



LUKENS ENERGY GROUP

## Memorandum

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**To:** Anthony Scott - State of Alaska  
Roger Marks – State of Alaska

**Cc:** Scott Smith, Jay Lukens

**From:** Deepa Poduval

**Date:** March 05, 2004

**Subject:** Analysis of pipeline take-away capacity from AECO Hub

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This analysis is intended to provide an initial assessment of pipeline take-away capacity in the AECO region to determine whether there is sufficient capacity for the incremental 4.5 Bcf/Day of supply entering Alberta with the construction of the Alaska Highway pipeline. This analysis and report is not intended to be a detailed analysis of pipeline capacity but a confirmation to support the State during their Stranded Gas Act Application negotiations.

### I. Key Findings

Based on the projected supply and demand in Alberta and British Columbia and the pipeline take-away capacity out of the region, there appears to be excess pipeline capacity in the analysis period from 2019 to 2025, sufficient to transport 4.5 Bcf/d of Alaskan Gas to demand centers at other Canadian provinces and the lower 48 states in the U.S. During the period 2010-2019, there is a shortfall in the pipeline capacity out of the region, declining from 1.29 Bcf/d in 2010 to 0.03 Bcf/d by 2018. The analysis has been completed using annual supply/demand projections. Seasonal demand patterns would make capacity constraints more pronounced in winter and less pronounced in summer.

Supply and demand forecasts for the analysis period were obtained from the National Energy Board's (NEB) projections in *Canada's Energy Future: Scenarios for Supply and Demand to 2025* ("NEB Report") which offered projections based on two different scenarios – Supply Push and Techno-Vert.<sup>1</sup> The Techno-Vert scenario is presented as the Base Case as a conservative approach since the projected excess pipeline capacity was lower in this scenario. The analysis using Supply Push scenario assumptions is presented in this memo as the Sensitivity Analysis.

Total supply from Alberta, BC, unconventional production and Mackenzie Valley is

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<sup>1</sup> *Canada's Energy Future: Scenarios for Supply and Demand to 2025*, National Energy Board, 2003.

2:25:47 PM 3/11/2004 AECO Take-away Memo 3-5-04

projected to decline from 16.63 Bcf/d to 14.19 Bcf/d between 2010 and 2025 in the Techno-Vert scenario. Alaskan production was assumed to provide 4.5 Bcf/d starting in 2010 and stay at this level till 2025.

Demand for natural gas in Alberta and British Columbia was projected to grow from 4.11 Bcf/d to 5.26 Bcf/d from 2010 to 2025 in the Techno-Vert scenario. Pipeline take-away capacity from Alberta and BC was assumed to remain constant at the current level of 15.73 Bcf/d during the analysis period. This pipeline capacity reflects the potential export demand for natural gas out of the region.

The net result of these projections is that even after Alaskan gas becomes available in 2010, the requirement for incremental pipeline capacity out of the Alberta/British Columbia region during the analysis period 2010-2025 is less than 30% of the total anticipated Alaska supply even during the most "constrained" year in both the scenarios assumed. Figure 1 shows the supply/demand balance in the Techno-Vert scenario. While our initial analysis suggests some short-term constraint in pipeline capacity, incremental expansion options on TCPL, Foothills and Alliance, if additional capacity is required, are expected to be a more cost effective alternative for expanding into the Midwestern US markets than building a "bullet line" from AECO to Chicago.

SGI\_003770

Page 2 of 15

CONFIDENTIAL

2:25:47 PM 3/11/2004 AECO Take-away Memo 3-5-04

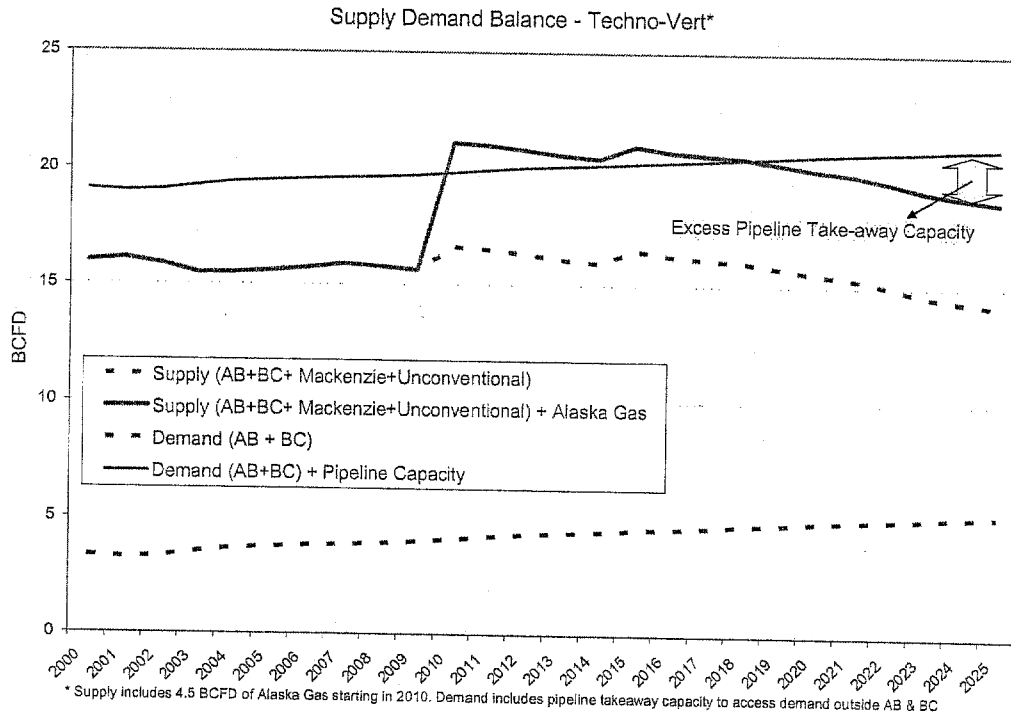


Figure 1 – Supply/Demand Balance – Techno-Vert

II. Further analysis

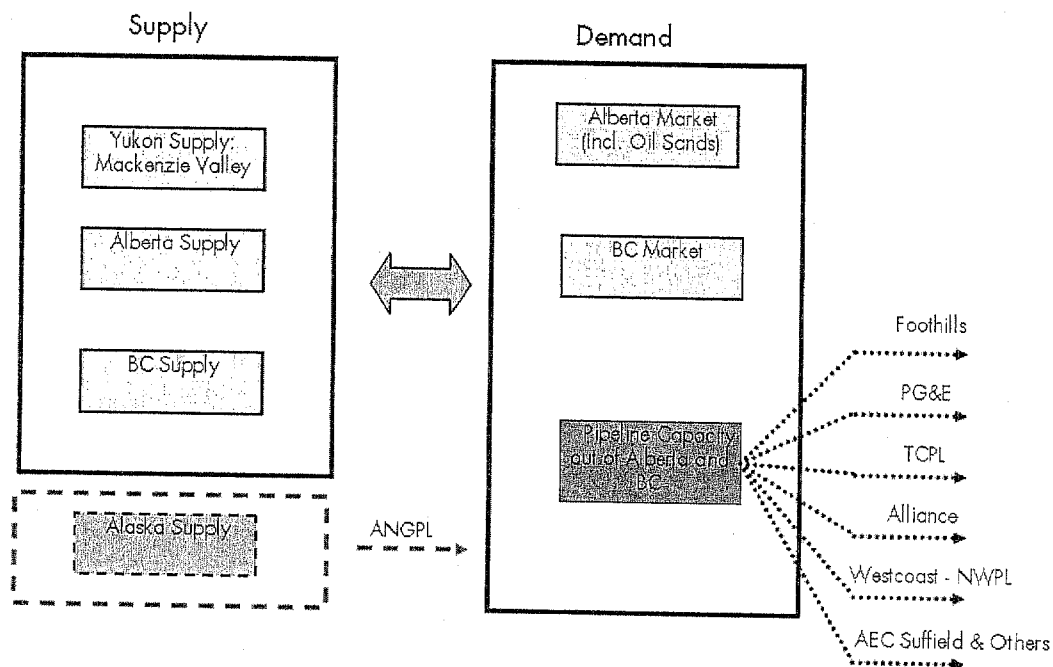
This report is intended to provide preliminary insights to support the State in their negotiations with MidAmerican and the Producer Group. If take-away capacity from the AECO region becomes a key element in the negotiation process, we recommend a more thorough analysis of the region to understand capacity utilization and constraints. Issues that require a more thorough analysis include: confirming NEB’s supply and demand projections (including determining unconventional production solely in Alberta & BC), undertaking a fundamental analysis of the AECO region and pipeline capacity, seasonalizing demand projects to understand the pipeline take-away capacity implications, and reviewing expansion costs / alternatives for the existing pipelines that transport natural gas out of the AECO region.

III. Analysis Assumptions

Analysis examined time period from 2010 to 2025. The provinces of Alberta and British Columbia were considered to define the region for analysis. Supply and demand in this region and pipeline capacity to transport gas out of this region were examined to understand the availability of take-away capacity for Alaskan gas. If current demand in Alberta and British Columbia and pipeline capacity out of the region to access export demand is equal to or greater than the total supply expected from Alberta, British Columbia and Alaskan gas, then there is sufficient take-away capacity for Alaskan gas

2:25:47 PM 3/11/2004 AECO Take-away Memo 3-5-04

from the AECO Hub area. The schematic in Figure 2 shows a pictorial representation of the framework for the analysis.



**Figure 2 – Schematic of Supply/Demand Balance in Analysis Region**

Supply and demand forecasts for the time period were obtained from the National Energy Board's (NEB) projections in *Canada's Energy Future: Scenarios for Supply and Demand to 2025* ("NEB Report").<sup>2</sup> In this report, rather than assuming a reference case for projections to 2025, the NEB presents two scenarios, Supply Push and Techno-Vert, both of which it considers as being equally likely. The two biggest uncertainties in projecting Canadian supply/demand forward were considered to be the nature and level of action that will be taken to enact environmental improvement, and the pace of technological developments. The NEB considered these two uncertainties in creating a scenario framework and decided to make projections for the Supply-Push and Techno-Vert scenarios since they represent divergent, but plausible views of the future.

A brief description of the difference in these scenarios, as described in the NEB Report, is given below. For a more detailed explanation of the scenarios and their assumptions, see Chapters 1 and 2, in the NEB Report.

#### *Supply Push:*

The Supply Push scenario represents a world in which technology advances gradually and Canadians take limited action on the environment. However, major technological

<sup>2</sup> *Canada's Energy Future: Scenarios for Supply and Demand to 2025*, National Energy Board, 2003.

2:25:47 PM 3/11/2004 AECO Take-away Memo 3-5-04

breakthroughs on alternative energy sources remain beyond reach and environmental action is focused on local initiatives. The main theme of the SP scenario is security of continental energy supply and the push to develop known conventional sources of energy.

*Techno-Vert:*

The Techno-Vert scenario is a world in which technology advances more rapidly. In addition, Canadians take broad action on the environment. The main theme of this scenario is the heightened concern for the environment and the accompanying preference for environmentally-friendly products and cleaner-burning fuels. Technological breakthroughs and the adaptation of improved technologies ("best practices") result in the development of diverse energy sources and energy efficiency improvements.

LEG has performed its analysis of the pipeline take-away capacity at the AECO hub considering supply and demand projections from both these scenarios with Techno-Vert as the Base Case scenario and Supply Push as the Sensitivity Analysis.

IV.                      Supply

Projections for supply into the analysis region were obtained from the NEB Report. Supply from production in Alberta, British Columbia and the Mackenzie Valley were included in the analysis. The key uncertainties driving the supply forecasts are the level of undiscovered reserves, unconventional reserves (mainly coal-bed methane (CBM)), and production levels. Some of the broader assumptions made in the NEB Report in modeling supply in Canada are outlined below:

*Techno-Vert:*

- Since some resources are located in isolated areas or small pools where it may not be economical to recover them, only 95% of available undiscovered resources are utilized to determine deliverability.
- CBM:
  - 300 wells in 2003 to 3500 wells per year by 2010. Constant level from 2010 to 2025.
  - Each well starts production at 150 Mcf/d, recovers 0.5 Bcf
  - Total CBM production in Canada at 4 Bcf/d by 2025
- Mackenzie Valley pipeline system flows from 2010 at rate of 1.2 Bcf/d. Expansion in 2015 to 1.9 Bcf/d.
- No development of Alaskan natural gas resources.

These broad assumptions can be considered as being applicable to the analysis region. Table 1 shows the reserves in Alberta, British Columbia, Mackenzie Valley and Unconventional resources. Since unconventional resource estimates for the analysis region were unavailable, a conservative assumption has been made to include unconventional supply for entire Canada in the analysis.

2:25:47 PM 3/11/2004 AECO Take-away Memo 3-5-04

(Bcf Year-end 2001)	Discovered Marketable Resources				Undiscovered Resources	Ultimate Resource Potential
	Cumulative Production	Remaining Reserves	Resources	Total		
<b>Techno-vert</b>						
Alberta	105804	41778	0	147546	70030	217576
British Columbia	14514	8899	0	23414	27016	50430
Mackenzie/Beaufort	0	0	9005	9005	55021	64026
WCSB Unconventional	0	0	0	0	80024	80024

Table 1 – Ultimate Potential Gas Resources – Techno Vert<sup>3</sup>

Figure 3 shows the expected supply from these sources.

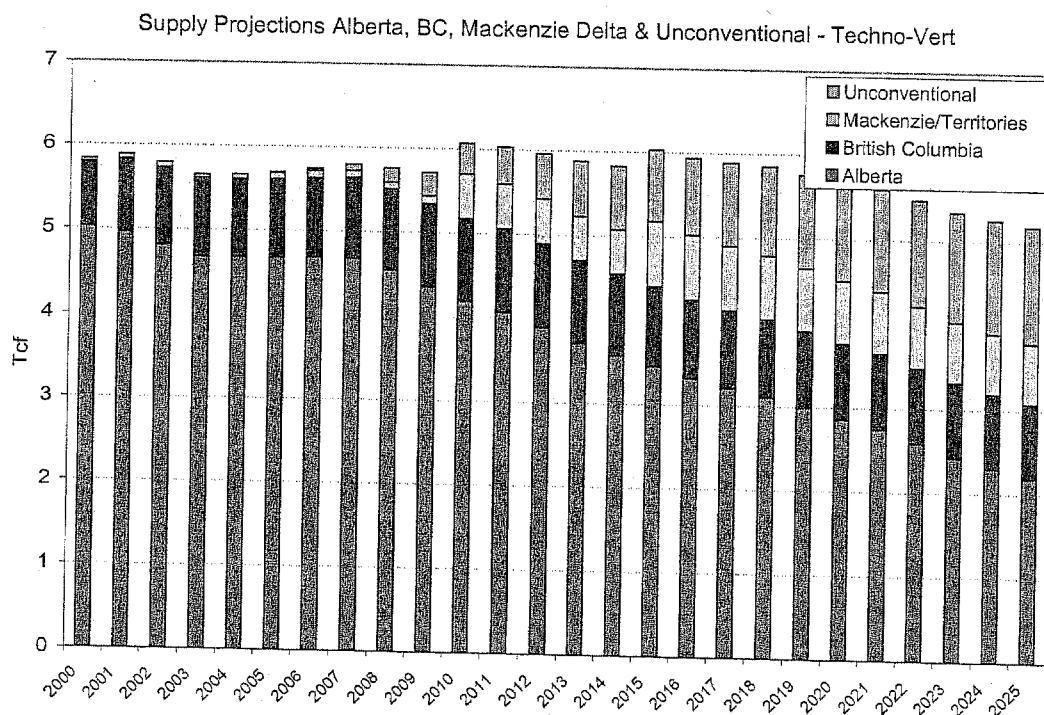


Figure 3 – Natural Gas Production (Techno-Vert)

Alaska production is assumed to become available as a supply source starting in 2010. Supply is assumed to be the capacity of the Alaska Pipeline at 4.5 Bcf/d, staying constant at this level till the end of the analysis period in 2025.

<sup>3</sup> Source: Table A6.1, *Canada's Energy Future: Scenarios for Supply and Demand to 2025*, National Energy Board, 2003.

2:25:47 PM 3/11/2004 AECO Take-away Memo 3-5-04

## V. Demand

Demand projections for Alberta and British Columbia from 2010 to 2025 were obtained from the NEB Report. Total demand includes residential, commercial, industrial and electric generation demand. Among the uncertainties in demand projections is the demand for natural gas expected from oil sands production. Since the technology for oil sands production is new, different estimates on the crude reserves and potential production rate exist. The NEB Report includes potential demand from oil sands production. Total Canadian demand from oil sands production is estimated to be 1.6 Bcf/d in the Techno-Vert scenario. Most of this demand can be expected from the provinces of Alberta and British Columbia.

The greatest growth in demand is seen in the industrial sector with a 2.54% growth rate in the Techno-Vert scenario for Alberta and British Columbia compared to 2.14% growth rate for the whole of Canada during the same period. As defined by the NEB Report, industrial demand also includes most of the natural gas consumption for electric generation. The Energy Information Administration's (EIA) projections for U.S. industrial and electric generation demand growth during the same period is 1.5%.

Residential and commercial demand is driven by population growth, energy efficiency and economic growth. Growth in residential and commercial demand remains low during the analysis period and there is even a marginal decrease in demand in some scenarios, driven by greater energy efficiency.

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2:26:47 PM 3/11/2004 AECO Take-away Memo 3-5-04

Figure 4 shows the demand projections by sector.

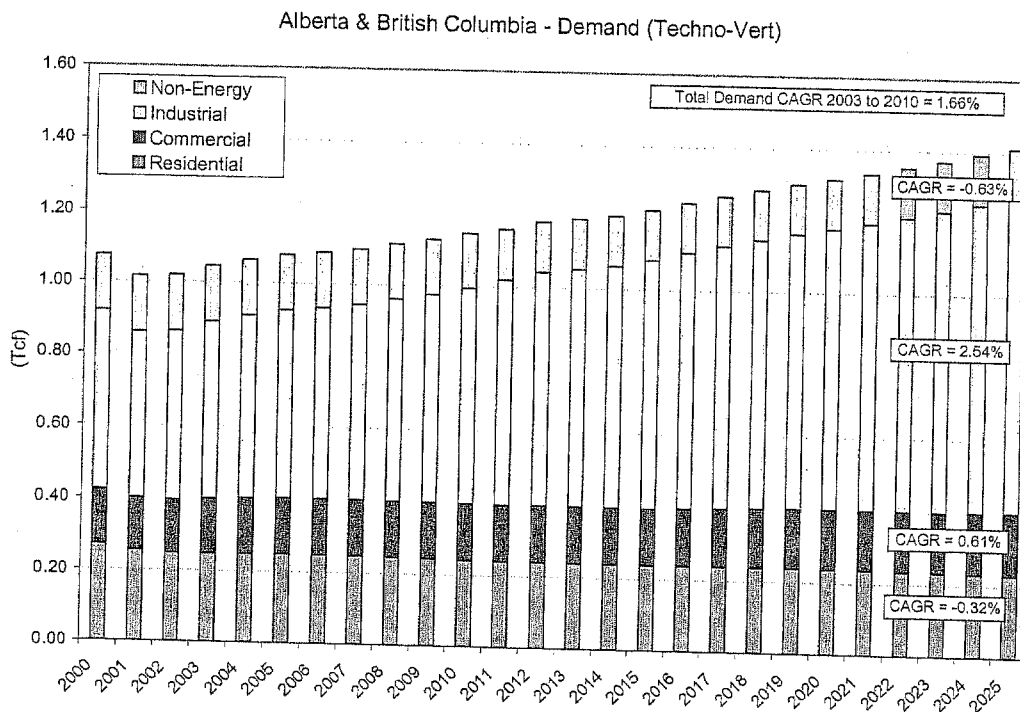


Figure 4 – Natural Gas Demand Projections (Techno-Vert)

#### VI. Pipeline Capacity

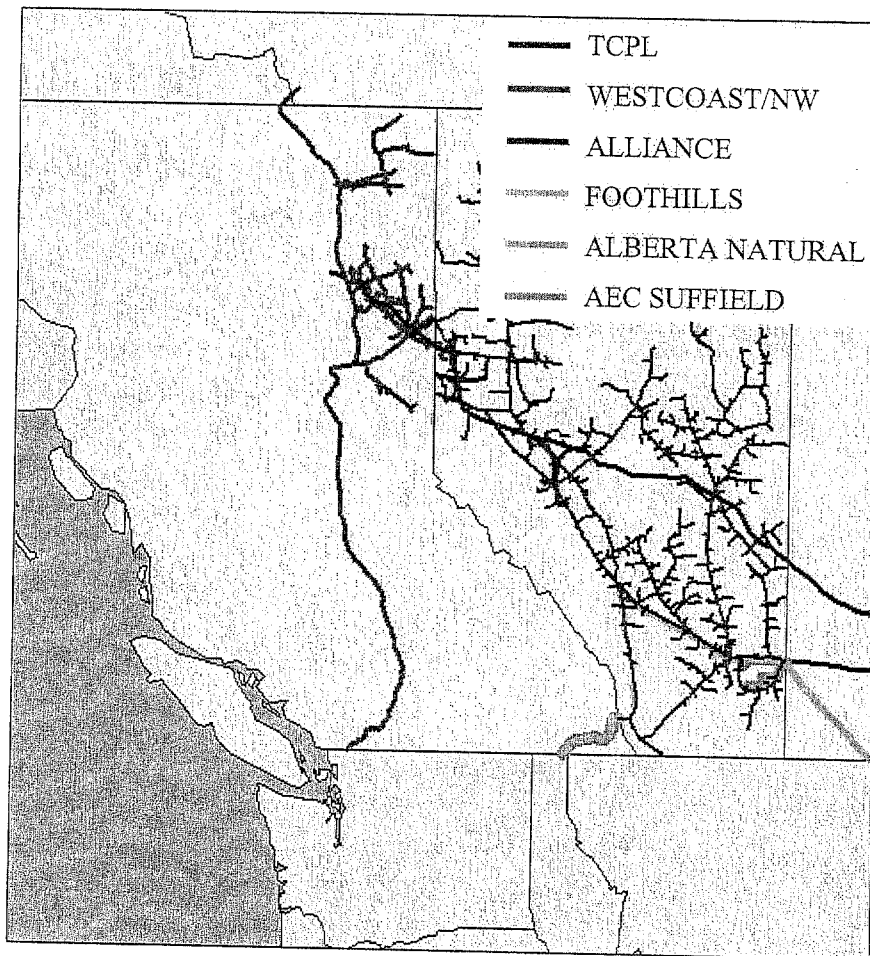
The analysis considered the total pipeline capacity out of Alberta and British Columbia in order to determine whether there will be sufficient pipeline take-away capacity to transport Alaskan gas out of the region without requiring additional pipeline construction. The current cross-border capacities of the pipelines were considered to remain constant over the analysis period 2010 to 2025. This reflects a conservative assumption since additional capacity from potential expansion projects has not been considered for the purpose of this analysis. Figure 5 shows a map of the major pipelines crossing the border from Alberta and British Columbia for delivery in the U.S. or in other provinces of Canada.

CONFIDENTIAL

Page 8 of 15

SGI\_003776

2:25:47 PM 3/11/2004 AECO Take-away Memo 3-5-04



**Figure 5: Alberta and BC Pipelines**

The current capacity across the borders of the analysis region on these pipelines was obtained from the EIA State-to-State Natural Gas Pipeline Capacity Database, December 2003.<sup>4</sup> The database provides capacity on each pipeline at every border it crosses between states in the U.S. and Canada. The capacities for all pipelines crossing the Alberta/British Columbia borders were taken into account. Cross-border capacity between Alberta and British Columbia was ignored. Table 2 shows the take-away capacity on the pipelines leaving the analysis region.

<sup>4</sup> EIA State-to-State Natural Gas Pipeline Capacity Database, Energy Information Administration, Department of Energy, December 2003

2:25:47 PM 3/11/2004 AECO Take-away Memo 3-5-04

Summary	MMcf/d
<b>From BC</b>	<b>1676</b>
Westcoast/Northwest Pipeline	1181
Ferndale & Sumas misc.	495
<b>From AL</b>	<b>14058</b>
Alliance Pipeline	1800
Foothills Pipeline (Eastern Leg) (incl. 2190 MMcf/d to Northern Border + SK drop off)	2375
TCPL	6526
PG&E (incl. Foothills Western leg + TCPL via Alberta Natural Gas)	2967
AEC Suffield	390
<b>Total</b>	<b>15734</b>

**Table 2 – Take-away capacity on Pipelines out of Alberta/British Columbia**

The take-away capacity enables movement of the natural gas from Alberta and British Columbia to Washington State and Idaho in the U.S. and to Saskatchewan province in Canada.

#### VII. Sensitivity Analysis

This sensitivity analysis presents the assumptions and findings using the Supply Push scenario projected in the NEB Report. It is worthwhile to remember that this scenario, although picked here to be shown as a sensitivity case, is projected by the NEB to be just as likely to occur as the Techno-Vert scenario.

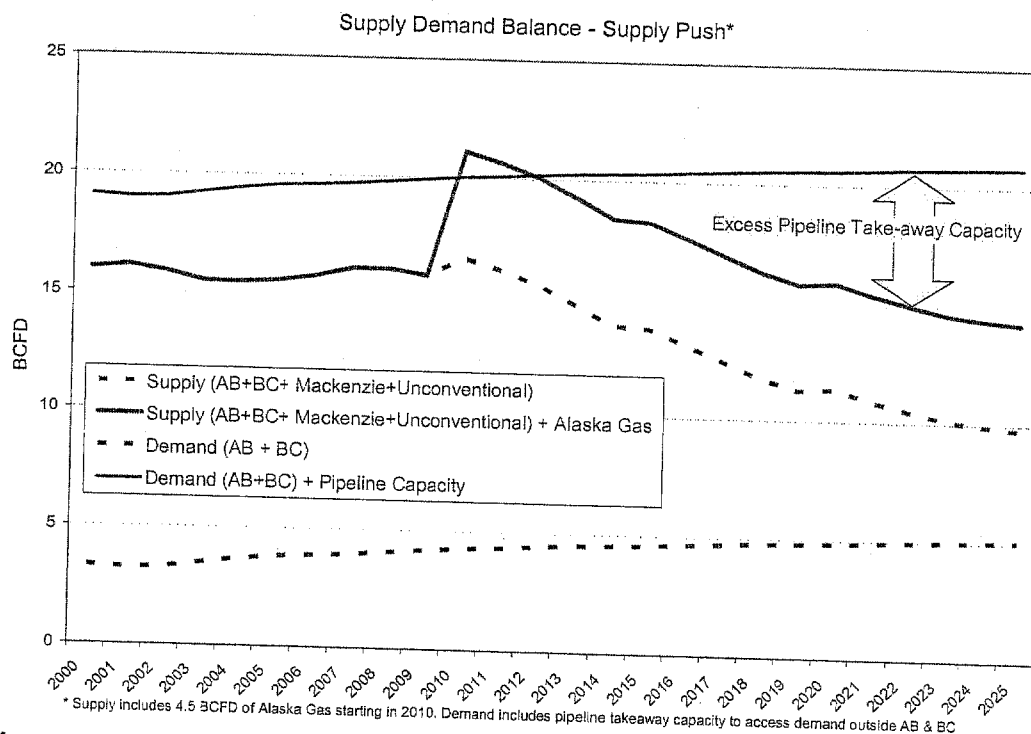
#### Key Findings:

Total supply from Alberta, BC and Mackenzie Valley is projected to decline from 16.60 Bcf/d to 9.78 Bcf/d between 2010 and 2025 in the Supply Push scenario. Alaskan production was assumed to provide 4.5 Bcf/d starting in 2010 and stay at this level till 2025.

Demand for natural gas in Alberta and British Columbia was projected to grow from 4.29 Bcf/d to 5.07 Bcf/d from 2010 to 2025 in the Supply Push scenario. Pipeline take-away capacity from Alberta and BC was assumed to remain constant at the current level of 15.73 Bcf/d during the analysis period. This pipeline capacity reflects the potential export demand for natural gas out of the region.

The net result of these projections is that even after Alaskan gas becomes available in 2010, there is excess pipeline capacity out of the Alberta/British Columbia region for all except the 2010-2012 time period. Figure 6 shows the supply/demand balance in the Supply Push scenario.

2:25:47 PM 3/11/2004 AECO Take-away Memo 3-5-04



**Figure 6 – Supply/Demand Balance – Supply Push**

Supply:

Some of the broader assumptions made in the NEB Report in modeling supply in Canada in the Supply Push scenario are outlined below:

*Supply Push*

- Since some resources are located in isolated areas or small pools where it may not be economical to recover them, only 90% of available undiscovered resources are utilized to determine deliverability
- Drilling levels similar to those in 2001 are maintained till 75% of available resources are produced.
- Producing characteristics of new wells assumed to be similar to current wells in same area.
- CBM:
  - 300 wells in 2003 to 3000 wells per year by 2010. Constant level from 2010 to 2025.
  - Each well starts production at 100 Mcf/d and recovers 0.375 Bcf
  - Total CBM production in Canada at 2.4 Bcf/d by 2025
- Offshore project in BC producing 500 MMcf/d, in operation by 2020.
- Mackenzie Valley pipeline system flows from 2010 at rate of 1.2 Bcf/d. Expansion in 2015 to 1.9 Bcf/d.
- Development of Alaskan natural gas resources – flows to lower 48 markets

2:25:47 PM 3/11/2004 AECO Take-away Memo 3-5-04

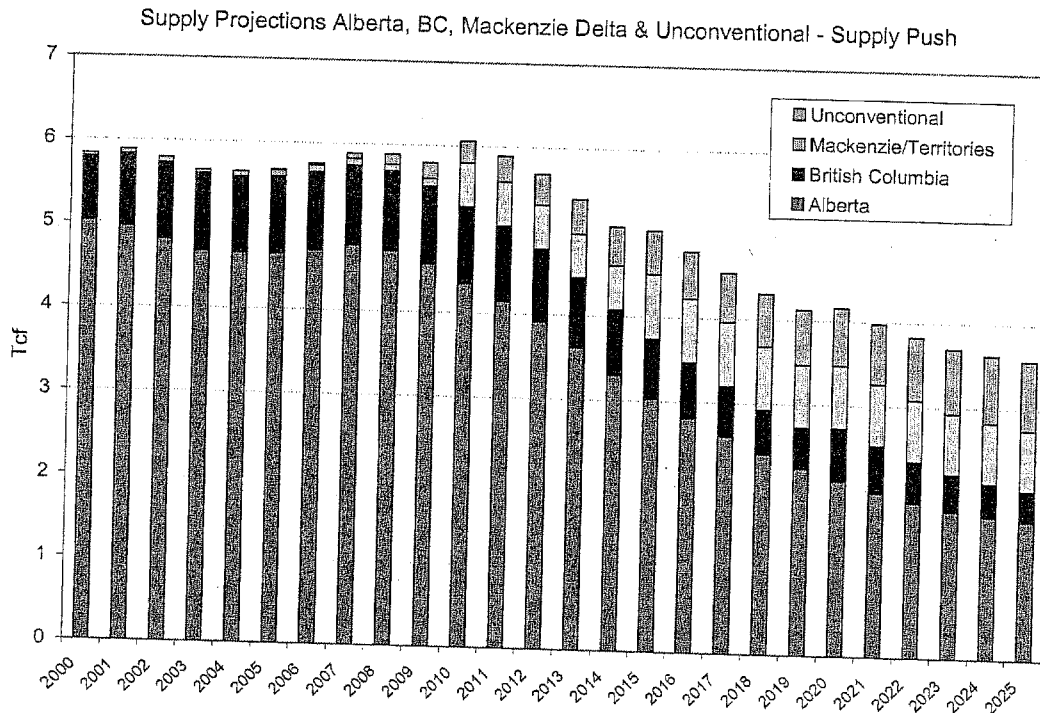
utilizing existing Canadian pipeline capacity. Increases pipeline utilization and moderates transportation rates.

These broad assumptions can be considered as being applicable to the analysis region. Table 3 shows the reserves in Alberta, British Columbia, Mackenzie Valley and Unconventional resources. Since unconventional resource estimates for the analysis region were unavailable, a conservative assumption has been made to include unconventional supply for entire Canada in the analysis.

(Bcf Year-end 2001)	Discovered Marketable Resources			Total	Undiscovered	Ultimate Resource
	Cumulative	Remaining	Resources			
<b>Supply Push</b>						
Alberta	105804	41778	0	147546	59011	206557
British Columbia	14514	8899	0	23414	9994	33408
Mackenzie/Beaufort	0	0	9005	9005	55021	64026
WCSB Unconventional	0	0	0	0	80024	80024

**Table 3 – Ultimate Potential Gas Resources – Supply Push**

Figure 7 shows the expected supply from these sources.



**Figure 7 – Natural Gas Production (Supply Push)**

Alaska production is assumed to become available as a supply source starting in 2010. Supply is assumed to be the capacity of the Alaska Pipeline at 4.5 Bcf/d, staying constant at this level till the end of the analysis period in 2025.

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2:25:47 PM 3/11/2004 AECO Take-away Memo 3-5-04

Demand:

Demand projections for Alberta and British Columbia from 2010 to 2025 were obtained from the NEB Report. Total demand includes residential, commercial, industrial and electric generation demand. Among the uncertainties in demand projections is the demand for natural gas expected from oil sands production. Total Canadian demand from oil sands production is estimated to be 1.8 Bcf/d in the Supply Push scenario. Most of this demand can be expected from the provinces of Alberta and British Columbia.

The greatest growth in demand is seen in the industrial sector with a 1.7% growth rate between 2010 and 2025 in the Supply Push scenario for Alberta and British Columbia compared to 0.78% growth rate for the whole of Canada during the same period. As defined by the NEB Report, industrial demand also includes most of the natural gas consumption for electric generation. The EIA projection for U.S. industrial and electric generation demand growth during the same period is 1.5%.

Residential and commercial demand is driven by population growth, energy efficiency and economic growth. Growth in residential and commercial demand remains low during the analysis period and there is even a marginal decrease in demand in some scenarios, driven by greater energy efficiency.

**CONFIDENTIAL**

Page 13 of 15

SGI\_003781

2:25:47 PM 3/11/2004 AECO Take-away Memo 3-5-04

Figure 8 shows the demand projections by sector for the Supply Push scenario.

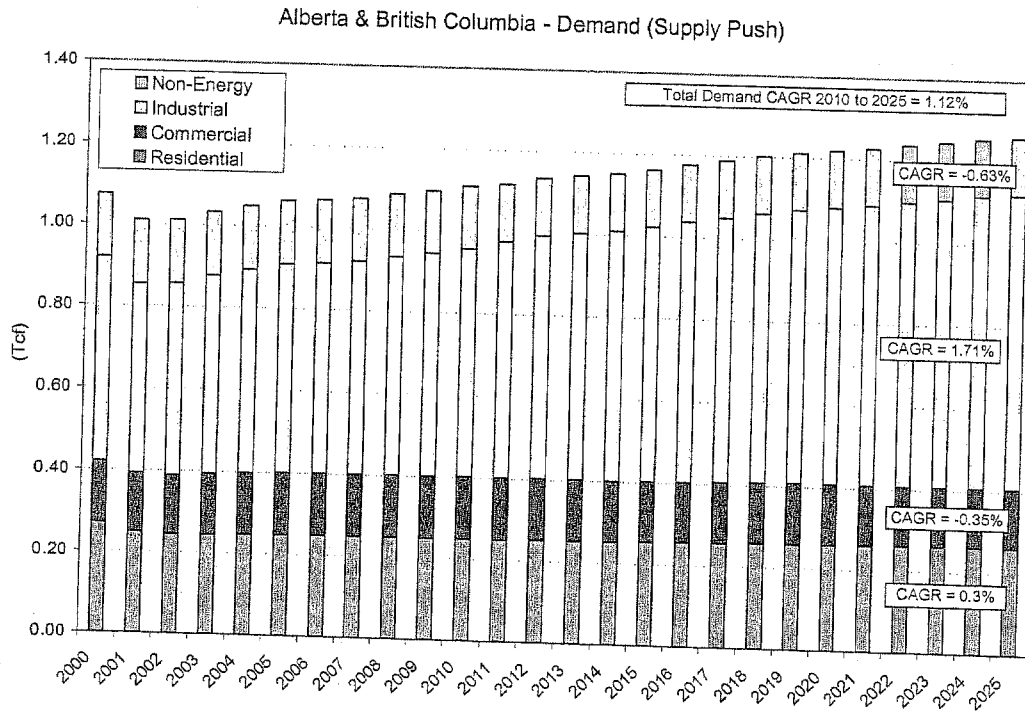


Figure 8 – Natural Gas Demand Projections (Supply Push)

Pipeline Capacity:

Pipeline capacity is considered to be the same as the assumptions made in the Base Case.