a big part, at least compared against 2001 peak production levels. Below I summarize some predictions for future production of Canadian natural gas and try to estimate how much of Canada's natural gas will be left over for regular Canadian citizens.

Here is the EIA's take on Canadian natural gas:

> In 2004, Canada provided 85 percent of gross U.S. imports of natural gas. Although Canada's unconventional and Arctic production both are expected to increase over the projection period, and LNG imports into Eastern Canada are expected to begin by the end of the decade, those supply increases are not expected to be sufficient to offset a decline in conventional production in Canada's largest producing basin, the Western Sedimentary Basin. Gross U.S. imports of LNG are projected to exceed gross pipeline imports from Canada after 2015, and Canada's share of gross U.S. imports is projected to decline to 25 percent in 2030.
> ...
> In Canada, natural gas consumption in the residential and commercial sectors is expected to increase steadily at rates of 0.5 and 0.7 percent per year, respectively. Strong growth rates of 2.2 percent per year in Canada's consumption of natural gas for electricity generation and 2.1 percent per year for industrial uses—including vast quantities of natural gas consumed in the mining of the country's oil sands deposits—are the main contributors to Canada's projected consumption growth.

In short, Canadian production decreases while consumption increases and LNG imports start while we're still exporting. From an energy security stand point, this is not good and will be felt over a broad range of industries. Canada will become a net natural gas importer, which will require new LNG terminals, some new pipeline connections and maybe even a reversal of the flow of gas from east to west depending on where the LNG will be coming from.

As far as Canadian exports to the US go, this is linked to production through NAFTA. NAFTA requires that Canada continue to export about 60% of its gas production to the US, and based on the EIA's predictions of Canadian NG imports, it seems as if the US will be holding Canada to this clause.

How much Canadian gas will be produced?

I've painstakingly dug up some good historical NG production data for Canada and compiled a small list of predictions from the NEB and EIA. I've put all of the data here for the world to enjoy (aside: why oh why don't my Canadian tax dollars pay for a *good* centralized service like the EIA for energy stats?).

Fig 1. Past natural gas production in Canada (data points), predicted future gas production including unconventional sources, excluding imports (broken lines) and my Hubbert model for gas depletion (solid line).

Sources for the historical data are:

- Stats Canada (two data sets: 1911-1980, 1970-2002 paid service thanks to TOD:C advertising revenue)
- EIA (1980-2005)
- NEB (2002-2008)
- IEA (1999-2008)

Sources for the outlooks:

- 2007 EIA International Energy Outlook (NG section)
- NEB energy futures to 2030
- My own simple Hubbert model

Most of these predictions come from the National Energy Board of Canada (NEB). The NEB seems to be playing it pretty safe with their predictions, which makes it hard to find a take home message from their work: The difference between their "Fortified Islands" projection and their "Triple E" projection by 2030 is 14.3bcf/d, 37% more gas than what Canada exports to the US now at close to peak production and most of which would come from unconventional sources. The predictions in Fig 1 do include unconventional natural gas as well as any gas that may come online from the Mackenzie Valley pipeline (not expected until 2015 and produces at most 0.5 bcf/d) and any Arctic sources (not expected until 2022, if at all, and produces at most 1 bcf/d). These scenarios also have some rather optimistic price predictions for oil and gas. No scenario sees WTI oil going above $85/bbl by 2030 and the highest Henry Hub gas price prediction is $12/MMBtu.

Continuing Trends

> This scenario is one of little change. In Continuing Trends, Canada experiences the most rapid economic growth and moderate oil and gas prices. As a result, energy demand, energy production and GHG emissions growth continue to be high.

WTI oil price: flatlines at $50 after 2010
NG Henry Hub price: flatlines at $6.65/MMBtu after 2010

Triple E

> The scenario seeks a balance of economic, environmental, and energy (Triple E) objectives. This scenario is the mid-case for Canadian economic growth, has the lowest oil and gas commodity prices, and includes numerous energy demand management programs and policies. Consequently, energy demand growth flattens. This is the lowest energy production scenario and GHG emissions decline.

WTI oil price: flatlines at $35 after 2020
NG Henry Hub price: flatlines at $5.50/MMBtu after 2020

Fortified Islands

> Fortified Islands is the scenario wherein national energy security concerns are emphasized. Geopolitical unrest, a lack of international cooperation and trust, and protectionist government policies characterize this scenario. Fortified Islands reflects the lowest Canadian economic growth and the highest oil and gas prices. This combination of factors ensures that this scenario has lower energy demand growth and lower GHG emissions growth than the Continuing Trends Scenario. It also results in the strongest domestic oil and gas production scenario.

WTI oil price: flatlines at $85 after 2010
NG Henry Hub price: $12/MMBtu

In reading these descriptions, it sounds as if the NEB is taking the approach of whatever the demand may be, production will keep up, not uncommon for these sorts of predictions although if you read through the report, they do focus on production. The Triple E scenario has the lowest production of NG and at the same time, the lowest commodity prices, as if somehow demand for NG will all of a sudden plummet. Fortified Islands has the most expensive commodity prices and as a result, it becomes viable to bring more unconventional gas online (64% of total 2030 production under this scenario is unconventional gas).

Natural gas usage by tar sands

The table below shows the predicted volumes of bitumen and SCO production (MMbbl/d):

Year	Continuing Trends	Triple E	Fortified Islands
2010	1.415	1.415	1.415
2015	1.827	1.757	1.972
2020	2.124	1.787	2.390
2025	2.415	1.764	2.782
2030	2.664	1.800	3.078

Using these tar sands production numbers, I've estimated how much gas the tar sands could be using, assuming: 1) the 2005 average natural gas usage of 638 cf/bbl (which falls between the high and low estimates of NG use by the strip mining process of the tar sands) and 2) a high estimate of natural gas usage by strip mining of 988 cf/bbl (in an attempt to account for increased in-situ tar sands development). The results are in the figure below.

Fig 2. Estimate of the natural gas consumption by the Canadian tar sands. Error bars represent the various scenarios of tar sands production from the NEB Outlook.

In short, full gas production from Mackenzie and Arctic sources (1.5bcf.d total by 2022) will not be enough to sustain tar sands production alone. Since most of Canada's bitumen is only available by in-situ mining techniques, which are expected to consume anywhere between 900-1200 cf/bbl, I might be generous in using a tar sands NG utilization value of 988 cf/bbl for the high end of my calculation. There is always the possibility that other energy sources, such as coal or nuclear (starting 2017 at the earliest) will contribute to the mining of the bitumen though.

Natural gas exported to the US

Under NAFTA, Canada must export ~60% of total gas production to the US. The table below compares expected exports to the US based on my Hubbert model and the expected imports used in the EIA's Energy Outlook.

Year	US imports of Canadian gas predicted by the EIA	Exports predicted by Hubbert model and 60% proportionality clause
2010	7.88	9.38
2015	7.33	7.91
2020	4.71	6.15
2025	3.78	4.57
2030	3.20	3.22

Interestingly, it seems as if the EIA is either more pessimistic about Canadian production than my Hubbert curve or they're giving Canada a break from the proportionality agreement (perhaps so they can have more oil).

What's left over for Canadians?

This is where a lot of assumptions accumulate and can stand to be refined with proper statistical techniques, but here's a rough go at it. First, I'm taking the Hubbert curve of Canadian NG production to be a rough estimate of how much gas will be produced. This production matches fairly closely with one of the NEB's predictions AND it appears as if the EIA has a scenario in which they predict less Canadian gas production (back calculated from the proportionality clause and their expected imports from Canada). Another assumption, probably a good one, is that the priority for Canada's natural gas will be the tar sands and exports to the US.

With this we can now estimate how much Canadian natural gas is actually left over for your average Canadian citizen (defined here as Canadian production - tar sands consumption - exports to US):

Fig 3. An estimate of Canadian gas left over for Canadian citizens (not including tar sands consumption)

Here I've compared two cases. The first, which I call the good case for Canadian citizens, uses the lowest NG consumption values that I've calculated from the tar sands as well as the lowest NG export numbers to the US. The bad case for Canadian citizens uses the highest NG consumption numbers from the tar sands and the highest NG consumption numbers for NG exports to the US.

As stated above, Canada's residential sector is expected to increase its natural gas usage by 0.5%

per year. By 2010, this corresponds to a residential NG use of ~~1.87bcf/d up to 4.97bcf/d~~ 1.55bcf/d up to 1.71bcf/d [thanks jorn] by 2030. Based only on residential use, tar sands production and exports to the US, Canada will need to become a LNG importer or ramp up unconventional gas production between ~~2015-2020~~ 2025-2030 (actually before this if we account for commercial NG use as well). The somewhat comforting news (if you we can say that becoming dependent on foreign LNG is comforting) is that 5.8bcf/d of LNG terminals is in the works and could be online by 2012 (the first will be online in 2009).

I'll end this post with a brief mention of some new unconventional gas finds in Canada. Within the last couple of month's there have been some new natural gas finds in British Columbia and in Quebec. The BC find could be 6 tcf of gas reserves and rival those of the Mackenzie Delta, and the one in Quebec could be 2.5tcf, but both quite expensive to develop.

Calc:
2005 bitumen production = 1.36 million bbl/d @ 6.1GJ/bbl
NG used by tar sands in 2005 ~ 0.87 bcf/d @ 1.1E6 GJ/bcf
NG energy content/upgraded bitumen energy content = 0.115
Average NG used per bbl tar sands oil: 18m^3
Source: Alberta Energy and Utilities Board