Conventional Natural Gas Production Decline Patterns

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Web: pages.ca.inter.net/~jhwalsh/wnatgas2.html

Abstract

In a previous paper, *Parabolic Projection of Four Assessments of Canadian Conventional Natural Gas Resources*, North American conventional gas production over the last decade (including that from Mexico) was found to approximate a flat, drawn-out peak termed here a 'plateau peak' (Web: pages.ca.inter.net/~jhwalsh/wngcanada.html). There is evidence Canadian production taken by itself will also approach such a peak probably at levels between seven and eight trillion cubic feet per year. This note focuses on overall decline rates of three to five per cent per year that may be expected as conventional natural gas production matures in Canada. This approach thus complements the parabolic technique used in the companion paper that does not deal explicitly with the decline period. Taken together, the two papers provide additional insight into the Canadian conventional natural gas situation.

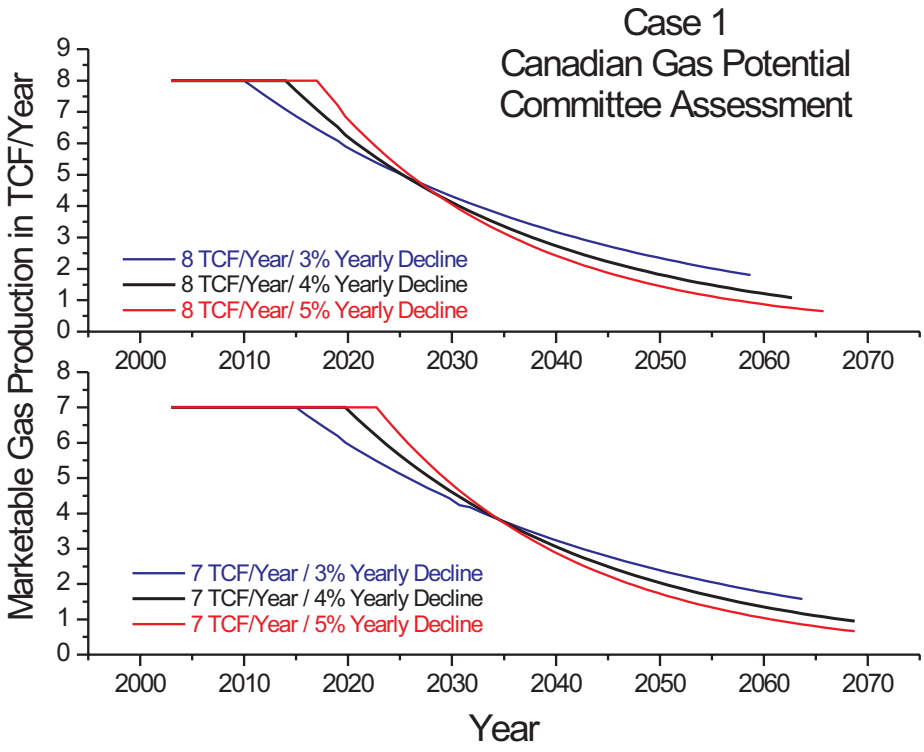
The dates of the onset of decline in conventional Canadian natural gas production estimated from the plateau peak approach employed in this note are reasonably close to those obtained from the parabolic technique in the companion paper for decline rates of 5% per year but less so for lower rates. These dates are in closer agreement when plateau production is eight TCF per year rather than seven.

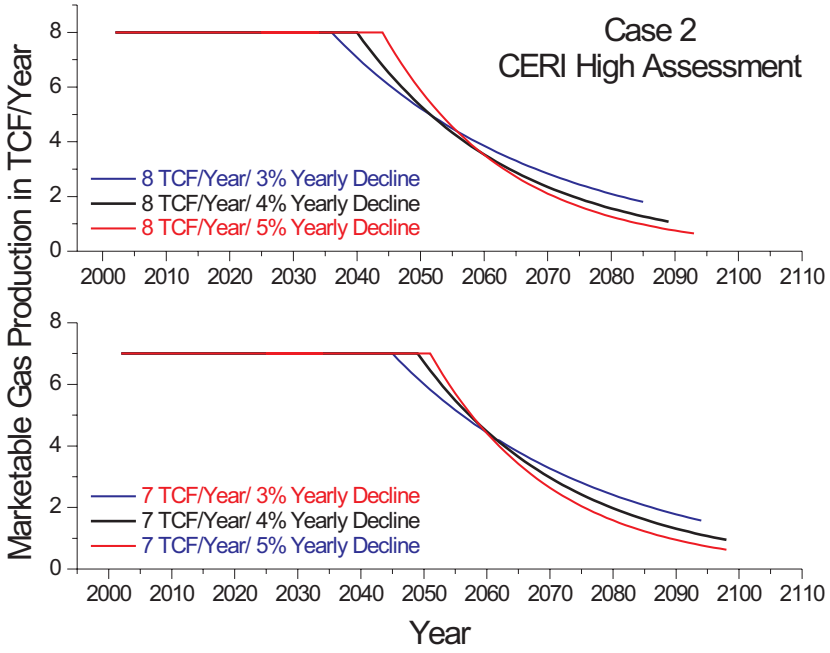
It is somewhat counter-intuitive that the higher the decline rate, the longer the prior plateau period but this is an inevitable consequence of the mathematics involved. There is an implied warning that higher decline rates lead to a 'cliff' after which production falls more rapidly that at lower rates. Because the plateau period is extended in time at higher rates, this danger may be compounded by the complacency fostered by this longer period at full production.

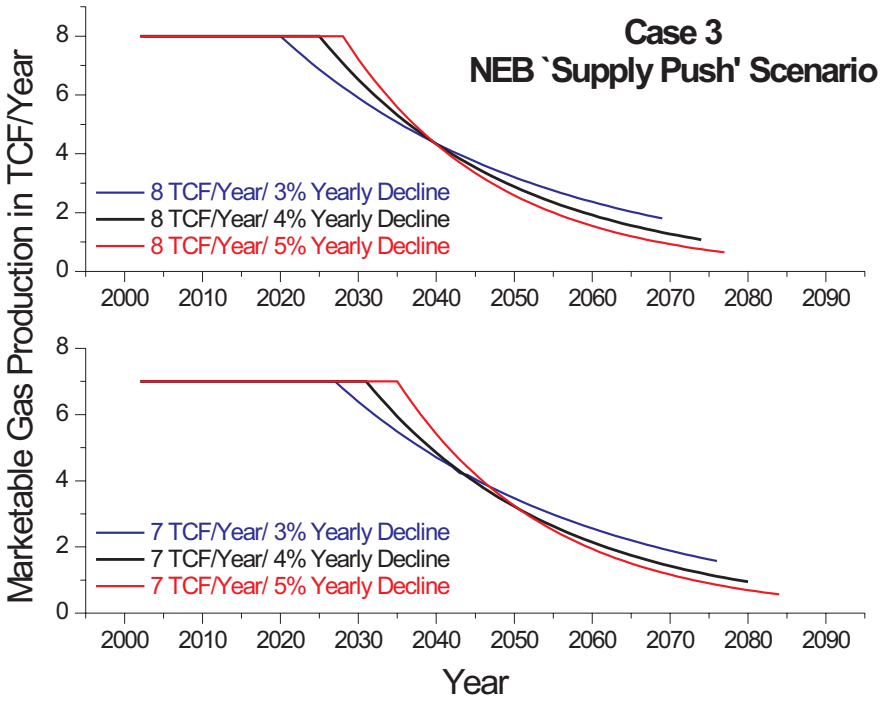
In Figure 1 of the previous companion paper[1], North American production of marketable natural gas (including that from Mexico) was found to be essentially flat over the past decade in what was termed a 'plateau peak' notwithstanding the rapid rise in Canadian production and exports over this period. It may be that the peak in North American production of conventional natural gas has already past its peak though this may not be sure except in retrospect. Nevertheless, it seems virtually certain that the peak in conventional production in the three countries will occur before 2010.

In the case of Canada alone, the rapid production increase of the past decade is showing signs of slowing, in part because of the high decline rates that have been experienced particularly in the shallow wells in the Western Canada Sedimentary Basin. It is thus possible Canada is approaching a 'plateau peak' of its own of the order seven or eight trillion cubic feet (TCF) per year. The gas production projections in the two scenarios formulated by the National Energy Board in its most recent supply/demand study support this view.

This note has been prepared to explore the characteristics of a 'plateau peak' that is followed by a steady decline in the production of conventional marketable natural gas under Canadian circumstances. The maximum quantity of conventional gas expected to be produced was taken as the sum of the published reserves plus the undiscovered resources in the four cases of the companion paper[1] reflecting resource assessments by the Canadian Gas Potential Committee, a high scenario prepared for the Canadian Energy Research Institute, and the published data supporting two scenarios developed by the National Energy Board. Two values of the 'plateau' or flat peak were assumed at seven and eight TCF/year respectively. It is possible that actual conventional production will oscillate between these two values for some years before the permanent steady decline sets in: if so, these values may be considered upper and lower bounds on conventional gas production.


Case 1
Canadian Gas Potential
Committee Assessment
Marketable Gas Production in TCF/Year
8 TCF/Year/ 3% Yearly Decline
8 TCF/Year/ 4% Yearly Decline
8 TCF/Year/ 5% Yearly Decline
7 TCF/Year / 3% Yearly Decline
7 TCF/Year / 4% Yearly Decline
7 TCF/Year / 5% Yearly Decline
Year


Case 2
CERI High Assessment
Marketable Gas Production in TCF/Year
8 TCF/Year/ 3% Yearly Decline
8 TCF/Year/ 4% Yearly Decline
8 TCF/Year/ 5% Yearly Decline
7 TCF/Year/ 3% Yearly Decline
7 TCF/Year/ 4% Yearly Decline
7 TCF/Year/ 5% Yearly Decline
Year


Case 3
NEB `Supply Push' Scenario
Marketable Gas Production in TCF/Year
8 TCF/Year/ 3% Yearly Decline
8 TCF/Year/ 4% Yearly Decline
8 TCF/Year/ 5% Yearly Decline
7 TCF/Year/ 3% Yearly Decline
7 TCF/Year/ 4% Yearly Decline
7 TCF/Year/ 5% Yearly Decline
Year

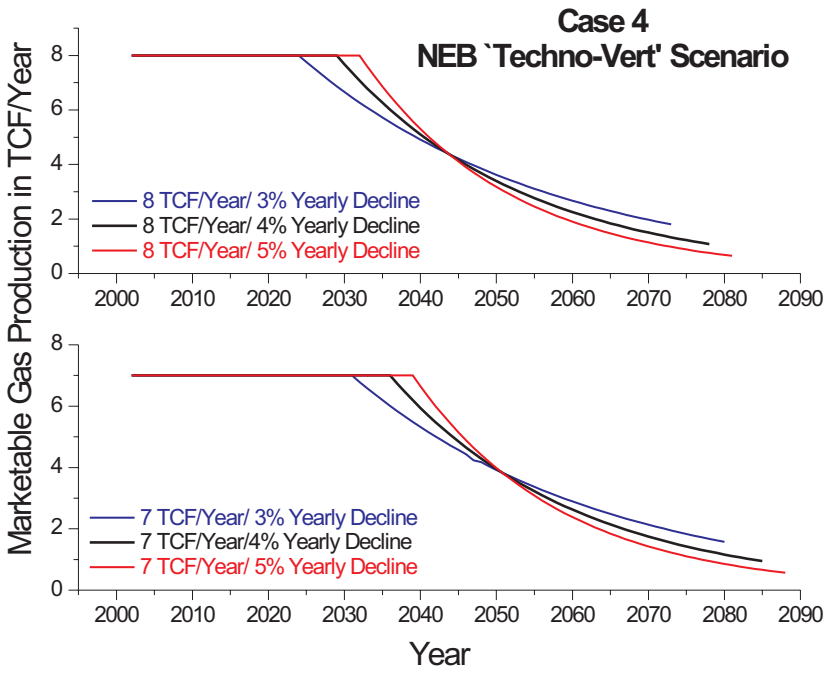
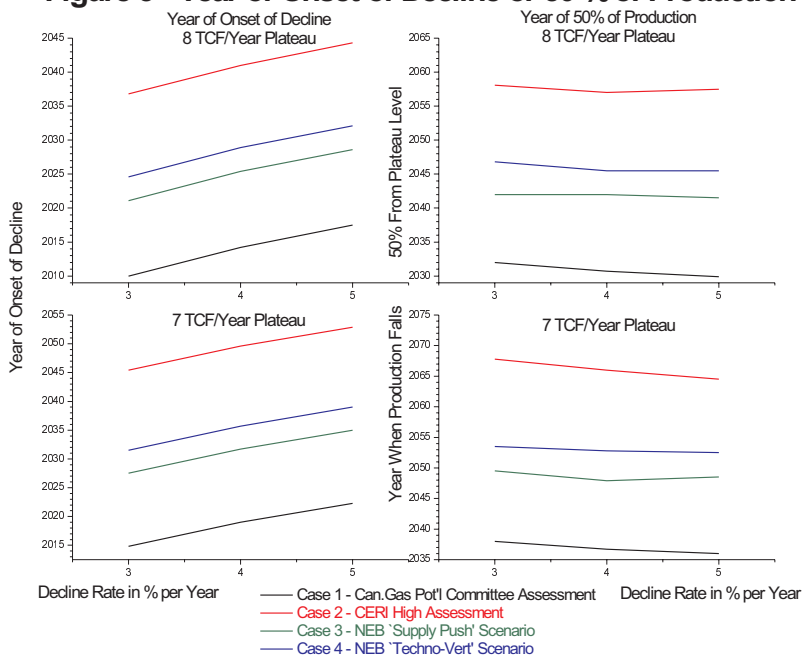

Case 4
NEB `Techno-Vert' Scenario
Marketable Gas Production in TCF/Year
8 TCF/Year/ 3% Yearly Decline
8 TCF/Year/ 4% Yearly Decline
8 TCF/Year/ 5% Yearly Decline
7 TCF/Year/ 3% Yearly Decline
7 TCF/Year/4% Yearly Decline
7 TCF/Year/ 5% Yearly Decline
Year

Figure 5 - Year of Onset of Decline or 50 % of Production



These two levels of production should thus be regarded as representing an average value expected over the entire plateau period.

The decline rates studied ranged from three to five per cent per year. These rates may appear low in comparison with some recent experience with particular producing zones of the Western Sedimentary Basin but they were considered appropriate for the nation in aggregate to reflect the inevitable delays as supplies from remote regions are gradually connected to the pipeline delivery system over time. Because the quantity of gas produced in the period of decline is less the higher the decline rate, the length of the plateau period is extended as the rate of decline is increased for a given resource endowment although production, of course, falls faster afterwards. This result is somewhat counter-intuitive and illustrates the danger of reaching an ‘over the cliff’ situation if in fact average overall decline rates are higher than expected in this note.

The quantity of gas produced in the decline period was calculated by integrating the three values assumed here for the range of decline rates (3, 4 and 5% per year) over fifty years calculated from the two bounds of plateau production expected at 7 and 8 TCF per year respectively. This integral quantity of gas was then deducted from the total marketable resource potential estimated for each of the four assessments to arrive at an estimate of that to be produced during the plateau period. The duration of the plateau period could then be calculated by dividing this difference by one or the other of the applicable two production levels. The results are plotted in Cases 1 to 4.

In essence, the opportunity was taken of an expected reasonably flat average period of natural gas production to estimate the date at which the steady decline in production would first occur in each of the four cases. Given the two levels of plateau production and the three decline rates assumed, a total of 24 initial dates were calculated in this way. These results appear in Figure 5. The dates computed for the onset of steady decline were then compared to the dates derived by a different technique from the parabolic projections used in the companion paper as in Table 1. Because the mathematics require the decline curves to cross each other, the dates that the production falls to one-half the plateau level are listed in Table 2.

Table 1
Dates of Onset of Decline

	Plateau Production 7 TCF/Year				Plateau Production 8 TCF/Year			
Decline Rate	**3%/Yr**	**4 %/Yr**	**5%/Yr**	**Para-bolic Case**	**3 %/Yr**	**4 %/Yr**	**5 %/Yr**	**Para-bolic Case**
Case 1	2015	2019	2022	2028	2010	2014	2018	2018
Case 2	2045	2050	2053	2059	2037	2041	2044	2048
Case 3	2027	2032	2035	2041	2021	2025	2029	2031
Case 4	2031	2036	2039	2045	2025	2029	2032	2035

Note:
The Parabolic Case is taken from the companion paper.[1]

Table 2
Date to Reach 50 % Reduction in Production

	Plateau Production 7 TCF/Year			Plateau Production 8 TCF/Year		
Decline Rate	**3 %/Yr**	**4 %/Yr**	**5 %/Yr**	**3 %/Yr**	**4 %/Yr**	**5 %/Yr**
Case 1	2038	2037	2036	2033	2031	2030
Case 2	2068	2066	2064	2058	2057	2057
Case 3	2050	2048	2049	2042	2042	2041
Case 4	2054	2053	2053	2047	2046	2045

Note:
The dates for a 50% fall in production for a given resource base are essentially independent of the decline rate.

Conclusion

The dates of the onset of decline in conventional Canadian natural gas production estimated from the plateau peak approach employed in this note are reasonably close to those obtained from the parabolic technique in the companion paper for decline rates of 5% per year. These dates are in closer agreement when plateau production is eight TCF per year rather than seven.

It is somewhat counter-intuitive that the higher the decline rate, the longer the prior plateau period but this is an inevitable consequence of the mathematics employed. There is an implied warning that higher decline rates lead to a 'cliff' after which production falls more rapidly that at lower rates. Because the plateau period is extended at higher rates, this danger may be compounded by the complacency fostered by this longer time at full production.

The plateau peak method employed in this note focuses on the decline rates that may be expected as conventional natural gas production matures in Canada. This approach thus complements the parabolic technique used in the companion paper that does not explicitly deal with these rates. Taken together the two techniques provide additional insight into the Canadian conventional natural gas situation.

References

1. J.H. Walsh, *Parabolic Projection of Four Assessments of Canadian Conventional Natural Gas Resources*, August 2003. (Web: pages.ca.inter.net/~jhwalsh/wngcanada.html

2. National Energy Board, *Canada's Energy Future: Scenarios for Supply and Demand to 2025*, 444 Seventh Avenue SW, Calgary, AB, T2P 0X8 (Web: www.neb-one.gc.ca)

September 2003

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