

**TransCanada PipeLines Limited Response to
Council of Canadians Interrogatory #6**

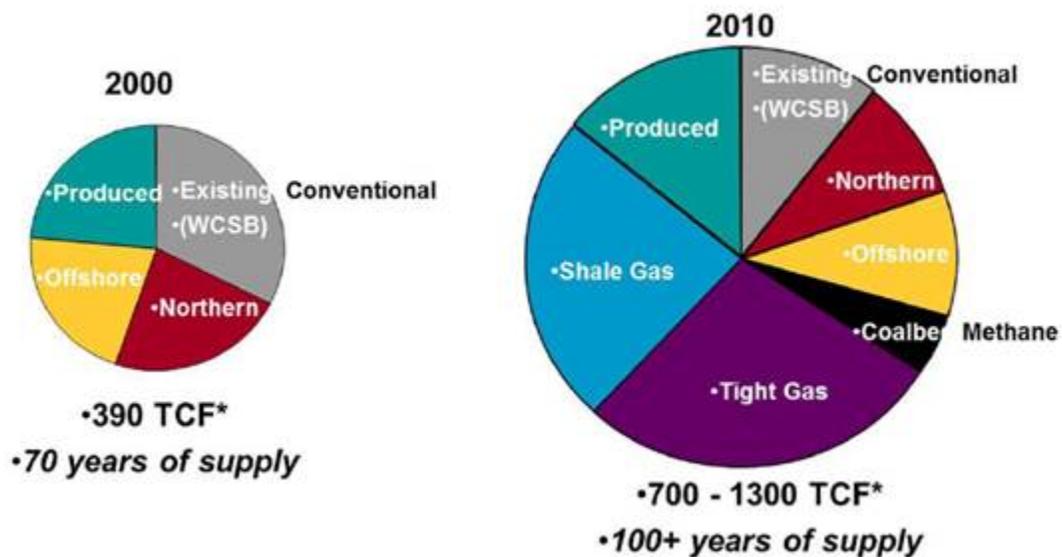
- Reference:** EB-2012O-0451, EB-2012-0433, EB-2013-0074: TransCanada Supplemental Evidence pp. 10-11/17
- Preamble:** TransCanada uses a technical recoverable estimate of approximately 560 Tcf for WCSB ultimate potential resources in its Base Case supply analysis. This number has more than tripled since 2005. This estimate has never been higher. Figure 7-1 shows the growth of forecast ultimate potential resources over time.
- Request:**
- (a) Please provide the data from National Energy Board (NEB), Energy Resources Conservation Board (ERCB), Alberta Geological Survey (AGS), British Columbia Ministry of Energy and Mines, BCMEM), Canadian Society of Unconventional Gas (CSUG), Canadian Association of Petroleum Producers (CAPP), that comprised the basis for the estimates noted above and by Figure 7-1.
 - (b) Please explain the method used for compiling this data to arrive at the aforementioned estimates.
 - (c) Please provide the actual production from the sources indicated in Figure 7-1 for each of the years of 2000 – 2012.

Response:

- (a) The data that forms the basis for these estimates are included in the reports and publicly available.
- (b) There have been significant improvements in drilling and completion technology over the last 5 -7 years which have resulted in dramatic changes in the economics of developing shale and tight gas resources. As a result, current resource estimates have increased substantially. However, there remains considerable uncertainty associated with estimates of total resource potential. After careful consideration of a range of estimates, TransCanada makes its own assessments based upon ground work done by others such as government agencies, industry associations, scholarly publications, producers, and financial institutions. TransCanada's estimates are scrutinized internally and compared to other information sources for reasonableness. In other cases estimates are adopted outright without the need for additional processing or compilation from reports that are widely quoted and available within the public domain. Various sources have been used to support the following resource estimates.
 - 1. Total Resource Potential: The chart from CAPP illustrates the wide range of estimates associated with total resource potential. Notwithstanding the current wide range of estimates, the chart clearly demonstrates the growth of resource

potential associated with unconventional resource plays such as shale and tight gas over a 10 year period. They now comprise approximately 50% of the total whereas in 2000 they weren't even considered as being contributors to total gas potential. The chart (slide 5) is extracted from a presentation titled "Natural Gas Development and Hydraulic Fracturing" presented at, CAPP Superport Days 2013 Guysborough, NS on July 4, 2013.

Canadian Resource Growth



2. Conventional Gas: Internal TransCanada analysis and assessment based in part on an in house database and the Canadian Gas Potential Committee Report titled "Natural Gas Potential in Canada 2005, Western Canada Sedimentary Basin Volume 2" updated with the Alberta Energy Regulator (AER) annual report "ERCB ST-98" There is considerable uncertainty associated with WCSB conventional gas estimates due to the successful application of horizontal drilling and hydraulic fracturing techniques to pervasively gas charged systems within the "Deep Basin" area of Alberta and British Columbia. Historically, these geological horizons were unproductive using conventional drilling and completion techniques because of extremely low rock permeabilities. These reservoirs occupy the very low end of a continuous spectrum of permeability distribution that have been sourced from the migration of distally derived hydrocarbons. As such, TransCanada considers these "continuous accumulation" reservoirs which fall into the category of conventional gas although they are now being exploited with unconventional drilling and completion techniques.

3. Coalbed Methane (CBM): Internal TransCanada analysis and assessment based on Canadian Gas Potential Committee Report titled “Natural Gas Potential in Canada 2005, Unconventional Gas Resources in Canada Volume 4” and original mapping done by Dave Hughes with the Geological Survey of Canada (GSC) and updated with the Alberta Energy Regulator (AER) annual report “ERCB ST-98”.
4. Montney Potential: Internal TransCanada analysis, assessment and compilation based on British Columbia Ministry of Energy, Mines and Petroleum Resources – Resource Development and Geoscience Branch titled “Regional Shale Gas Potential of the Triassic Doig and Montney Formations, Northeastern British Columbia” Petroleum Geology Open File 2006-02.
5. Duvernay Potential: TransCanada has adopted the estimate of 90 TCF as published in the Alberta Geological Survey (AGS) Study titled “Summary of Alberta’s Shale and Siltstone Hosted Hydrocarbon Resource Potential” - ERCB/AGS Open File Report 2012-06.
6. Horn River Potential: TransCanada has adopted the estimate of 78 TCF as published in the joint National Energy Board and British Columbia Ministry of Energy and Mines study titled “Oil and Gas Reports 2011-1 – “Ultimate Potential for Unconventional Natural Gas in Northeastern British Columbia’s Horn River Basin” May 2011 (Table 2.1) .
7. Cordova Potential: Assessed internally using the American Association of Petroleum Geologists AAPG Bulletin, v. 92, no. 1 (January 2008), pp. 87–125 titled “Characterizing the shale gas resource potential of Devonian–Mississippian strata in the Western Canada sedimentary basin: Application of an integrated formation evaluation” by Daniel J. K. Ross and R. Marc Bustin (figure 20).
8. Liard Potential: Apache and 50% partner Chevron Canada have estimated that they control 430,000 acres of the Liard basin with 210 TCF of gas in place of which 48 TCF is recoverable.

Their estimates are publically available on their website at:
“http://www.apachecorp.com/Operations/Resource_rich_in_North_America/Liard_Basin/index.asp”

Only a handful of wells have been drilled into the basin, however with spectacular results. Because Apache is the dominant landholder and most active driller in the basin, TransCanada has used their company estimates for the basis of its own assessment of the play which currently stands at 96 TCF from an area comprising

860,000 acres. The range of uncertainty associated with the Liard basin spans 80 – 120 TCF.

There is considerable uncertainty associated with the remaining technical resource potential associated with the shale plays as they encompass vast areas of which only relatively small portions have been explored, tested and developed. The base case estimate for the shales in total is 282 TCF, however the range of possibilities extends from 226 TCF in the low case to 341 TCF in the high case.

Gas resource estimation begins with an estimate of the original gas in place (GIP) which can include both “free gas” and “adsorbed” gas depending on the play type. These estimates of original GIP are reduced by a factor that addresses the reality that only a portion of the total play area may be “developable.” The GIP associated with the “developable” area is further reduced by a recovery factor that considers various play types and the specific drilling and completion technology being employed to arrive at a final technical resource estimate.

- (c) Please see the following table for production from 2000 to 2012 for the following sources:

Year	Conventional	CBM	Montney	Shale
2000	16.21	0.10	0.01	0.00
2001	16.92	0.11	0.01	0.00
2002	16.69	0.11	0.01	0.00
2003	16.24	0.13	0.02	0.00
2004	16.40	0.22	0.02	0.00
2005	16.27	0.39	0.02	0.00
2006	16.09	0.66	0.04	0.00
2007	15.50	0.83	0.11	0.00
2008	14.60	0.91	0.21	0.00
2009	13.39	0.94	0.38	0.04
2010	12.56	0.89	0.66	0.13
2011	11.96	0.86	1.13	0.33
2012	10.81	0.79	1.54	0.50

**TransCanada PipeLines Limited Response to
Council of Canadians Interrogatory #7**

Reference: EB-2012-0451, EB-2012-0433, EB-2013-0074: TransCanada Supplemental Evidence, pp. 13-14/17

Preamble: As a result of the generally positive developments related to the potential economic production of 12 shale and other tight formation plays and in anticipation of LNG export capability, TransCanada has included approximately 11 Bcf/d of production in its Base Case by 2025 from new areas such as the Montney gas play, Duvernay, Horn River, Liard and Cordova shales (Figure 7-4).

Request:

- (a) Please describe the positive developments referred to and how these were taken into account in generating the estimate of 11 Bcf/d of production in its Base Case by 2025.
- (b) Please provide the production growth assumptions used to make the 11 Bcf/d forecast for the Montney gas play (in both BC and Alberta), and the Duvernay, Horn River, Liard and Cordova shale plays for each year between 2013 and 2025.
- (c) Please provide the number of wells that were assumed to be added to each of these plays in each year over the period 2013-2025 in order to arrive at these production forecasts.
- (d) Please list the other shale and tight formations, other than the Montney, Duvernay, Horn River, Liard and Cordova, that were included in the 11 Bcf/d forecast and the production levels assumed for each (by year from 2013 to 2025), and provide the number of wells that were assumed to be drilled in each year in each of these plays to meet this forecast.

Response:

a) In summary, the positive developments referred to include horizontally drilled wells, multi-stage hydraulic fracturing, fit for purpose drilling rigs, economic uplift from “liquids rich” gas plays and an emerging export market for dry gas via Pacific coast LNG developments to serve the Asian market.

The ever increasing horizontal leg of long reach ” horizontal wells” in combination with a growing number of massive and sequentially fractured stages have resulted in well bores making unprecedented reservoir contact with the gas bearing formations they are in. The result is that well performance is constantly improving with respect to initial production rates and estimated ultimate recoveries from gas formation that were considered “unproducible” as recently as 2005.

New “fit for purpose” self-propelled drilling rigs are being built with increasing depth capabilities that optimize large single pad, multi-well drilling operations. Drilling, completion and tie-in operations are now being performed in a “batch process” assembly line approach as opposed to sequentially as in the past, further increasing efficiencies related to the development of unconventional gas.

The emergence of multiple LNG developments on BC’s Pacific coast and the economic uplift provided by the robust demand for diluent, are additional positive developments that anticipate increasing drilling and supply coming from both dry and liquids rich gas plays.

b) through d)

Please refer to COC 7 Attachment 7A for production and well activity assumptions for the Montney, Duvernay, Horn River, Liard, Cordova and Coalbed methane plays that comprise TransCanada’s unconventional gas forecast.

Unconventional Gas Production (bcf/d)

Year	CBM	Montney	Horn	Cordova	Duvernay	Liard
2013	0.74	1.94	0.42	0.03	0.07	0.00
2014	0.71	2.27	0.35	0.04	0.18	0.00
2015	0.68	2.55	0.38	0.05	0.29	0.00
2016	0.64	2.84	0.51	0.06	0.43	0.00
2017	0.61	3.13	0.73	0.10	0.56	0.03
2018	0.59	3.44	0.99	0.14	0.77	0.08
2019	0.56	3.75	1.30	0.17	0.96	0.13
2020	0.54	4.06	1.61	0.20	1.10	0.15
2021	0.53	4.35	1.87	0.22	1.22	0.21
2022	0.52	4.62	2.08	0.24	1.32	0.39
2023	0.50	4.87	2.24	0.26	1.41	0.58
2024	0.50	5.08	2.36	0.27	1.49	0.70
2025	0.49	5.31	2.47	0.28	1.56	0.78

Unconventional Gas Wells/year

Year	CBM	Montney	Horn	Cordova	Duvernay	Liard
2013	600	330	10	6	75	0
2014	576	360	20	6	125	0
2015	553	392	40	6	150	0
2016	531	425	70	12	200	0
2017	510	462	100	24	200	6
2018	489	500	130	24	300	14
2019	470	533	160	24	300	14
2020	451	565	180	24	300	14
2021	433	590	190	24	300	14
2022	416	615	190	24	300	60
2023	399	630	190	24	300	60
2024	383	640	190	24	300	60
2025	368	645	190	24	300	60

**TransCanada PipeLines Limited Response to
Council of Canadians Interrogatory #8**

Preamble: The regulatory environment for shale gas extraction in the United States has been progressively tightening as more information becomes available related to impacts associated with development.

It is apparent that progressive regulatory reform is needed in Canada. For example: the British Columbia (BC) government has set a target of cutting greenhouse gas emissions by at least 33 per cent by 2020 and 80 per cent by 2050. According to the Pembina Institute, emissions from shale gas extraction will need to be addressed in order to meet these goals, which in turn could affect the pace and scale of shale gas development in BC.¹

Request:

- (a) Please describe the assumptions TCPL has made about the extent and costs of regulation of shale gas extraction from the WCSB for the present period and through 2025, including any future regulation required to achieve present Canadian commitments to reduce greenhouse gas emissions.
- (b) Please describe whether the regulation and/or taxation of carbon has been considered in this regard, and if so please provide any assessment that was carried out and in what manner.
- (c) Please provide any assessment or estimate of the extent of greenhouse gas emissions associated with the shale gas development that is projected to occur in the WCSB.

Response:

(a) and (b)

TransCanada's forecasts of gas supply are based on the producer economics of developing the resource base which include any costs associated with current regulations. Future changes to regulation and the associated costs have not been considered. However, it is in TransCanada's view that any additional costs due to changes in regulation will need to be considered in the context of changes to all other supply factors such as changes in gas price, on-going improvements in technology

¹ According to the Pembina Institute, [BC's] Climate Action Plan estimated that the plan's policies "would be sufficient to reduce provincial emissions to 19% below 2007 levels by 2020. . . unaccounted for factors in the natural gas sector exacerbate that gap. Shrinking — and eventually eliminating — the gap will require all of the proposals in the Climate Action Plan to be fully implemented and a number of additional steps to be taken." (The Pembina Institute. Sept. 2011. Shale Gas: Risks to B.C.'s Climate Action Objectives. p. 26. <http://pubs.pembina.org/reports/shale-and-climate.pdf>)

and production practices that will reduce costs as well as any other supply factors that have changed over time.

- (c) TransCanada has not performed any such study.