CANADIAN GAS SUPPLY: GOING UP? OR DOWN?

R.H. Woronuk

Canadian Gas Potential Committee

GasEnergy Strategies Inc.

175 - Oakmount Rd. SW
Calgary, AB T2V 4X3
(403) 251-4048

ABSTRACT

While Canada contains significant natural gas resources, gas supply over the near term will rely heavily on the exploitation of the conventional potential of the Western Canada Sedimentary Basin (WCSB) and the Sable Sub-Basin on the Canadian east coast. There are clear trends suggesting that the gas market is moving from a supply/demand balance controlled by demand to one controlled by supply. Consumption of WCSB gas has been greater than reserve additions for all but one of the last sixteen years. Of necessity, consumption cannot grow (or even be maintained) indefinitely under such a regime.

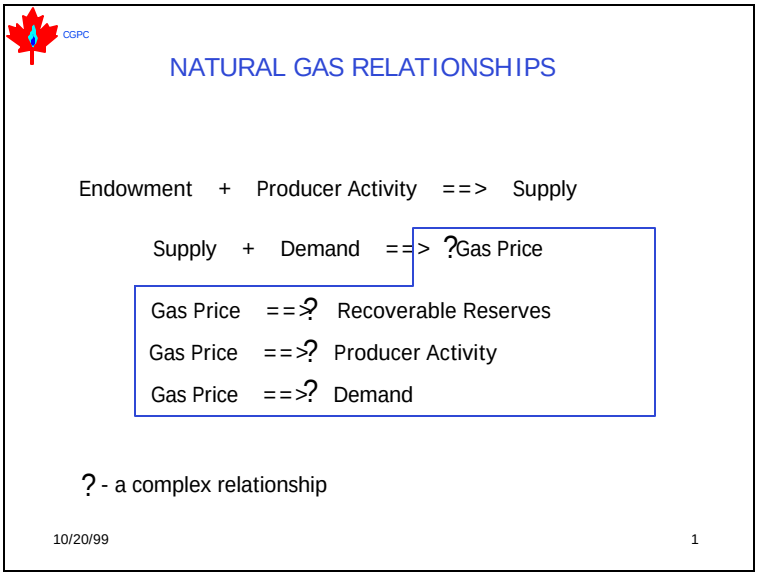
This paper argues that the cessation of ever increasing production from the WCSB is imminent and that a more aggressive approach to exploration and development in the WCSB (particularly in the deeper and more environmentally sensitive areas) together with the exploitation of conventional gas in frontier areas and unconventional resources will be necessary to arrest the projected supply declines.

INTRODUCTION

The Canadian Gas Potential Committee (CGPC) is a volunteer group of senior geoscientists from industry and government formed in 1991 to conduct independent assessments of the undiscovered gas potential in Canada. The Committee is supported by government agencies, industry organizations and petroleum companies. It released its first report in 1997 based on 1993 data and will be releasing its second report in 2000 based on 1998 data.

GasEnergy Strategies Inc. (GESI) is a consulting company specializing in the analysis of historic gas supply and demand issues and the projection of future supply/demand relationships in Canada. The company publishes the GasEnergy Reports, a subscription service available to producers, consumers, transporters and government agencies in the natural gas industry. The author is one of over thirty volunteers in the CGPC.

As depicted in Figure 1, gas potential or endowment (a volume concept) is related to gas supply (a flow concept) through the application of producer activity: exploring for, development of, processing of and delivering of natural gas to transportation systems. The area under the production curve for a basin will ultimately generate the recoverable endowment of that basin. *Differing production projections do not change this area, only the shape of the curve overlying the area.*

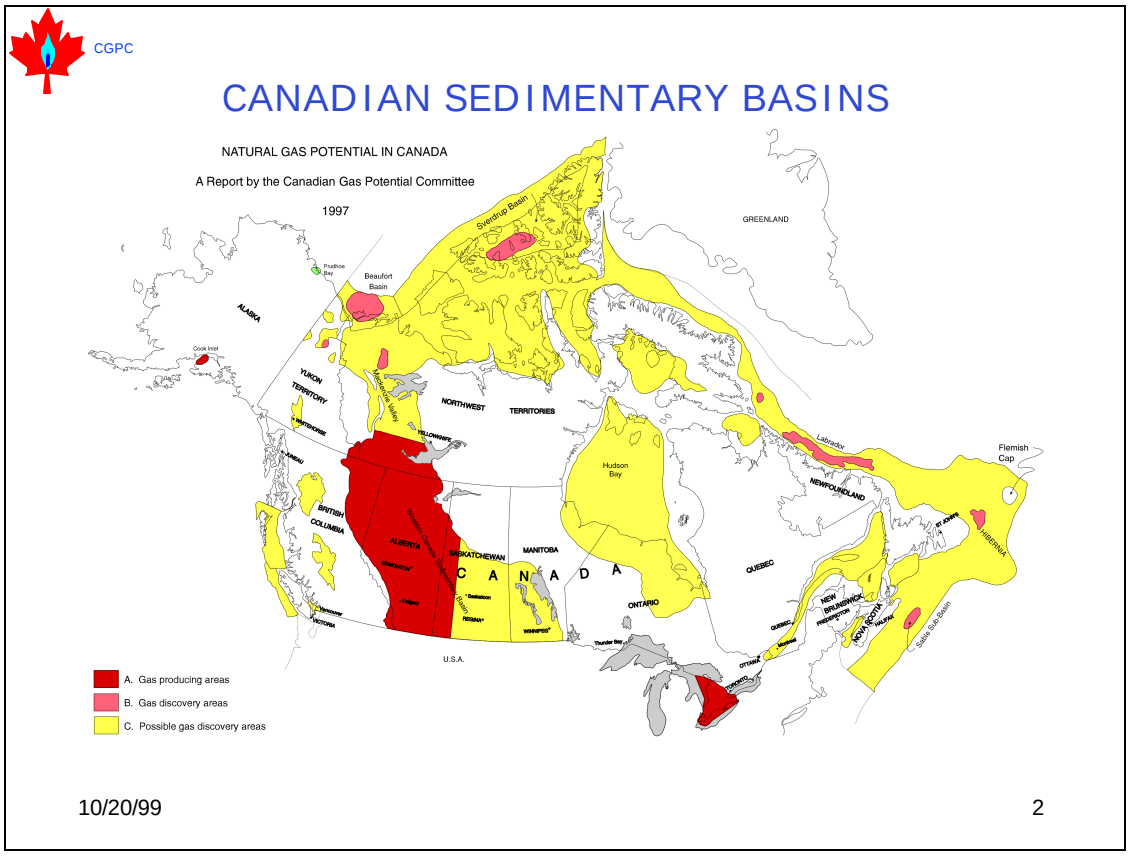


While producer activity generates supply, actual production can be dependent on demand (in a free market, production is the lesser of supply and demand). Historically, demand has constrained production. Some projections such as those from the Alberta Energy and Utilities Board (EUB) and GESI include both supply and demand projections while others such as those from the NEB provide only production projections. These latter projections are driven by a requirement that an equilibrium gas price will evolve that will balance the forces of supply and demand. Unfortunately, it is very difficult to quantify the magnitudes of gas price impacts on supply, demand, producer activity, recoverable reserves and production efficiencies. Certainly, increasing gas prices will tend to result in increasing producer activity, but how much? And which activities? And where? And how will supply be impacted? These are very complex relationships.

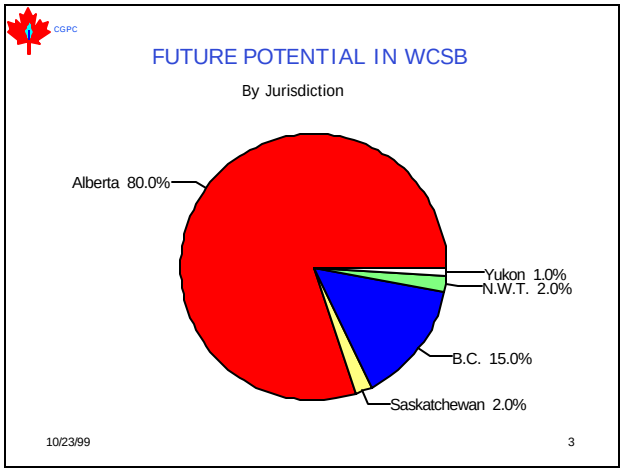
To carry the price/producer activity relationship further, it is not even clear if an analogue relationship is available. Is the relationship like the food retail market where high prices by one store retailer will be subject to price cutting by its competitors, thus driving down prices? Or might natural gas be like hockey player salaries, where increased prices are translated into pure inflation with no apparent improvement in product? While the gas industry will lie somewhere between these two extremes, there is some evidence to suggest it is nearer the latter: at $10.00/Mcf producers will always manage to find some way to increase finding and development costs so that the industry's return will still average the historic 4 percent.

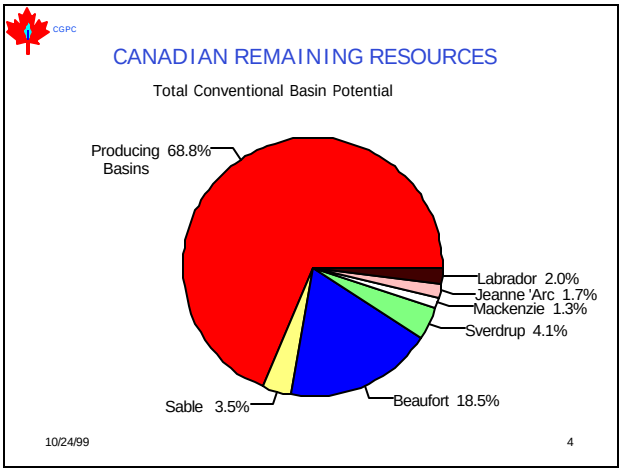
ENDOWMENT

The map of Canada in Figure 2 identifies the locations of sedimentary basins where oil and gas have been or are expected to be discovered. The areas currently producing gas are the Western Canada Sedimentary Basin and the Southern Ontario/Quebec region. Production from the latter is negligible relative to the WCSB. Later this year production from the Sable Sub-Basin will commence.



In 1997 the CGPC reported that within the WCSB the distribution of conventional potential reserves was as depicted in Figure 3. Figure 4 displays the allocation of the remaining (discovered and undiscovered) conventional natural gas resources in Canada.

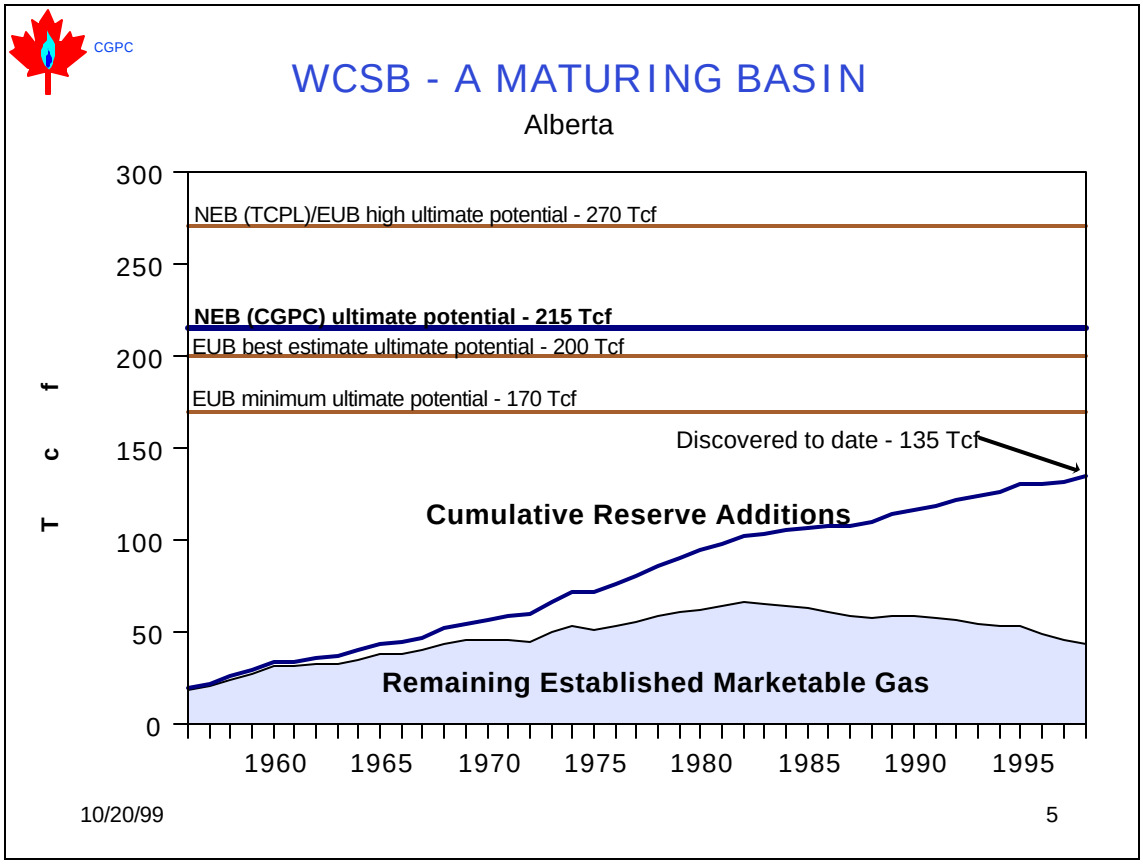




Based on 1993 reserves data, Canada's total marketable endowment of conventional natural gas resources was estimated at 373 Tcf by the CGPC[1] in 1997. Removing the gas consumed through 1998, about 250 Tcf of conventional marketable gas resources remain to be exploited in all of Canada.

In addition to this volume, Canada holds undetermined amounts of conventional gas in frontier basins where no discoveries have been made, and unconventional gas in place in the forms of coalbed methane, tight gas, shale gas and gas hydrates. Estimates of these volumes are ***highly*** speculative. Technological and economic uncertainties about these resources are sufficiently high that *no forecast of the conversion of these resources into future supply can be justified at this time*.

This means that the WCSB must carry the bulk of the responsibility for supply over the near term. In the WCSB, 80% of the future potential is expected in Alberta. Figure 5 presents various estimates of Alberta's ultimate potential relative to cumulative reserve additions and remaining established marketable gas. These endowment estimates are used in the production projections later in this paper. It is seen that the remaining established marketable gas has been in continuous decline (except for a slight rise in 1989) since 1982. This trend must not continue if current levels of consumption are to be maintained. Servicing demand growth will be an even more difficult challenge.

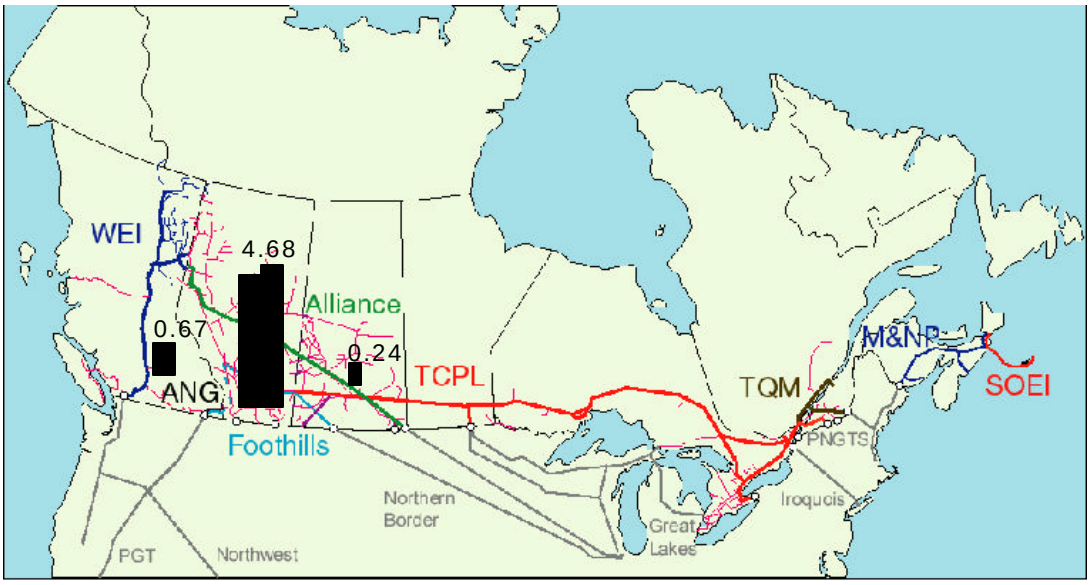


CURRENT SUPPLY and DISPOSITION by REGION

Figures 6 and 7 present the current supply and disposition of gas by region respectively. Supply has been increasing in British Columbia and Alberta but is in decline in Saskatchewan. Southern Ontario supply is too small to be seen in Figure 6.

CGPC

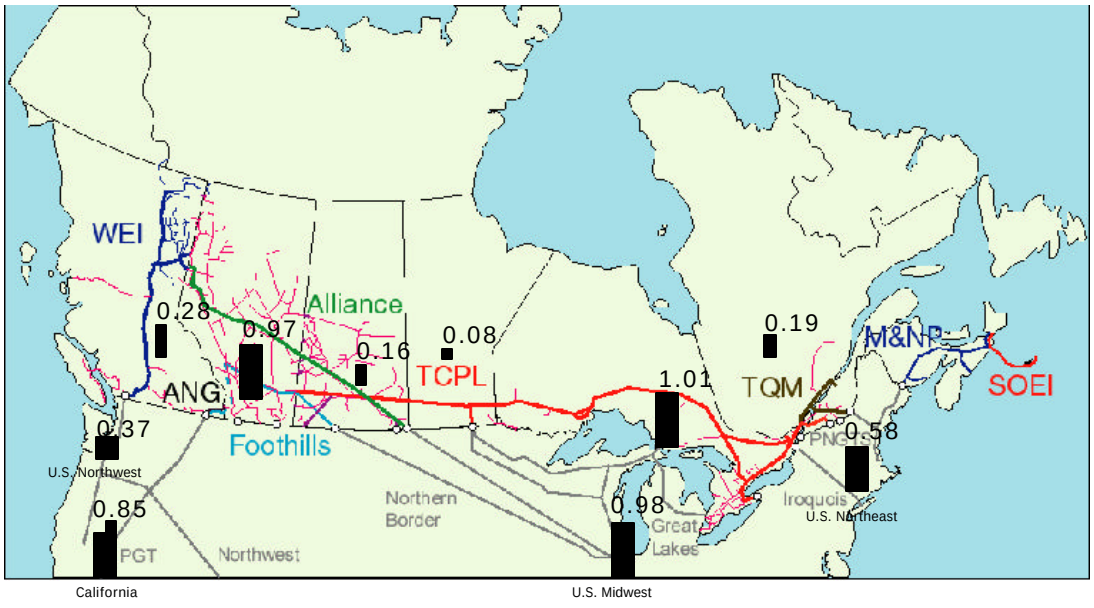
SUPPLY



10/20/99 ■ = 0.1 Tcf/Y 6

CGPC

DISPOSITION



10/20/99 ■ = 0.1 Tcf/Y 7

Demand continues to increase and is expected to continue to increase (particularly for electricity generation). Supply however, is lagging behind. In recent years all export pipelines have been full - often carrying more gas than their rated capacity. This is no longer true, and in 1999 the flow through the ANG/PGT pipeline from Alberta to California has fallen below 80% of capacity. The consensus is that the Alliance Pipeline, when completed in the fall of 2000, will not increase deliveries materially. Rather, gas transported by Alliance will be at the expense of gas moving through TCPL. *For the first time since Canadian gas markets were liberalized we have entered into a period during which transportation capacity exceeds supply.*

Is this just a temporary phenomenon, or does it mark the beginning of fundamental new order in the marketplace? As will be seen below, views are widely divergent on this subject.

RECENT TRENDS

One means of approaching the question of future supply is to examine historical trends. Has industry been able to replace consumption with newly connected reserves? What are the characteristics of recent discoveries? What have been the levels of producer activity and is this sufficient? Have the recent advances in new technologies improved the supply position, and will new technologies grow at a more rapid, the same, or a slower rate that in the recent past - what will follow 3-D seismic, horizontal drilling, underbalanced drilling, flexible tubing etc.?

Reserve Replacement

Figure 8 below is based on the best publicly available gas reserves database, the 1998 joint EUB/NEB reserves database for Alberta. Over the last 40 years, only two years (1959 and 1961) had *new* reserve additions at a higher level than today's level of consumption. Even when very recent discoveries are appreciated and assumed connected, they replace only 27% of 1998 consumption. The shortfall amounts to 4.2 Tcf for 1998. If this shortfall is to be made up from other reserves, the source must be the appreciation of old reserves resulting from development drilling, and a more accurate assessment of older booked reserves.

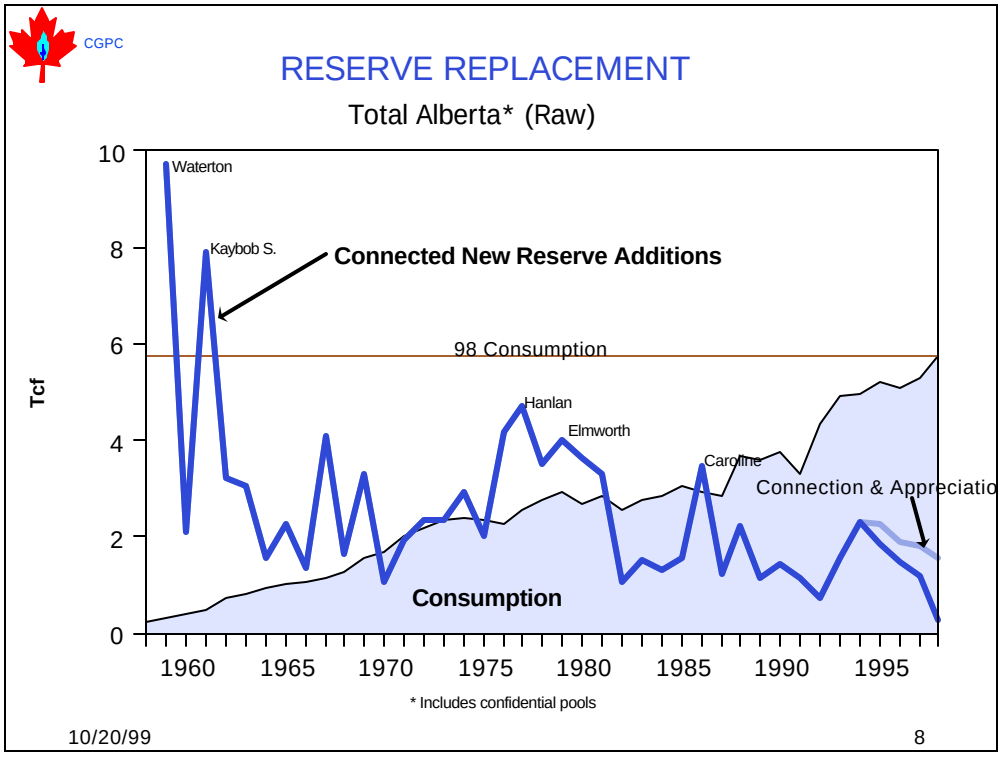
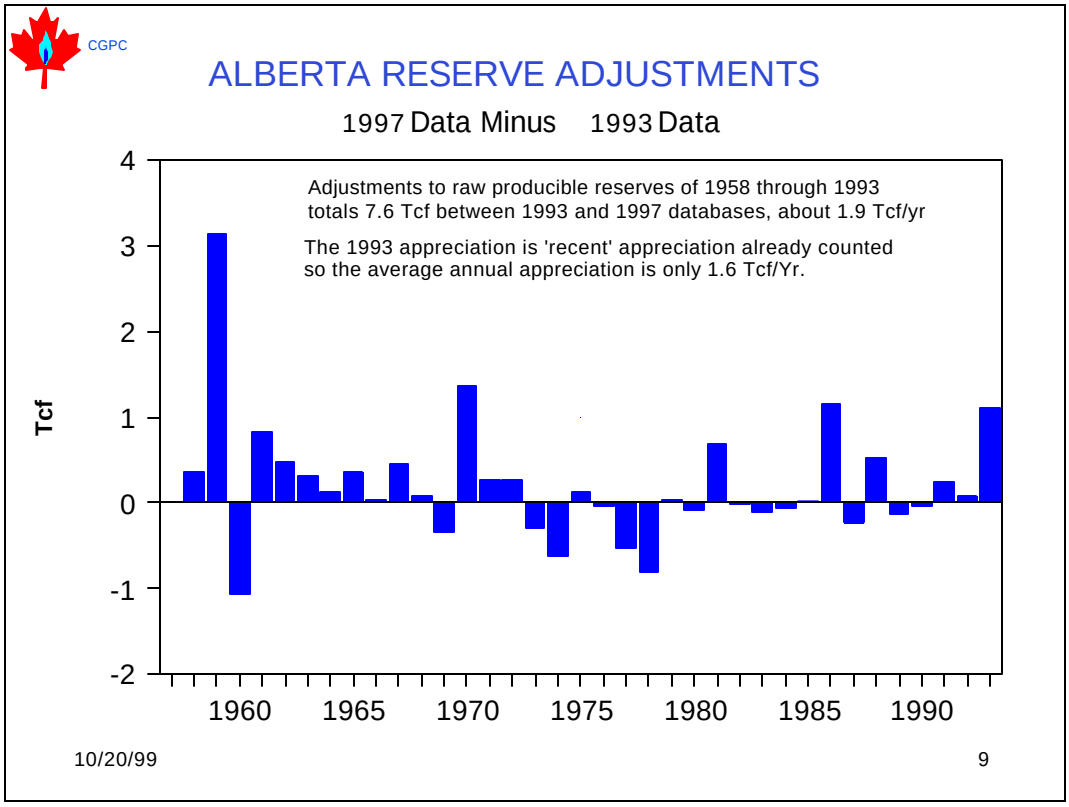


Figure 9 presents the year by year differences in new connected reserve additions between the 1997 reserves database and an identical database but for the year 1993 (the 1997 database rather than the 1998 database of Figure 8 is used as there appears to be some discrepancies in the connection information in the 1998 data).



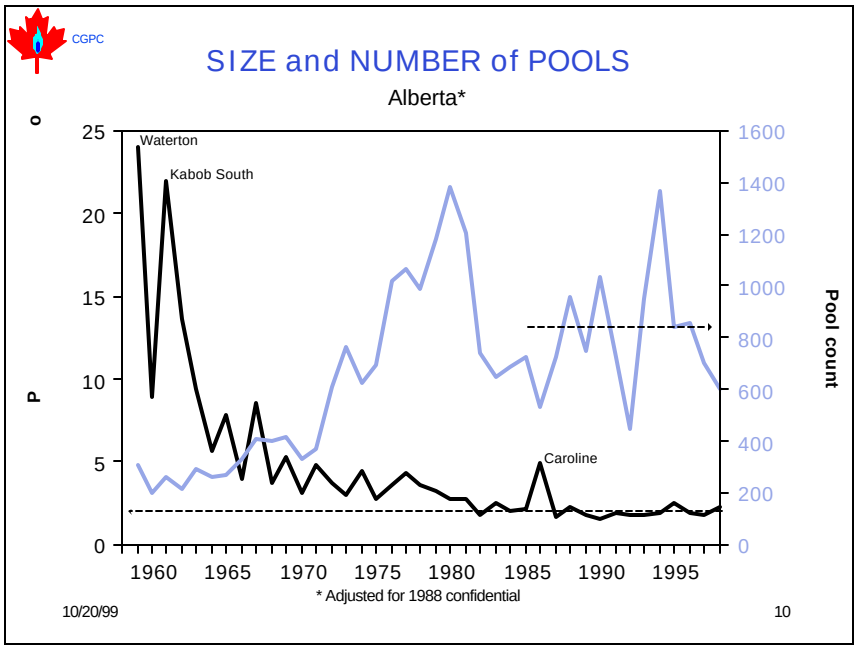
Clearly the appreciation is positive and amounts to an average 1.9 Tcf increase per year (1.6 Tcf per year is a better number as the 1.9 double accounts appreciation in recent years). Even using optimistic numbers, replacement is running at about 70% of consumption.

Will old reserves continue to appreciate? There is good reason to believe that they will, but not forever. Our information becomes better and better as the reserves grow older, so at some point in time a Boards' pool reserves data will be absolutely correct, even if it must await the cessation of production of the pool. Thus the 1.6 Tcf/y appreciation of old reserves is much more likely to fall than increase and this, in turn, transfers more of the supply burden on new reserve discoveries.

Reserve Characterization

Part of the problem of consumption replacement is that the average new pool size has become very small, so many more pools are needed to generate the same reserves. Figure 10 presents the average pool size in each of the last 40 years and the number of pools discovered in these years. Since 1987 the average pool size has remained very constant at about 2 Bcf per pool. During this time the number of new pool discoveries has varied considerably, but are averaging over 800 per year - again not enough for replacement even when augmented by large amounts of appreciation.

The inescapable conclusion is that either more pools have to be discovered each year, or the industry must increase the average pool size discovered. Differences between supply projections by various groups do not disagree on this fact, but on the likelihood of industry's ability to accomplish this turnaround in the rate of new reserve additions.



The industry has been targeting shallow gas prospects, with more emphasis on development drilling than exploration. Producers are very much aware that greater reserves per well drilled will be achieved in the deeper, riskier Foothills and Deep Basin prospects, but these wells are costlier, occur in environmentally sensitive areas and often discover sour gas pools which require processing plant construction or expansion. The time between well spud date and first production date is very much greater for Foothills and Deep Basin wells than for SE Alberta shallow gas wells.

Unconnected Gas Reserves

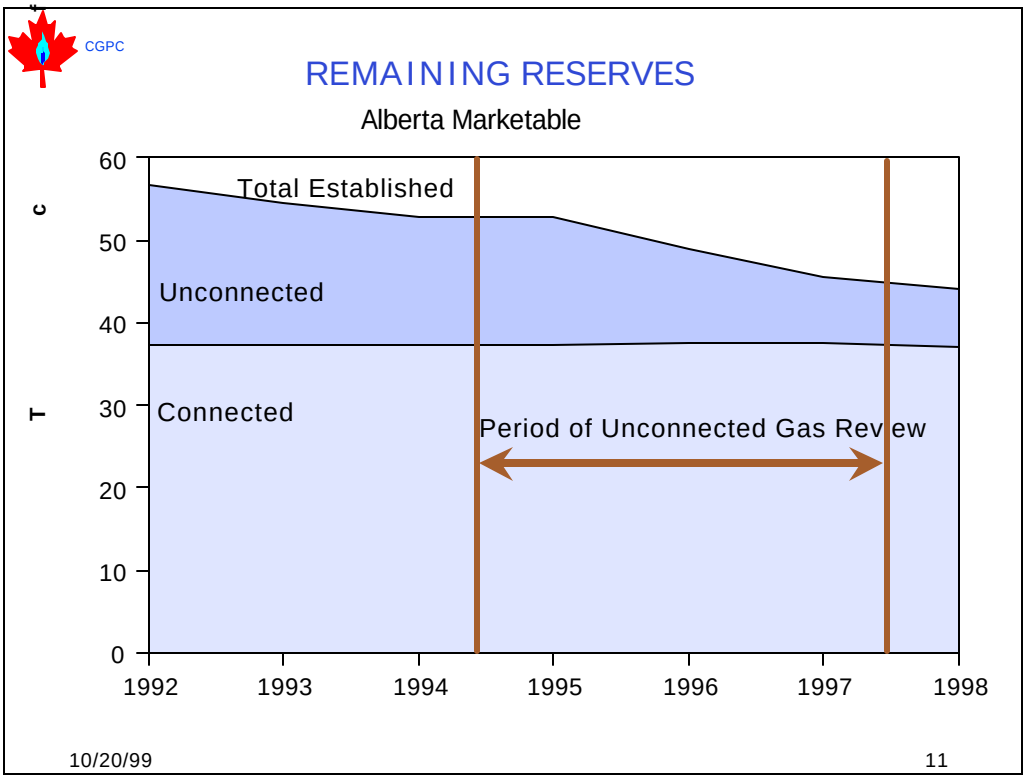
Alberta and B.C. have a significant amount of unconnected gas reserves. Would not connecting these improve our immediate supply position? The answer is no. If a pool is unconnected, there is almost always a very good reason. Most often the producer is actively in the process of connecting the reserve; every pool ever discovered will have been unconnected for some period of time - this is simply part of the overhead of finding and producing gas. For this reason, the more active the exploratory effort, the more reserves will be in this transition state. High exploration rates imply high numbers of unconnected pools.

On the other hand, an unconnected reserve might simply be of very poor quality. Not all discoveries are equal, and sometimes a producer will determine that its capital is better employed searching for a new, more economic pool than connecting a poor quality pool. Sometimes one just finds crumbs. These may be connected someday but not until the producer has nothing better to do with its time and money.

Another source of 'unconnected' pools is simply the result of the reserve accounting process. Reserves are booked, but are later determined to be non-existent. But once booked, they have remained booked for lack of formal review process.

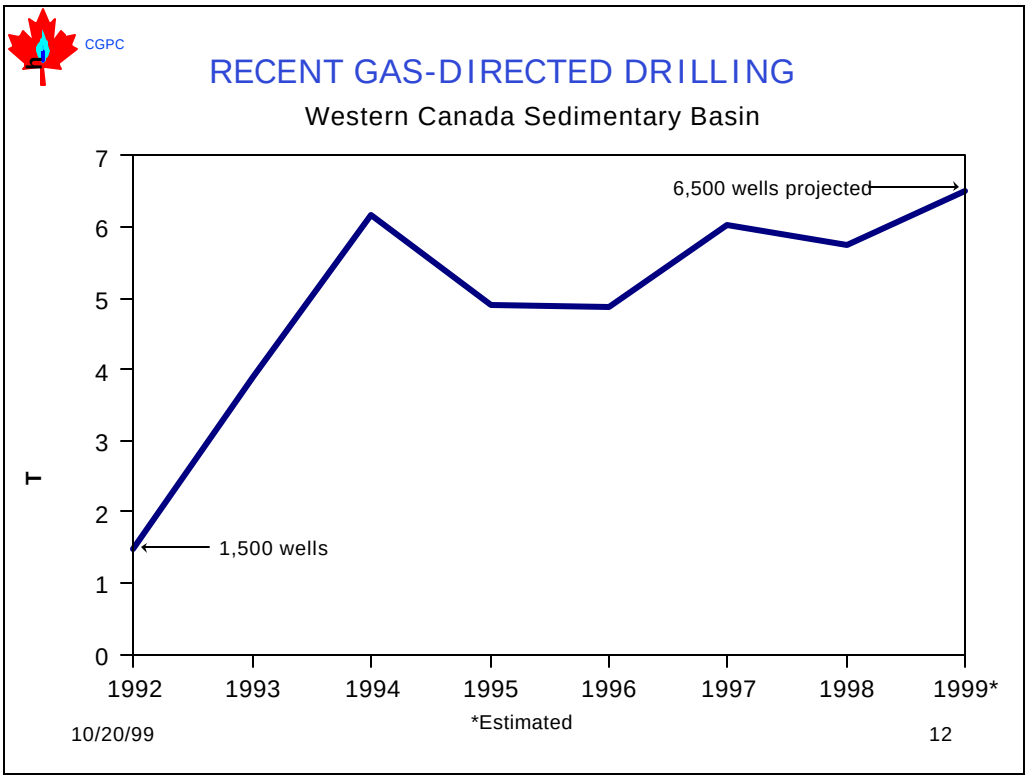
Because of the accumulation of many of these 'crumbs' and the need for a review, the EUB and NEB decided to investigate the older unconnected pools by inquiring of the producers their plans for any well completed but not connected for over 10 years. Figure 11 shows the results of this study. Over 50% of the unconnected pools' reserves were written off in both Alberta and B.C. as a result of this investigation.

This unconnected well study is ongoing. In 1998, those wells entering their eleventh years of being unconnected resulted in a 55% reduction in the reserves attributed to them. Note also, in Figure 11 the negligible increase in the amount of connected reserves over the period even as consumption rose.



Producer Activity

Figure 12 shows the huge increase in drilling since 1992. A record for gas-directed drilling (dry wells are included in the count) was established in 1994 but the record could be exceeded this year.

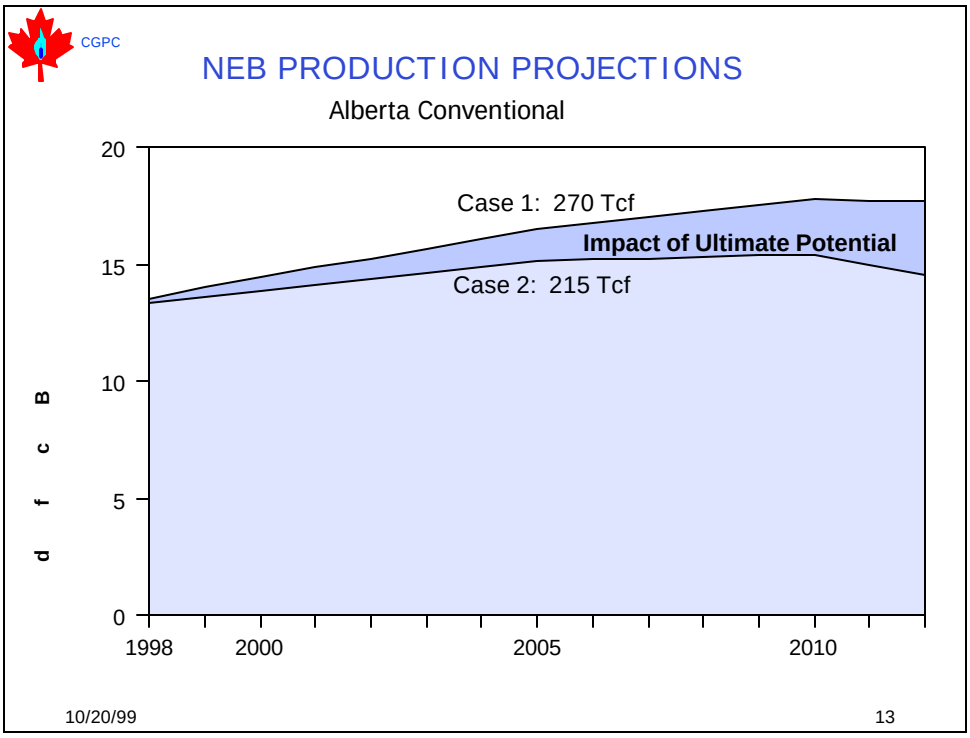


PROJECTIONS

The production projections of the NEB, EUB and GESI examined below are for Alberta from 1998 through 2012. This is the common denominator for the comparison. The EUB only prepares projections only for Alberta and only through 2012, while the NEB only prepares production projections (both the EUB and GESI prepare supply/demand projections, the lesser of supply and demand being production).

View from the NEB [2]

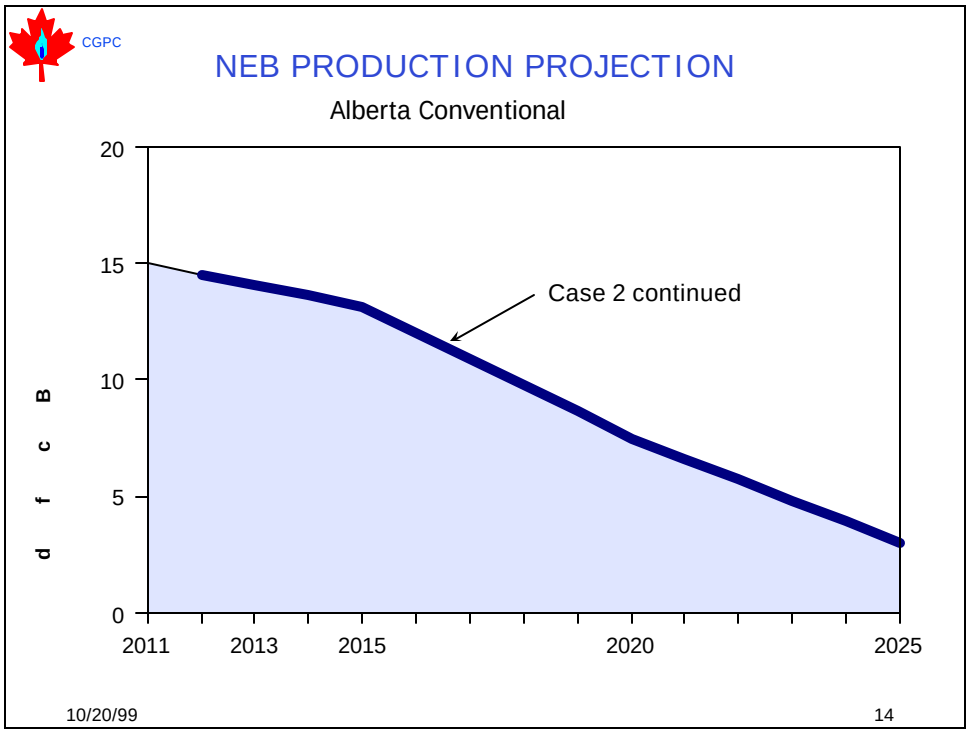
At the end of June 1999 the NEB released its 'Canadian Energy Supply and Demand to 2025', which carried the production projections for Case 1 and Case 2 presented in Figure 13. Case 1 was based on an Alberta ultimate potential of 270 Tcf (a TCPL supported estimate) plus low finding costs, while Case 2 used an ultimate potential of 215 Tcf (approximately that of the CGPC) and slightly higher finding costs.



Both Cases project increasing production from the WCSB until 2010, but in Case 2, production begins to fall in 2011. Two factors permit this increase: increased producer activity and new technologies. In Case 2 technological growth continues at its current pace, so we can expect the continuation of trends that gave us 3-D seismic, horizontal drilling, under-balanced drilling, flexible tubing and rapid increases in computing power. Case 1 assumes that the increases in technology will be even more dramatic and rapid.

Both Cases can be considered as low cost supply relative to current gas prices. In Case 2, plantgate prices 'grow' to about CDN $2.00/GJ (US $1.41/MMBtu) in 2003, while Case 1 prices hold constant at CDN $1.65/GJ (US $1.14/MMBtu) through 2010. The Henry Hub equivalent prices for Cases 1 and 2 are US $1.50 through 2010 and US $1.85 by 2003 respectively. With Henry Hub prices hovering around US $3.00 already, there are few in industry who would agree with the NEB price projections (especially Case 1).

And, as discussed in the introduction, the area under the production curve must be constant for the same ultimate potential. Production in Case 2 must therefore fall off a cliff after 2011. Figure 14 depicts this phenomenon.

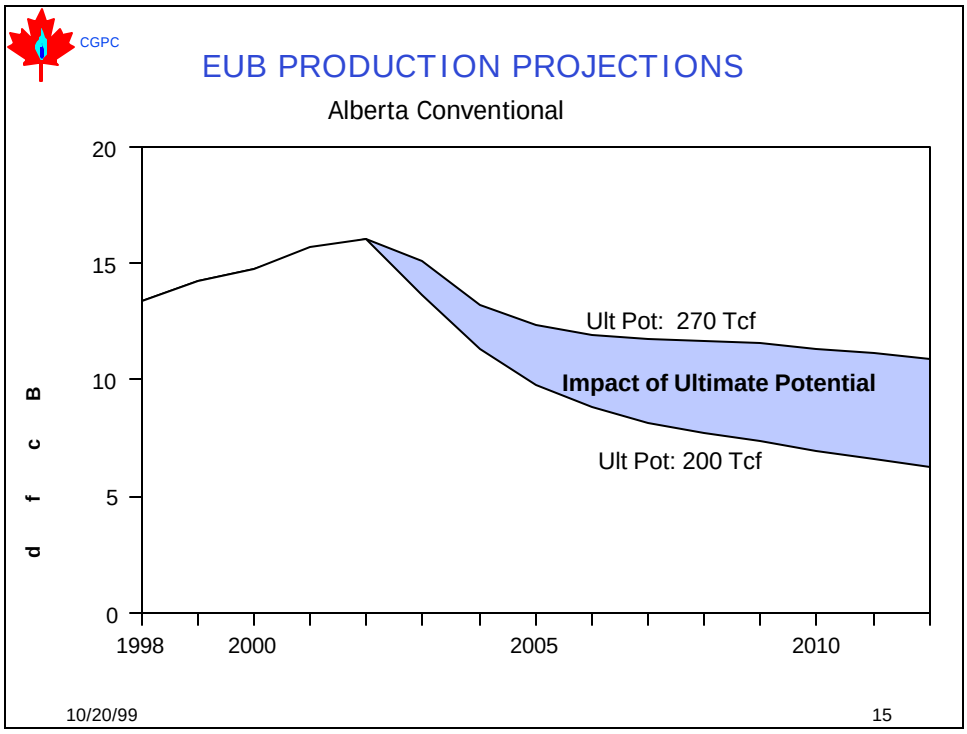


View from the EUB[3]

The staff of the EUB presented its supply/demand projections just two weeks prior to the release of the NEB report. In 1992 the EUB's best estimate of Alberta's ultimate potential was 200 Tcf, with a minimum of 170 Tcf and a maximum of 270 Tcf. To date, the EUB has not seen any reason to revise these estimates, and they offer strong support for the efforts of the CGPC in assessing Canada's natural gas endowment. The production projections presented by the EUB staff were for the 200 and 270 Tcf estimates only. The result of their analysis is reproduced below in Figure 15.

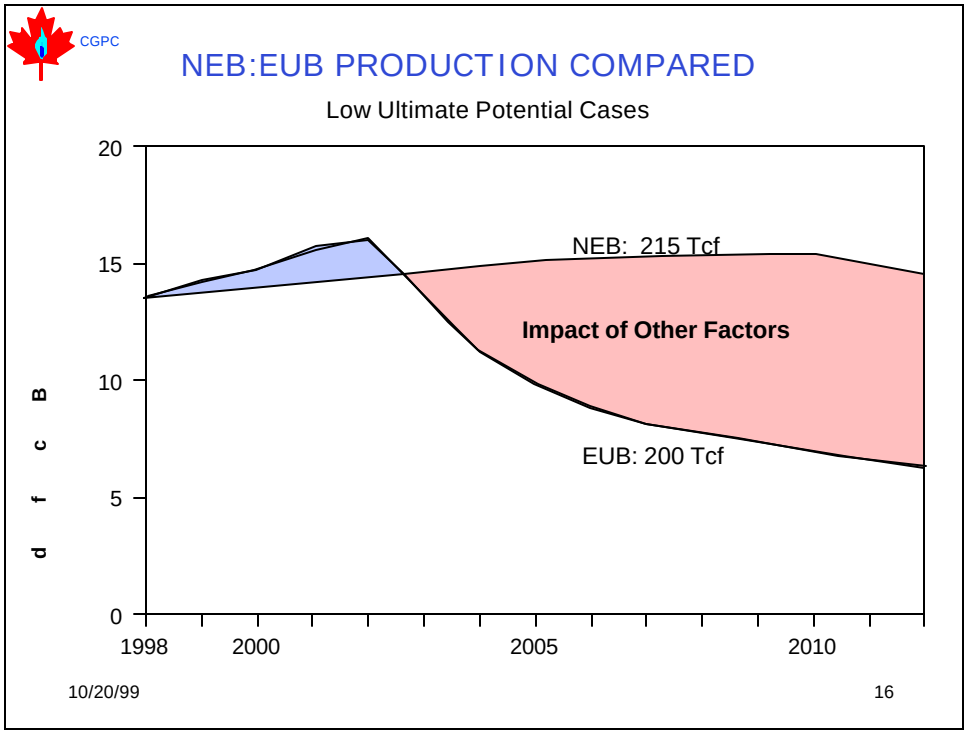
Here we see a more rapid growth in production through 2002 (supply during this period is actually higher than demand, so the Alliance Pipeline (and all others) will be filled - but for just one year. In 2002 there is a sharp supply/demand crossover as supply hits a wall.

The problem of the EUB projection is that its model finds a large amount of development activity to keep the producers occupied. This activity provides good deliverability, but little in the way of reserve additions, so when established reserves can no longer meet the gas demand, supply drops precipitously. Unfortunately, this does seem to be the type of activity currently being undertaken by producers and, if it were to continue, the obvious result would be precisely what the EUB analysis shows in Figure 15: the supply/demand wall of 2002.



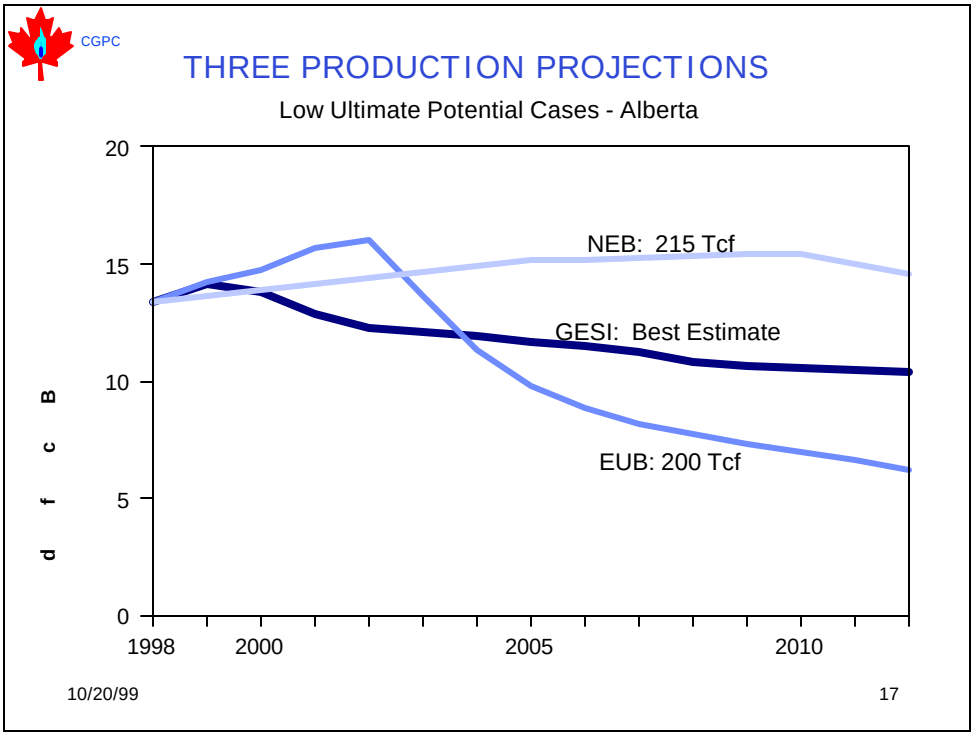
Comparative Analysis

Figure 16 compares Case 2 (215 Tcf) of the NEB with the 200 Tcf ultimate potential case of the EUB to demonstrate the magnitude of the difference between the projections of production.



View from GESI[4]

In January 1999, GESI produced three supply/demand projections for three scenarios, and then in April produced a fourth, the Best Estimate, based on major producers' views of the direction and magnitude of producer activity. The GasEnergy ManageMent (GEMM) model was used. This model is, in most respects, the same as the version of GEMM used by the EUB, but constrains development drilling in nearly depleted pools. GESI's ultimate potential was slightly higher than that of the CGPC, but producers were unable or unwilling to suggest a better alternative to the 1997 CGPC estimate. The result of the scenario is presented in Figure 17.



The producers did believe that there would be a shift toward more exploration and deeper plays. Drilling footage would increase significantly. Based on this scenario, larger pools are discovered, but the time between discovery and connection is increased. This results in an earlier drop in supply than either the EUB or NEB suggest, but the shortfall is not great, and supply does not either "hit a wall" or "fall off a cliff". (Actually, were the GESI projection continued beyond 2012, it would tend to fall off a cliff like the NEB projection, but just a little later.)

The lower short term supply of the Best Estimate was believed to be better, and more easily addressed by demand side management than by having producers pursue short term supply fixes.

The producers contacted for to the Best Estimate were major producers, and there is good reason to believe that their views could differ markedly from those of the smaller players. Smaller companies (especially those in need of cash flow) are the main driving force behind the quick deliverability, shallow gas targeting seen in recent years. Typically smaller companies will not possess the capital and experience to aggressively seek out Foothills and Deep Basin prospects. If a major producer bias is present, then a better forecast over the short term might be one between that of the EUB and GESI. In any event, Figure 17 is indicative of very different differences regarding future available supply.

SUMMARY and CONCLUSIONS

Gas supply from a basin is a function of the basin's endowment and the degree of producer activity exploiting its resources. In the early stages of exploitation it is activity that predominantly determines supply levels, but as the basin matures, endowment becomes the more significant issue. The WCSB is becoming a mature basin, with over half its reserves already discovered.

While the endowment of the WCSB cannot be changed, it is increasingly important that an accurate measure of the ultimate potential be determined, so neither complacency nor pessimism influence the operation of the gas market. The forthcoming analysis of the Canadian Gas Potential Committee will provide a much greater understanding of Canada's resource base. This is expected to reduce the degree of uncertainty about the future potential reserves, and hence better define the limits to future natural gas supply in Canada.

Outwardly the production projections of the NEB, EUB and GESI are confusing and even contradictory. But they really carry the same message: the limits of the WCSB are being recognized. We could gradually increase consumption of the basin's reserves over the next decade and accept sharply falling supply thereafter (the NEB result). We can rapidly increase consumption through drilling quick, short lived deliverability wells and live with an early rapid supply decline (the EUB result). Or, we could redirect more activity to larger reserve plays that require greater lead times and thereby accept an earlier, but gradual supply decline (the GESI result).

The key to Canada's continuation of an adequate supply level including exports lies in the:

- efficient exploitation of existing plays in the WCSB;
- identification of new geological plays;
- exploration for and connection of reserves in Canada's frontiers; and
- development of technologies to economically recover the potential of our vast unconventional gas resources.

The latter three activities involve increasingly long lead times. Initiatives to address the forthcoming supply issues should probably have commenced yesterday. Perhaps they will start today.

REFERENCES

[1] *Natural Gas Potential in Canada*, Canadian Gas Potential Committee, 1997.

[2] *Canadian Energy Supply and Demand to 2025*, National Energy Board, June 1999.

[3] *Alberta's Development and Exploratory Drilling, Gas Reserve Additions and Gas Supply and Demand*, The Petroleum Society Paper 99-02, L.A. Samson and M.A. Kirsch, Alberta Energy and Utilities Board, June 1999.

[4] *GasEnergy Reports: Year End Update 1999*, GasEnergy Strategies, April 1999 (proprietary report).