

Canadian Energy Research Institute & Canadian Society for  
Unconventional Gas

Socio-Economic Impact of Horseshoe Canyon Coalbed  
Methane Development in Alberta

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**SOCIO-ECONOMIC IMPACT OF HORSESHOE CANYON COALBED METHANE  
DEVELOPMENT IN ALBERTA**

Socio-Economic Impact of Horseshoe Canyon Coalbed Methane Development in Alberta  
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- Coalbed Methane
- Tight Gas Sands
- Shale Gas
- Gas Hydrates

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- Educate the media about unconventional gas sources and provide them with the materials necessary for them to accurately report the facts and issues surrounding these resources.
- Increase the dialogue between the unconventional gas industry and the federal and provincial governments.
- Increase the amount, and improve the quality and consistency, of communications with stakeholder groups in both Alberta and BC.
- Improve and streamline communication to/from CSUG member companies.
- Design and introduce new administrative communication elements to reduce response time and increase effectiveness of all communication activities.

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- Providing a conduit to increase dialogue between the unconventional gas industry and the federal and Alberta and BC provincial governments.
- Developing materials for the public and the industry that provide overview information on processes and operations.
- Supplying and/or presenting information to the general public and landowners.
- Responding to governmental regulatory challenges by providing input, data, and area expertise through our membership.
- Providing the media with a credible source of information on the history, operations, and best practices of the industry.

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## EXECUTIVE SUMMARY

This report summarizes the results of a socio-economic benefits analysis of Horseshoe Canyon coalbed methane (CBM) or natural gas from coal (NGC) development in Alberta. This project was conceived by the Alberta Ministry for Economic Development (AED) and co-funded by the ministry, the Canadian Association of Petroleum Producers (CAPP), and the Canadian Society for Unconventional Gas (CSUG). CSUG formed a steering committee to develop an updated predictive model for future Horseshoe Canyon (HC) CBM development. The committee also developed economic analysis assumptions for evaluating the economic outcomes of different scenarios of future HC CBM development. The Canadian Energy Research Institute (CERI) then used these data and forecasts to evaluate the socio-economic benefits of HC CBM development using an economic impact assessment model. This model is based on one previously developed by CERI for a similar evaluation of oil sands development.

This study resulted in a revised resource assessment for the HC coals of ~36 trillion standard cubic feet (Tcf) of gas in place, with about 30 Tcf in areas thought to be developable under current conditions. Nine different development scenarios were run which predicted peak HC CBM rates of between 1.4 and 1.9 Bcf/day between 2011 and 2017 with sustained rates of about 185 MMcf/day as far into the future as 2050, with production extending beyond 2060. Estimated total HC CBM recovery is about 10 to 12 Tcf from ~35,000 wells, or about 1/3 of the original gas in place.

CERI's analysis indicates the predicted HC CBM development will result in about 9 billion \$ of cumulative investment between 2006 and 2026 resulting in total production revenue of 80 to 106 billion dollars in the same period. Between 2006 and 2064 HC CBM development will contribute between 97 and 123 billion dollars (2004 Canadian dollars) to Alberta's gross domestic product (GDP) and another 7 to 12 billion dollars (2004 Canadian dollars) in GDP outside Alberta. The GDP and other socio-economic impacts are distributed over 19 different economic sectors in the report. Over 650,000 man-years of employment and 15 to 19 billion dollars (2004 Canadian dollars) in tax and royalty revenues will be created by HC CBM development, much in Alberta. Tax and royalty revenues include provincial, federal and municipal governments. Clearly, the development of HC CBM in Alberta will have a significant, positive impact on the future economy of Alberta and Canada.

There are non-economic impacts associated with this development, including environmental and sociological impacts that are not addressed in this study. CSUG, CAPP and other stakeholders are actively involved in other processes that do address these impacts, positive and negative.

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## CHAPTER 1 INTRODUCTION AND BACKGROUND

### 1.1 Background

The Alberta Ministry of Economic Development (AED) approached the Canadian Society for Unconventional Gas (CSUG) about performing such a study, similar to an earlier AED-sponsored study of Alberta's oil sands, in 2005. The Canadian Association of Petroleum Producers (CAPP) also expressed interest in supporting this project. CSUG organized a steering committee of representatives of interested member companies and representatives of AED, CAPP, and the Canadian Energy Research Institute (CERI) which first met in late 2005 to discuss this project. On the basis of the earlier work CERI had done for AED in the oil sands, CERI was asked to perform this socio-economic impact analysis, which they agreed to do, with input from CSUG members. Originally, the study was intended to cover all CBM development in Alberta, but the steering committee decided that there was insufficient data available on other Alberta CBM plays, like the Mannville and Ardley CBM plays, to justify such an analysis at this time. Given the relatively advanced state of the HC CBM development in Alberta, the committee directed the study team to focus on the HC CBM play.

On behalf of CSUG, representatives of MGV Energy Inc. (now Quicksilver Resources Canada) prepared an updated resource assessment and developed predictive type curves for use in this study. They also developed some basic drilling, completion, gathering, compression, and operating cost assumptions based on late 2005 and early 2006 estimates to be used in the study. After review by the CSUG steering committee and with subsequent modifications, this information was provided to CERI for their socio-economic impact analysis, as discussed in Chapters 3 and 4. MGV also provided an economic analysis model for generating various development scenarios and economic outputs for use by CERI.

### 1.2 Objectives

The overall objective of this study is to analyze economic impacts of investment in and natural gas production from the HC Coal Formation currently being developed in central Alberta. The study measures impacts on government revenues, employment and gross domestic product associated with the investment and production. In order to accomplish this objective, the following activities were undertaken by the study team:

- Update of the resource assessment and estimation of investment and production forecasts under nine alternative scenarios;
- Estimation of direct benefits from the project including revenue from natural gas production, government revenues (royalties and taxes) under nine alternative scenarios; and

- Assessment of indirect socio-economic impacts of the project at the provincial, national and international levels.

### 1.3 History of CBM in Alberta

As shown in Figure 1.1, various different coal groups underlie much of Alberta, including practically all of Central and Southern Alberta<sup>1,2</sup>. There are various estimates of the CBM resource associated with these coals, and the Alberta Geological Survey (AGS) estimates about 386 Tcf of original gas in place<sup>1</sup>, with most in the three major CBM plays: the Mannville, Horseshoe Canyon (including the Belly River in this report), and Ardley. In the 1980s, when commercial CBM development began taking place in the US, a few CBM tests were conducted in existing and new wells in Canada, with no commercial success and the predecessor to CSUG<sup>3</sup>, the Canadian CBM Forum was created.

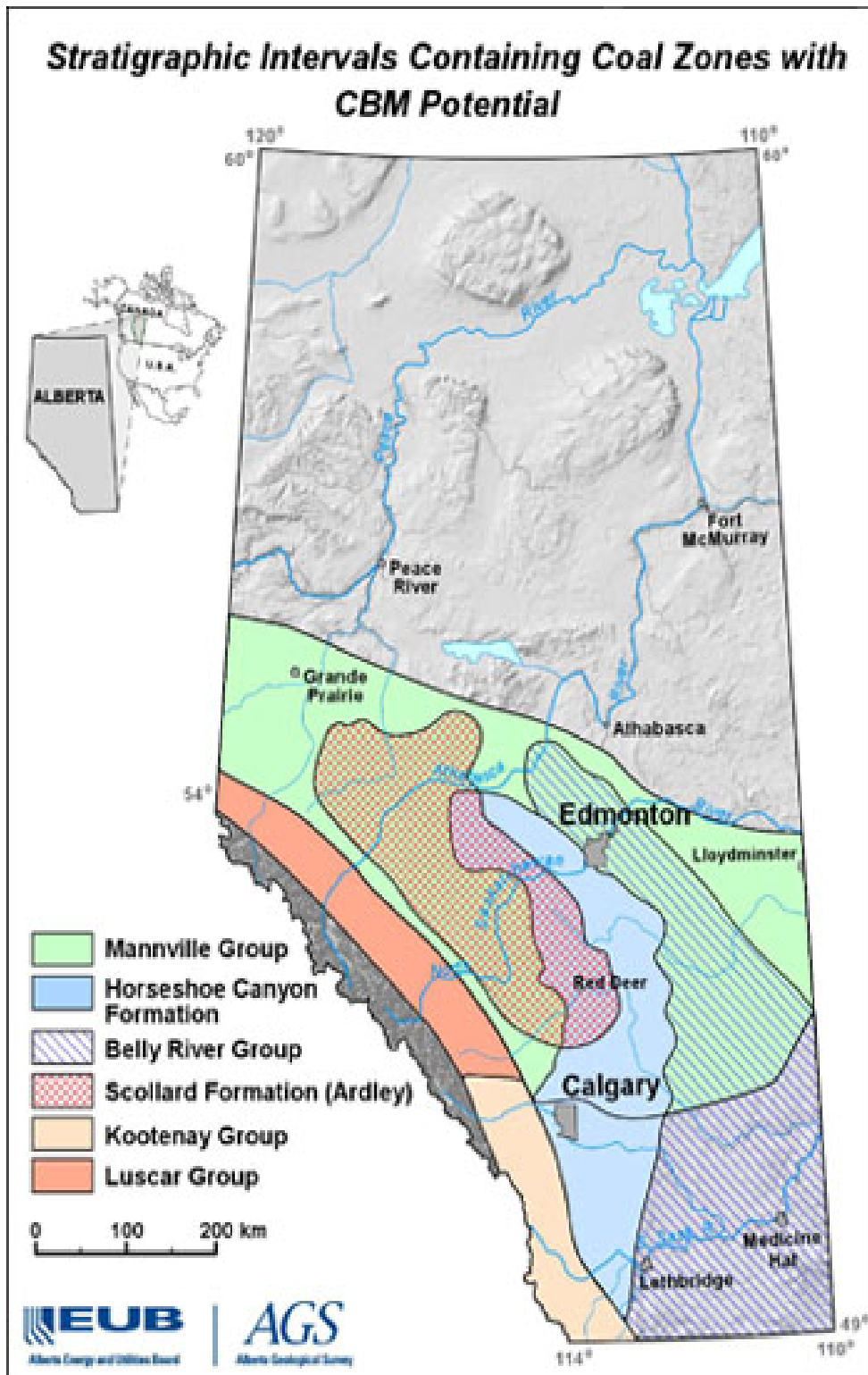
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<sup>1</sup> Beaton, A.P. "Production Potential of Coalbed Methane Resources in Alberta." EUB/AGS Earth Sciences Report 2003-03, p. 59

<sup>2</sup> Alberta Energy and Utilities Board presentation to the Alberta Multi-Stakeholder Advisory Committee. Red Deer, AB, January, 2005.

<sup>3</sup> Canadian Society of Unconventional Gas (CSUG) website, <<http://www.csug.ca>>

Figure 1.1  
Geologic Map of Alberta Coals



In 2000, a joint venture between PanCanadian Petroleum (now EnCana) and MGV Energy Inc. (now Quicksilver Resources Canada) began a large CBM exploration program in Alberta. This joint venture established Canada's first significant commercial CBM production in late 2001 from the Horseshoe Canyon and Belly River coals<sup>4,5</sup>. During this same time period, a number of other companies, including Trident Exploration, Nexen, ConocoPhillips, Apache Canada, and others were also evaluating CBM prospects in Alberta and British Columbia<sup>6,7</sup>. CDX Canada<sup>8</sup> established commercial production from a horizontal well in the Mannville coals in 2004, and in 2005, a joint venture between Nexen and Trident Exploration announced commercial production and plans for substantial development in the Mannville coals<sup>9</sup>.

As of December 31, 2005, there were about 7,764 CBM wells in Alberta, with about 7,377, or 96 percent in the shallow, "dry" Horseshoe Canyon (HC) coals<sup>10</sup>. Development of these coals has advanced rapidly in Alberta compared to other coals, partly because these HC wells produce little or no water. Only about 5,419, of these CBM wells were producing at year-end 2005 and the EUB estimates cumulative CBM production to be about 73 Bcf<sup>10</sup>. CBM and commingled sands and shales are estimated to account for about 500 MMcf/day of Alberta gas production as of September 2006, again with most coming from the HC coals<sup>11</sup>. It is difficult to precisely estimate Alberta's CBM production because many wells are commingled with other shallow gas zones, but the growth in CBM production has been great and is estimated to continue over the next 20 years. The National Energy Board (NEB) has predicted CBM will account for over three Bcf/day in Canada by 2025, as shown in Figure 1.2<sup>12,13</sup>.

The Mannville formation, with over 260 Tcf of gas resource, is the single most important CBM resource in Alberta and is just getting established in commercial developments around the Nexen/Trident joint venture area<sup>1,9</sup>. The Mannville coals are deeper than the HC and Ardley coals and most often include some "de-watering" of saline water to establish commercial gas rates, which adds to the cost of drilling and equipping these wells to lift and dispose of this saline water. The Ardley coals also show commercial CBM promise, but have demonstrated some potential for water production which might include usable water. Water studies are being undertaken by

<sup>4</sup> Hysert, M., "Geologic Characterization of Horseshoe Canyon Coal Seams in Alberta," presented at the CSUG Fifth Annual Unconventional Gas Conference, Calgary, Alberta, October 22-24, 2003.

<sup>5</sup> Bastian, P.A., Wirth, O.F.R., Wang, L., and Voneiff, G.W., "Assessment and Development of the Dry Horseshoe Canyon CBM Play in Canada," paper SPE 96899 presented at the Annual Technical Conference and Exhibition, Dallas, Texas, October 9-12, 2004.

<sup>6</sup> Rodgers, M., "An Update on the Major NGC Plains Plays," CSUG Sixth Annual Unconventional Gas Conference, Calgary, Alberta, November 17-19, 2003.

<sup>7</sup> Mahony, J., "Alberta Set for Record Number of CBM Wells", Nickles Daily Oil Bulletin, Feb 23, 2004

<sup>8</sup> Private correspondence with CDX Canada.

<sup>9</sup> Mahony, J., "Nexen Approves CBM Project, Reports Higher Earnings," Nickles Daily Oil Bulletin, July 14, 2005.

<sup>10</sup> Bulletin 2006-33 "2005 Alberta Coal Bed Methane Activity Summary and Well Locations", Alberta Energy and Utilities Board, September 29, 2006.

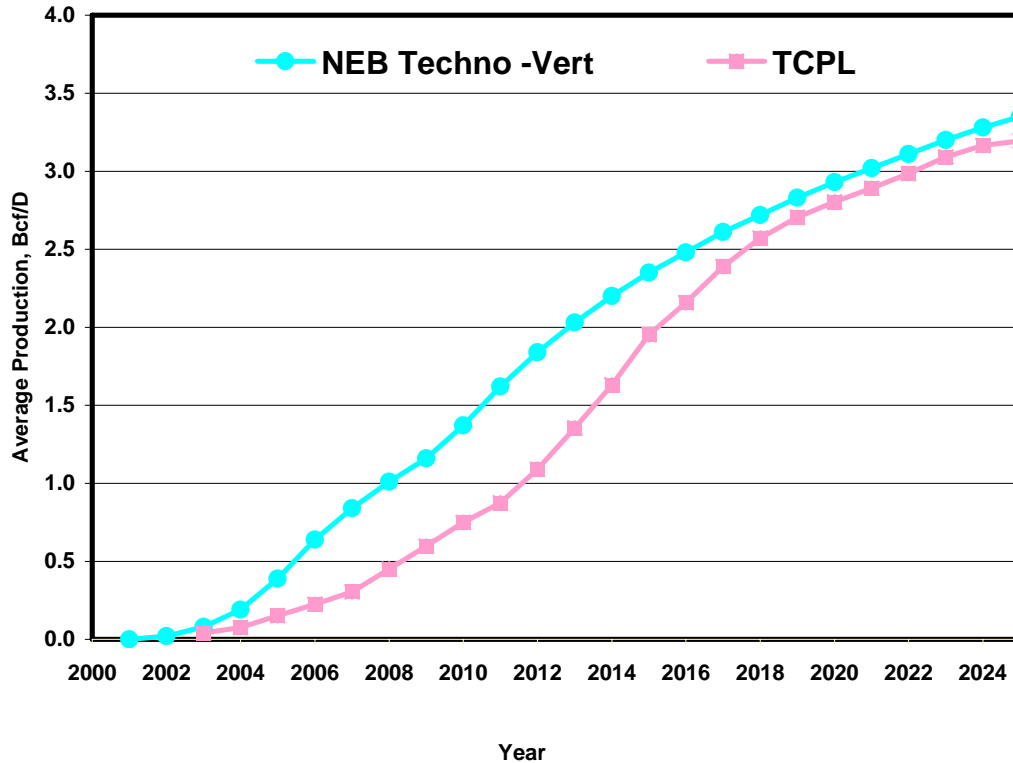
<sup>11</sup> QRCI internal estimate.

<sup>12</sup> "Canada's Energy Future: Scenarios for Supply and Demand to 2025", Canada National Energy Board Report", Calgary 2003.

<sup>13</sup> Internal forecast by TransCanada Pipeline.

government and industry to develop guidelines for efficiently harvesting Ardley CBM, while protecting any usable water that might be associated with this production<sup>14,15</sup>.

**Figure 1.2**  
**Predicted CBM Production in Canada**



Between 2004 and 2006, the Alberta Ministries of Energy and Environment formed a Multi-stakeholder Advisory Committee (MAC) to evaluate the potential impacts of the growing CBM industry in Alberta and to develop new best practices, guidelines, and regulations as necessary to responsibly manage the growth of this resource<sup>14</sup>. A number of important issues were raised and discussed around major topic areas, including water, surface land, air, fiscal, and tenure, and a report was issued in July 2006. Substantive changes have been made in industry practices, including a Best Management Practices guideline by CAPP, and government regulatory requirements,<sup>14,15,16,17,18</sup> many as a result of this MAC process. During this process, several

<sup>14</sup> "Report Provides Blueprint for Responsible Coalbed Methane Development", Alberta Government news release, May 11, 2006 ([www.energy.gov.ab.ca/245.asp](http://www.energy.gov.ab.ca/245.asp)).

<sup>15</sup> "Baseline Testing of Water Wells Now Mandatory Prior to Coalbed Methane Drilling", Alberta Ministry of Environment news release, April 6, 2006.

<sup>16</sup> "Shallow Fracturing Operations-Interim Controls, Restricted Operations, and Technical Review", Alberta EUB Directive 027, January 31, 2006.

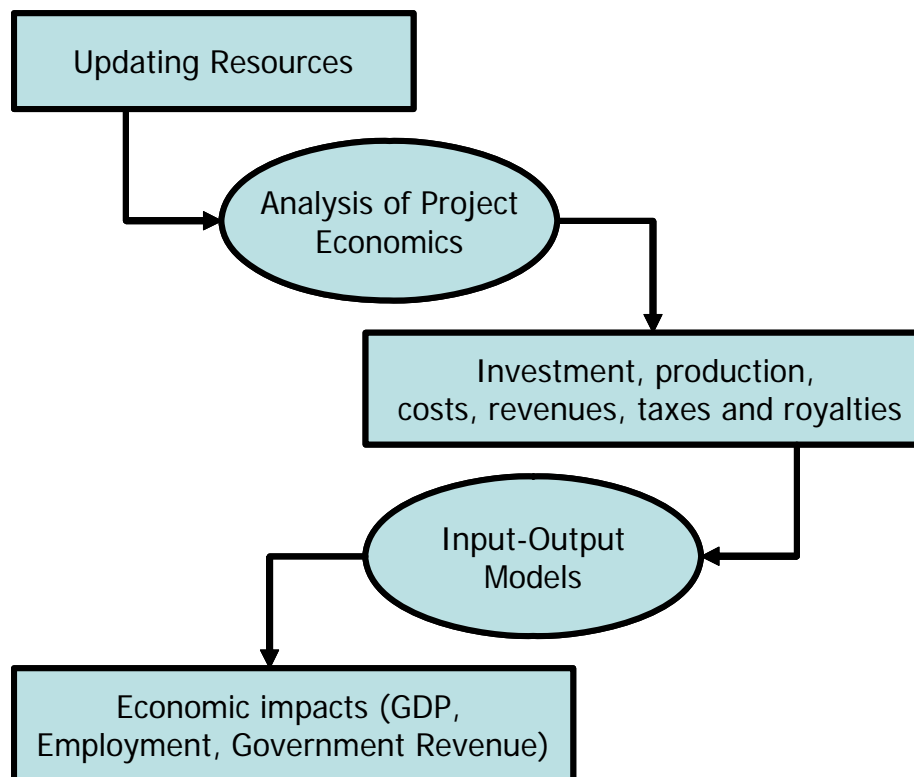
<sup>17</sup> "Well Spacing Amendment Regulation Regarding Changes to Reservoir-Related Well Spacing Regulations, Application Requirements, and Application Review Process", Alberta EUB Bulletin 2006-24 July 7, 2006.

stakeholders identified the need to better quantify the socio-economic benefits of CBM development for use in evaluating and guiding CBM growth responsibly now and in the future. The purpose of this report is to provide such a study for the HC CBM development in Alberta.

#### 1.4 Methodology

Figure 1.3 illustrates the overall approach used to carry out the study. As can be seen from the figure, the first step of the methodology is to update the resource estimates within the project area, meaning that updating of the natural gas reserves in the HC Coal Seam. This is followed by project cost analysis. This includes project feasibility analysis under alternative scenarios. Production volume and values, investment and production costs, royalty, taxes and profit margins are estimated in this step. The annual investment and production costs are then fed into input-output (I-O) models developed by CERI. The I-O models used in this study are the same employed in the CERI study entitled, 'Economic Impacts of Alberta's Oil Sands' released in September 2005. Detailed description of these I-O models will be provided in Chapter 3.

**Figure 1.3**  
**Overall Methodological Approach**



<sup>18</sup> "Changes to the Management of Commingling of Production from Two or More Pools in the Wellbore", Alberta EUB Bulletin 2006-28, August 8, 2006.

The I-O models included are for Alberta, Ontario, Quebec, Rest of Canada and the Rest of the World (or Outside Canada). The economic impact assessment is focused on GDP, employment and government revenue impacts.

### 1.5 Organization of Report

- **Chapter 1** highlights the background of the study and presents the objectives and methodology.
- **Chapter 2** updates of the natural gas resources in the HC Coal Seam. This chapter then presents analysis of project economics under alternative scenarios. Estimations of production volume and values, investment and production costs, royalty, taxes and profit margins are presented and discussed.
- **Chapter 3** presents the overall methodology employed in the study. It includes a discussion of the CERI input-output (I-O) model and techniques employed to measure economic impacts of production and investment activities in the HC coalbed methane project using CERI I-O models.
- **Chapter 4** presents and discusses the economic impacts. The impacts include gross domestic product, employment and government revenues. The results include the direct impacts of the projects, and indirect impacts at the provincial, national and international levels.

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## CHAPTER 2 HORSESHOE CANYON CBM DEVELOPMENT MODEL

In late 2005, the Steering Committee met and developed a plan to generate sufficient technical information on projected future CBM production for CERI to apply their input-output model. As part of this discussion, it was agreed to proceed aggressively with the information available for the HC coals, which were actively being developed, with over 7,300 wells and about 300 MMcf/day of production at year end 2005<sup>10,11</sup>. Representatives from MGV/QRCI were asked to take the lead on the HC effort. Representatives from Trident Exploration and Nexen agreed to investigate the availability of relevant data for the Mannville coals and a representative of Enerplus agreed to investigate the same for the Ardley coals. As mentioned above, at a follow-up meeting in January 2006, the steering committee agreed to focus on the HC coals for this report.

The HC team focused on developing the following deliverables for use by CERI in their socio-economic impact analysis:

- A revised resource assessment for the HC coals
- A map dividing the HC coals into different sub-areas, developable and undevelopable
- Predictive well performance type curves for each sub-area
- Different future development scenarios for the HC play in Alberta
- Estimates of well, facility, and operating cost for use in economic analyses
- Economic analysis of the different development scenarios

Each of these deliverables are discussed in the following sections.

### 2.1 Updated Resource Assessment

Several different estimates of the HC CBM resource in Alberta were available to the steering committee<sup>1,19-22</sup>. The Canadian Natural Gas Potential Committee estimated 139 Tcf in 2000 and provided a revised estimate of 53.6 Tcf in 2005 with a reference case recoverable of 9.1 Tcf and a high case of 11.6 Tcf<sup>19,20</sup>. The Alberta Geologic Survey estimated 66 Tcf in 2002 (including the Belly River coals)<sup>1</sup>. MGV estimated 70 Tcf in 2002, with 13 to 23 Tcf potentially recoverable<sup>21</sup> and Trident estimated 6 to 11 Tcf recoverable in the "trend" area in 2005<sup>22</sup>.

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<sup>19</sup> Canadian Gas Potential Committee, "Natural Gas Potential in Canada", report, 2001.

<sup>20</sup> Canadian Gas Potential Committee, "Natural Gas Potential in Canada", report, 2005

<sup>21</sup> Gatens, J.M., "A Changing Business Model for Canadian Coalbed Methane", MGV Energy Inc presentation to the Conference Board of Canada, Calgary, March 1, 2005.

<sup>22</sup> Trident Exploration website ([www.tridentexploration.ca](http://www.tridentexploration.ca))

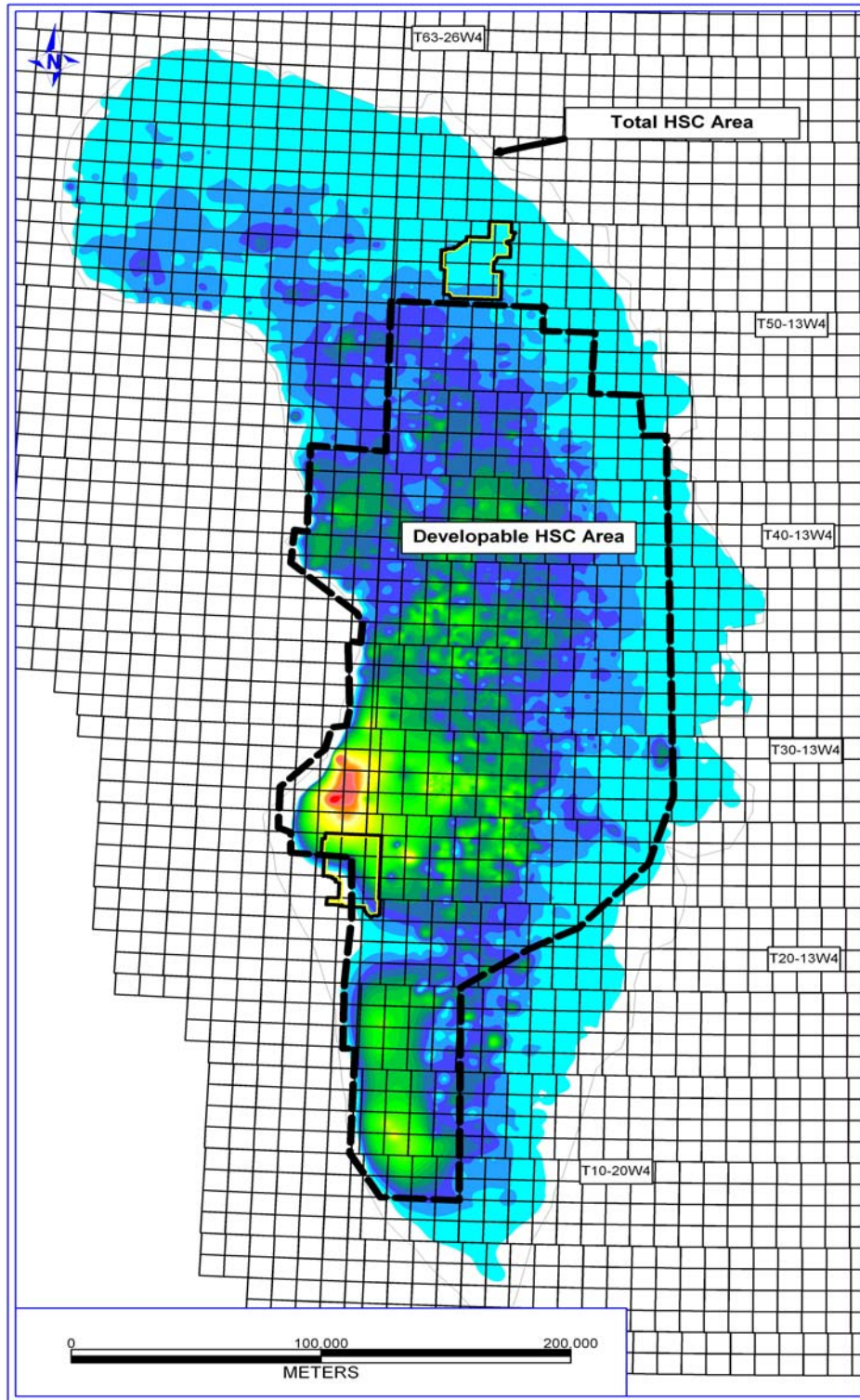
At the direction of the steering committee, MGV used maps of coal thickness originally generated for them by the GSC for the HC and Belly River coals<sup>23</sup> and updated them with the latest data from their internal database, including wells from all operators in the HC trend area. MGV then applied recent estimates of average depth, pore-pressure gradient, adsorbed and free gas in place to develop the gas-in-place map shown in Figure 2.1. The contours in Figure 2.1 represent an estimate of original gas resource in Bcf/section of land. This map indicates the HC coals cover a gross trend area of about 31,854 sections, or about 20.4 million acres, with a total resource of 36.4 Tcf. This resource estimate is much lower than many of the earlier estimates mentioned above, mainly due to the lower reservoir pressure and gas contents encountered over the trend area based on actual modern well data.

The steering committee recommended that only HC areas with gas concentrations of over 0.5 Bcf/section be considered economically developable under current economic conditions. On the basis of that assumption, the “developable” HC trend area is reduced by over half, to about 14,500 sections, or 9.3 million acres with a resource of 30.3 Tcf. This represents the HC resource which is in areas which are deemed to be developable today and which forms the foundation for the performance forecasts presented below.

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<sup>23</sup> Hughes, J.D., “In Situ Assessment of Coalbed Methane Resources in the Alberta Plains Volume I – Unconstrained Case”, Geological Survey of Canada report to MGV Energy Inc., 2001

Figure 2.1  
Horseshoe Canyon Gas-in-Place Map



## 2.2 Predictive Type Curve Development

Upon review of local variations in HC depth, pressure, resource, and observed well performance, the steering committee advised dividing the developable area into appropriate sub-areas for use in developing type curves and predicting future production. As shown in Figures 2.1 and 2.3 and Table 2.1, the developable HC area was divided into eight sub-areas, with resource estimates ranging from 1.2 to 7.0 Tcf. Also shown in Table 2.1 are the average resource per section, depth, and net coal thickness assumed for each sub-area. These values were used by MGV to develop "type" reservoir models for wells in each sub-area for the purposes of predicting future performance under different development scenarios.

**Table 2.1**  
**Resource Estimates and Analysis Assumptions by Sub-Area**

<b>Sub-Area</b>	<b>Sections</b>	<b>Townships</b>	<b>HC Resource (Tcf)</b>	<b>Average Resource (Bcf/sec)</b>	<b>Average Total Well Depth (m)</b>	<b>Average HC Thickness (m)</b>
1	1,496	42	3.9	2.6	1000	2.3
2	1,463	41	4.7	3.2	550	14.2
3	1,057	29	7.0	7.3	900	5.0
4	1,862	52	4.4	2.4	600	9.1
5	1,932	54	3.0	1.6	350	12.6
6	744	21	1.2	1.8	700	2.9
7	1,673	47	2.2	1.3	400	7.7
8	4,269	119	2.7	0.6	250	7.7

MGV had previously developed a composite reservoir modeling approach to analyzing and predicted HC well performance with a coalbed methane numerical simulator, which uses five different layers from the top to the bottom of the gross HC completion interval<sup>6,21</sup>. General predictions of HC well performance had been generated by MGV and presented at industry meetings using this approach as shown in Figure 2.2<sup>21</sup>. MGV had also matched well performance of typical wells in each of the eight sub-areas to estimate the average permeability and stimulation effectiveness which would yield rate vs. time estimates similar to what has been observed in the field. Public domain data indicate a wide range of actual HC well rates, from about 500 Mcf/day to less than 50 Mcf/day, depending upon area, operator, geologic characteristics, coal and sand zones commingled, and operating constraints, although 100

Mcf/day/well is more representative of the whole. The steering committee authorized MGV to apply this methodology to distribute the gas in place over 5 different layers while honoring the volumetric assumptions in Figure 2.1 and Table 2.1.

**Figure 2.2**  
**Example of Horseshoe Canyon Well Production Forecasts**

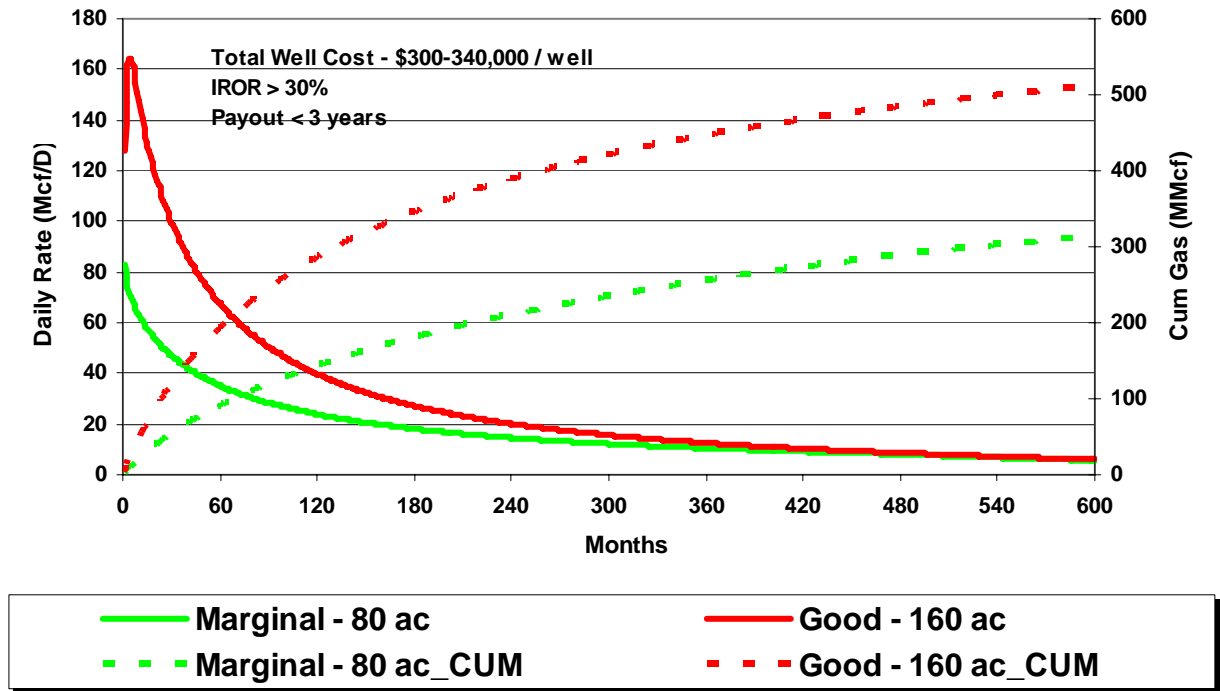
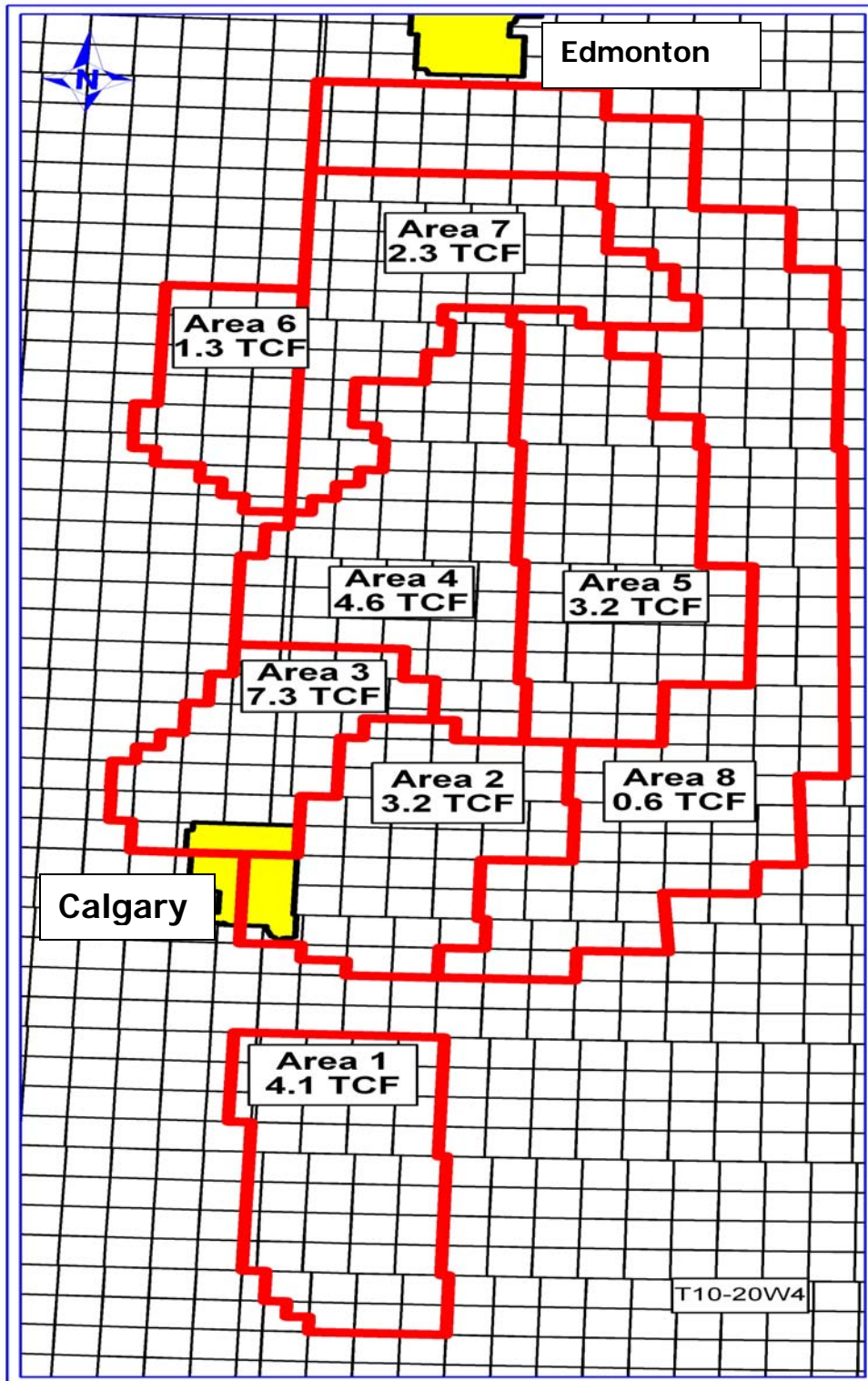


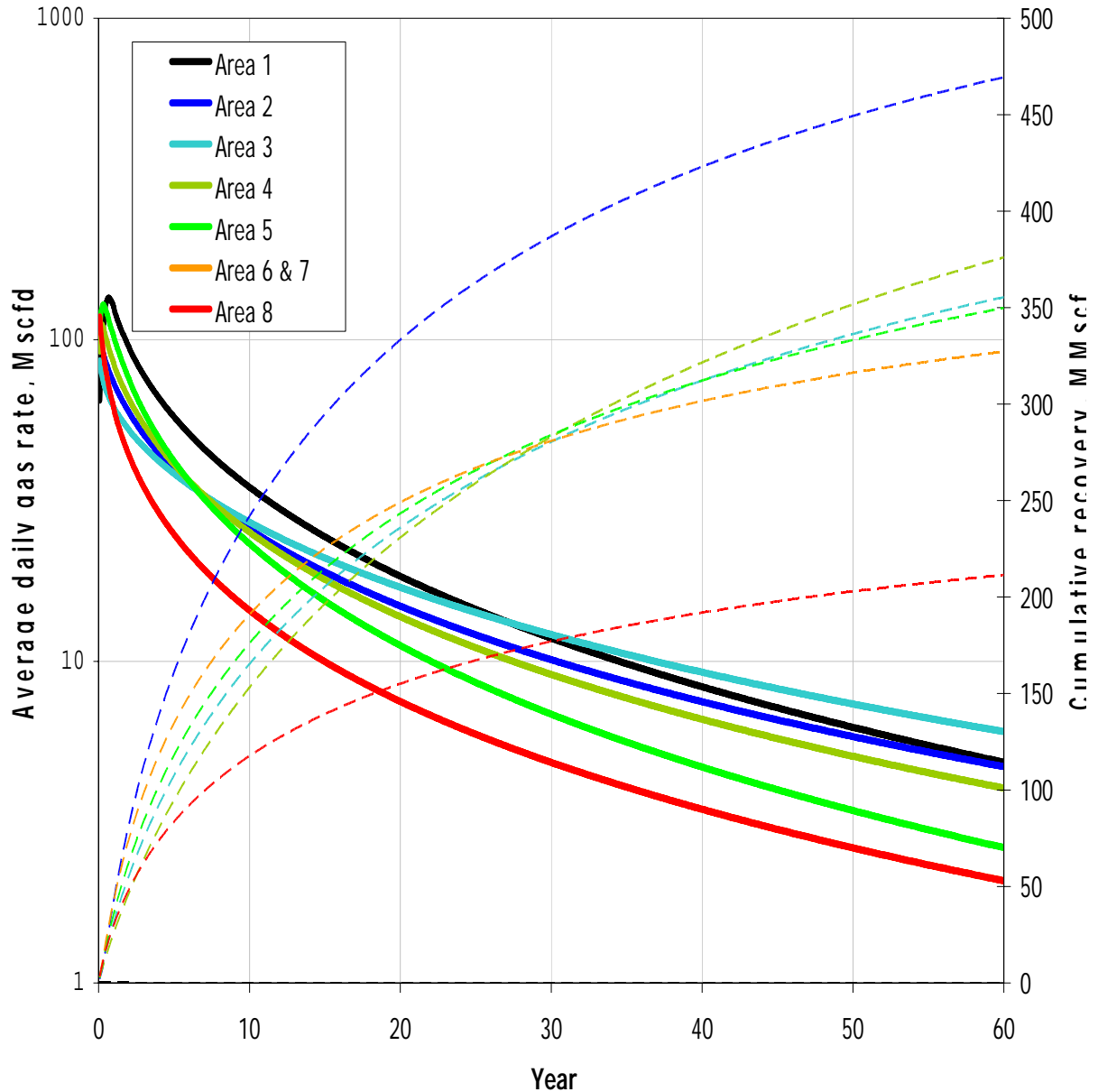
Figure 2.3  
Horseshoe Canyon Development Sub-Areas



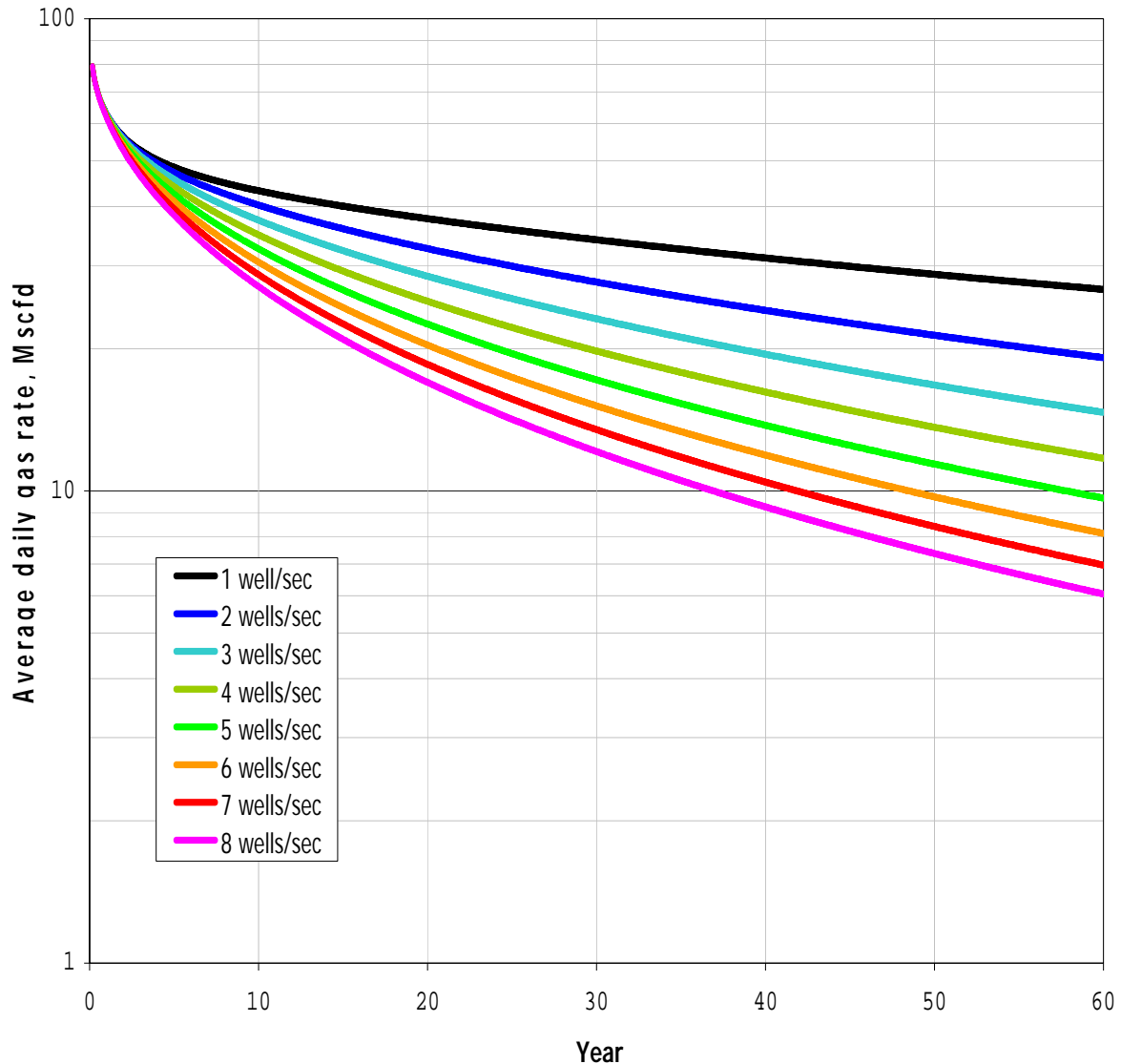
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Figures 2.4 and 2.5 are examples of the resulting type curves. In Figure 2.4, rate and cumulative production vs. time plots are shown for each sub-area with an assumed optimal well spacing for each sub-area. These examples result in initial rates of 70 to 180 Mcf/day/well and cumulative recoveries of 211 to 470 MMcf/well over 60 years of producing life. Figure 2.5 shows the impact of varying well spacing from 1 to 8 wells per section on typical well rates in sub-area 3.

**Figure 2.4**  
**Predicted Production Rate and Cumulative Recovery for Type Wells in each Sub-Area**



**Figure 2.5**  
**Impact of Well Spacing on Well Rates in Sub-Area 3**



On the basis of this approach, and the experience of various operators on the steering committee, MGV was directed to assume a single optimal well spacing for the ultimate development of each sub-area as shown in Table 2.1 rather than perform a more detailed area-by-area well spacing optimization for different assumed economic inputs. On this basis, the shallower wells with higher permeability are developed at one to two wells per section and the deeper, higher resource wells are on four to eight wells per section.

The type curves developed as described above were used to generate the performance forecasts presented in this report.

### 2.3 Economic Analysis Assumptions and Methodology

The steering committee reviewed a number of economic analysis assumptions presented by MGV and, after discussion, developed some consensus guidelines for use by CERI in their socio-economic analysis. These assumptions were varied by sub-area to account for differences in well depth and well spacing on well and gathering system costs. The basic assumptions are listed in Table 2.2. The costs to drill and complete a well varied from \$170,000 to \$225,000, depending on depth and assuming nitrogen stimulation treatments. Gathering and tie-in costs varied from \$78,000 to \$195,000 per well depending on well spacing, with higher well costs with fewer wells per section. Compression facility costs were \$3,750,000 for the first 5 MMcf/day of production in a development area. An additional \$1,900,000 to \$2,400,000 was added for each incremental 5 MMcf/day in a development area as necessary, depending upon the development pace and total production. Central compression was assumed with one facility per township as a general rule.

**Table 2.2**  
**Economic Analysis Assumptions**

<b>Parameter</b>	<b>Value</b>
Drill + Complete Capital per well	\$170 – 225,000
Gathering & Tie-in Capital per well	\$78 – 195,000
Compression - first 5 MMcf/day	\$3.75 million
Compression - each incr. 5 MMcf/day	\$1.9 - 2.4 million
Operating Costs - Fixed (\$/well/mo)	\$675
Operating Costs - Variable (\$/mcf)	\$0.20
Probability of Success	100%
Portion of HSC lands developable	95%

**Table 2.3  
Crown/Freehold Royalty Assumptions**

<b>Area</b>	<b>Sections</b>	<b>% Crown</b>	<b>% FH</b>	<b>Avg FH Royalty %*</b>
1	1,496	50%	50%	19.8%
2	1,463	15%	85%	6.5%
3	1,057	42%	58%	17.9%
4	1,862	57%	43%	17.6%
5	1,932	68%	32%	15.9%
6	744	60%	40%	14.5%
7	1,673	52%	48%	17.7%
8	4,269	48%	52%	12.2%
<b>Total</b>	<b>14,496</b>	<b>49%</b>	<b>51%</b>	<b>14.8%</b>

\* FH Royalty % varies based on estimated portion of FH lands that will be developed by the FH mineral owner.

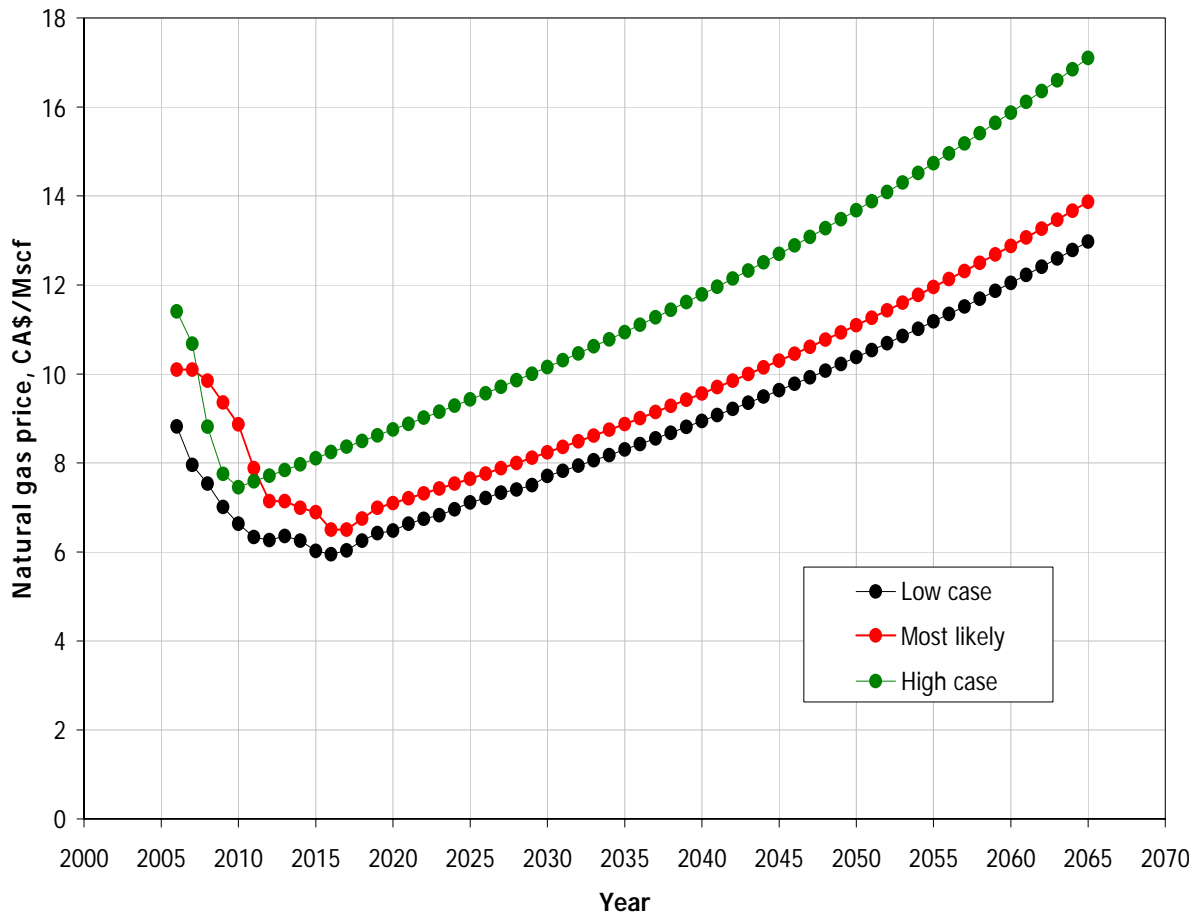
Operating well costs were assumed to be a fixed cost of \$675/well/month and a variable cost of \$0.20/Mcf. In each developable sub-area, the steering committee directed MGCV to assume that 95 percent of the developable land could actually be accessed. Ownership was also directed to be distributed into Crown and freehold royalty as shown in Table 2.3. Three gas price forecasts were used in our analysis: high, medium, and low, as shown in Figure 2.6 and were provided by CERI<sup>24</sup>. We also assumed maximum wells drilled per year to be 5,000/yr, 3,500/year, or 2,500/year. According to the EUB, about 4,189 wells were drilled in Alberta in 2005<sup>10</sup>. We also assumed that about 5,600 HC CBM wells were drilled prior to the start of the forecast, with about 2,500 tied on and producing as of January 2006 with a cumulative production of about 95 Bcf and 3,100 wells soon to be added to production.

These economic analysis assumptions were used to evaluate the different scenarios presented in the following section on the basis of estimates made in late 2005 and early 2006. The actual costs being realized in the HC industry in late 2006 are higher than the assumptions used in this report.

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<sup>24</sup> CERI Price Assumption

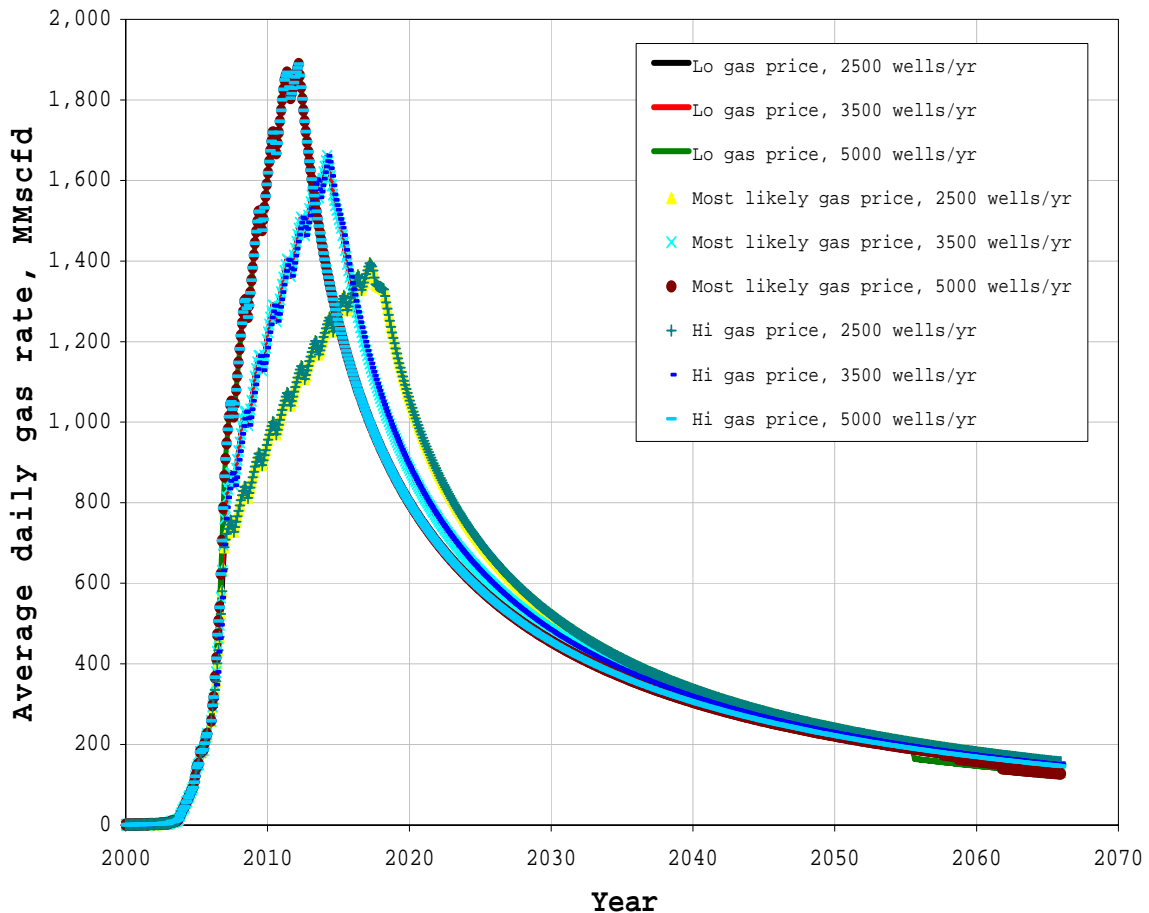
Figure 2.6  
Gas Price Forecasts



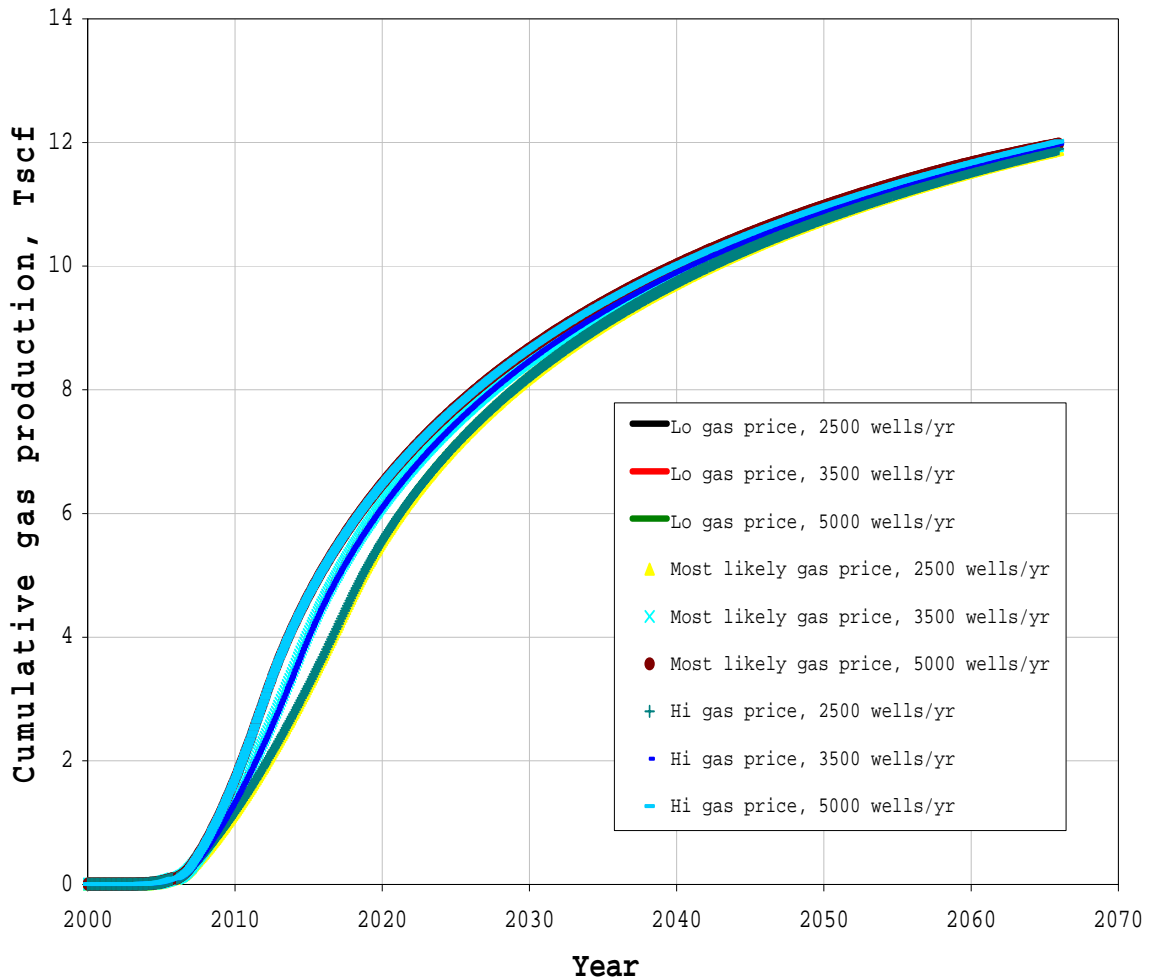
## 2.4 Horseshoe Canyon Development Scenarios

In discussion with CERI, MGV was directed to develop nine different development scenarios for each combination of gas price assumption (high, medium, and low shown in Figure 2.6) and maximum wells drilled per year (5,000, 3,500, or 2,500). These nine different scenarios resulted in the nine different production forecasts shown in Figures 2.7 and 2.8. As shown in Figure 2.7, predicted gross HC CBM rates are 1.4 to 1.9 Bcf/day, occurring between 2011 and 2017, depending upon the pace of development. These volumes are gross produced volumes, before shrinkage and royalties. The numbers used to generate the project economics to the producing companies (working interest owners) are reduced by a shrinkage of about 5 percent and royalty interests as shown in Table 2.4. Sustained long-term rates are as high as 185 MMcf/day as far into the future as 2050 with economic production extending beyond 2060. As shown in Figure 2.8, gross HC CBM recovery is estimated at about 12 Tcf from about 35,000 wells, or about 40 percent of the developable gas in place. This also corresponds to an average recovery of about 314 MMcf/well.

**Figure 2.7**  
**Gross Predicted Production Rate for Nine Forecast Cases**



**Figure 2.8**  
**Gross Predictive Cumulative Recovery for Nine Forecast Cases**



## 2.5 Economic Analysis Results

CERI asked MGV to run each of the nine development scenarios through their economical analysis model to provide further input to the CERI socio-economic impact model. A summary of the economic outcomes for each scenario is presented in Table 2.4. Capital expenditures for the HC programs total about \$9 billion dollars and result in a net present value (at 10 percent discount factor) of \$10-17 billion and a project rate of return of 41-70 percent. Net production (reserves) to the operators is 9.9 Tcf, with about 0.8 Tcf consumed as fuel gas and 1.2 Tcf going to the royalty owners, mostly the Crown or freehold mineral owners. From a producer's perspective, these projected economic analysis results are attractive and support the actual HC development activity that is currently ongoing in Alberta. Likewise, the monies spent in Alberta by the producers and royalty revenues generated (\$3.3-4.4 billion) mostly received by the provincial government, are also attractive to the provincial economy. Clearly, there is great incentive for the Crown, industry, and all stakeholders to see that this vast potential can be achieved in an

environmentally responsible fashion going forward. In the next section, CERI applies its socio-economic impact model to assess the potential impacts to Albertans and Canadians more broadly, which is the primary objective of this report.

**Table 2.4  
Economic Analysis Results Summary**

Case #	1	2	3	4	5	6	7	8	9
Price Case	Low	Low	Low	ML	ML	ML	High	High	High
Wells/yr	5000	3500	2500	5000	3500	2500	5000	3500	2500
Raw Gas (Tcf)	11.85	11.83	11.78	11.89	11.88	11.81	11.94	11.90	11.82
Fuel Gas (Tcf)	0.77	0.77	0.77	0.77	0.77	0.77	0.78	0.77	0.77
Sales Gas (Tcf)	11.08	11.06	11.01	11.12	11.11	11.04	11.16	11.13	11.05
Royalty Gas (Tcf)	1.22	1.22	1.22	1.23	1.23	1.22	1.23	1.23	1.22
Reserves (Tcf)	9.85	9.84	9.79	9.89	9.88	9.82	9.93	9.90	9.83
PV10 (\$B)	\$11.82	\$10.96	\$10.12	\$16.37	\$14.84	\$13.43	\$17.45	\$16.39	\$15.25
ROR	43.10%	42.03%	41.30%	69.70%	67.90%	66.76%	64.20%	63.20%	62.45%
Royalties (\$B)	\$2.61	\$2.59	\$2.59	\$3.09	\$3.04	\$3.00	\$3.45	\$3.46	\$3.49
Mineral Tax (\$B)	\$0.73	\$0.72	\$0.72	\$0.84	\$0.83	\$0.82	\$0.94	\$0.94	\$0.95
Total Paid (\$B)	\$3.33	\$3.32	\$3.32	\$3.94	\$3.87	\$3.82	\$4.39	\$4.41	\$4.44
Capital (\$B)	\$9.03	\$9.02	\$8.98	\$9.03	\$9.02	\$8.98	\$9.03	\$9.02	\$8.98

### CHAPTER 3 METHODOLOGY

The modeling approach used in this study is the same used in the previous study entitled “Economic Impacts of Alberta’s Oil Sands” released by CERI in September 2005. In this section, we present the overall modeling framework followed by the description of CERI I-O models.

#### 3.1 Overall Modeling Framework

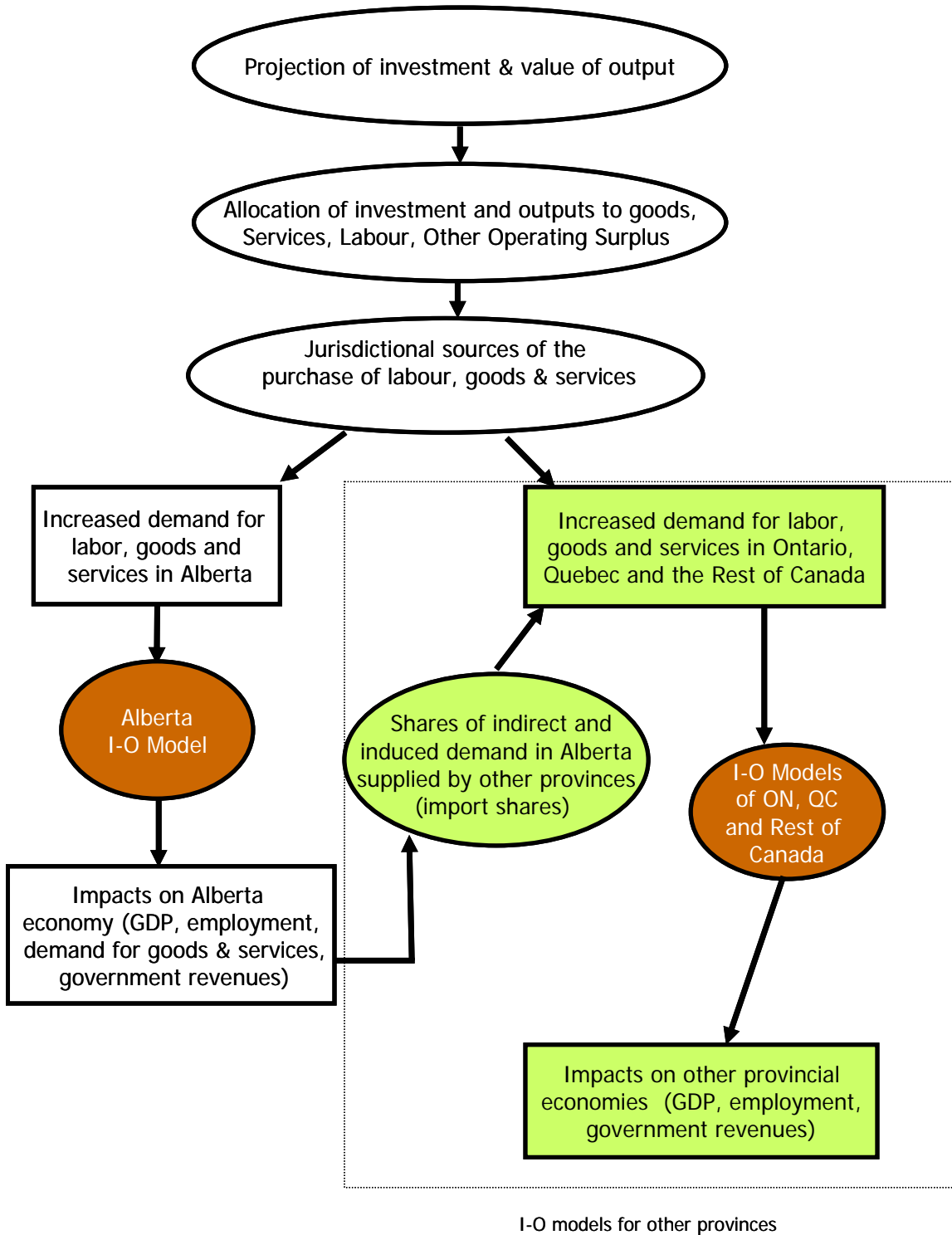
Any activity that led to an increase in production capacity in an economy has two components: construction or development of the capacity and operation (or utilization) of the capacity to generate outputs. The first component is referred to as investment and the second as production. Both activities affect the economy through purchases of goods/services and labour. Figure 3.1 illustrates the approach used to assess economic impacts resulting from these activities. As can be seen from the figure, the first step is to estimate and forecast the value of investment (i.e., construction or development expenditures) and production (sales). The total investment or development expenditures are then disaggregated into the purchases of various goods and services (e.g., manufacturing, fuel, business service, etc.) and labour using the expenditure shares. The expenditure shares for the construction sector, conventional oil production sector, refinery sector and the petrochemical sectors are presented later in this chapter. Similar to the treatment of investment or development expenditure, the value of total production (or output or sales) from a production activity (e.g., conventional oil production, petroleum refinery, etc.) is allocated to the purchase of goods and services, payment to labour, payment to government (e.g., royalty and taxes) and other operating surplus (profits, depreciation etc.).

Briefly, the value of the investment and the revenue generated from produced gas is broken down into labour, goods and services. These elements are further broken down regionally into ones supplied from within Alberta, outside Alberta (but within Canada) and outside Canada.

The shares across goods and services and labour combined with the forecasted values of investment and production are then used to estimate demand for the various goods and services and labour used in both development and production activities. These demands are met through two sources: (i) domestic production, and (ii) imports. Domestic contents of the goods and services are calculated using Statistics Canada data.

Inter-provincial trade tables published by Statistics Canada are used to derive import shares for each type of good and service considered in the model for Ontario, Quebec, the rest of Canada and abroad. These shares, here, are termed as ‘import shares’ and they are taken from the previous CERI study – Economic Impacts of Alberta’s Oil Sands. The value of goods and services produced in Ontario, Quebec and the rest of Canada required by an Alberta industry is calculated using the import shares. The economic impacts of the production of these goods and services in Ontario, Quebec and the rest of Canada are calculated in the manner similar to the process followed for Alberta.

**Figure 3.1**  
**Overall Modelling Approach**



### 3.2 CERI I-O Models

The CERI I-O model is based on national and provincial I-O tables produced by Statistics Canada<sup>25</sup>. The Statistics Canada I-O structure consists of three tables (or matrices): (i) "Make" or "Output" matrix, (ii) "Use" or "Input" matrix, and (iii) "Final Demand" matrix. The Make matrix presents production of commodities (row) by various industries (column). The Use matrix presents consumption or use of commodities (row) by various industries (column). The Final Demand matrix presents consumption or use of commodities (row) by various final demand sectors (column), such as household, government, investment, trade, and inventory. The CERI I-O model database combines these three matrices and data from national and provincial accounts to form national and provincial social accounting matrices.

The Statistics Canada I-O tables presented in Catalogue No. 15-201 have 47 commodities (goods and services) and 25 industries. One of the key limitations of these tables is that a detailed breakdown for the oil and gas sector is not available. All energy commodities (e.g., coal, crude oil, natural gas) are lumped together as a single 'mineral fuel' and all energy industries (e.g., coal production, coal mining, gas production) are embedded into a single 'mining and oil & gas extraction' industry.

A key feature of the CERI I-O model is that the mineral fuel commodities in the Statistics Canada I-O table are split into coal, natural gas and crude oil, which include crude bitumen and SCO from oil sands industry. Similarly the 'mining and oil & gas industry' category is broken down into four industries: (i) coal mining, (ii) oil production, (iii) natural gas production, and (iv) other mining (i.e., metal and non-metal mining except coal and bitumen mining). Services incidental to mining is also allocated to these individual energy sectors and the other mining sector. Coalbed methane is part of natural gas industry. Moreover, the utility sector is disaggregated into electric, gas and water utility. While electric and gas utilities are separately presented, water utility is lumped together with other services. A wide range of data including: production, consumption, energy commodity prices, sectoral GDP, and gross outputs (or total sales value) are required to segment the aggregated energy commodities (i.e., mineral fuels and utility services) and industries (i.e., mining, oil & gas industry and utility industry). These data are collected from various sources such as Statistics Canada, the Canadian Association of Petroleum Producers (CAPP), the Alberta Energy and Utilities Board (AEUB) and Natural Resources Canada. The Statistics Canada I-O table presents a very detailed disaggregation of some sectors such as service sectors. Such a detailed disaggregation of this sector is not necessary for energy and environmental policy analysis, as this sector is a less energy intensive sector. Hence, the CERI I-O model represents the service activities through a few sectors such as business services, other services, etc.

The CERI I-O model contains only one manufacturing sector as a result of the primary data source, Statistics Canada's, presenting only one manufacturing sector<sup>25</sup>. Representing all

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<sup>25</sup> The Input-Output Structure of the Canadian Economy, 1999-2000, Catalogue No. 15-201-XIE, Statistics Canada, July 2004.

manufacturing activities through a single manufacturing industry greatly limits the capability of the model in dealing with industry sector demand side policy analysis. Nevertheless, this limitation does not affect the ability to assess the economic impacts of coalbed methane industry.

After incorporating the aggregation and disaggregation as mentioned above, the CERI I-O model incorporates a 19 sector square transaction table as presented in Table 3.1.

**Table 3.1**  
**Sectors/Commodities in CERI I-O Model**

<b>Serial No.</b>	<b>Sector or Commodity</b>	<b>Examples of activities under the sector or commodity</b>
1	Agriculture	Farming of wheat, corn, rice, soybean, tobacco, cotton, hay, vegetables and fruits; greenhouse, nursery, and floriculture production; cattle ranching and farming; dairy, egg and meat production; fishing, hunting and trapping
2	Forestry	Timber tract operations; Forest nurseries and gathering of forest products; Logging.
3	Other Mining	Mining of iron, gold and silver ores; copper, nickel, lead, and zinc mining; sand, gravel, clay, ceramic, limestone and granite mining; potash, soda, borate and phosphate mining.
4	Crude Oil	Conventional oil, oil sands and service incidental to conventional oil and oil sands
5	Natural Gas	Natural gas and service incidental to natural gas including coal bed methane activities
6	Coal	Coal and service incidental to coal mining
7	Manufacturing	Food, beverage and tobacco; textile and apparel; leather and footwear; rubber and plastics; furniture and fixtures; pulp and paper; petroleum refinery; drugs, chemicals and fertilizer; lime, glass, clay and cement; iron, aluminum and other metals; fabricated metal, machinery and equipment, electrical, electronic and transportation equipment
8	Construction	Construction of residential, commercial and industrial buildings; Highway, street and bridge; gas and oil pipelines; water and sewer system; power and communication lines
9	Transportation & Communication	Road, rail, air and water transportation services; postal and warehousing; information and communication
10	Electricity Utility	Electric power generation, transmission and distribution
11	Gas Utility	Natural gas distribution
12	Wholesale	Wholesale activities
13	Retail	Retail activities
14	Finance, Insurance & Real Estate	Banking, insurance and credit companies; Real estate, renting and leasing
15	Business Services	Architectural, engineering, and related services; legal and accounting services; Management, environmental, research and development and advertising services; Employment and business support services
16	Education	Educational services; business schools and training
17	Health	Hospitals; nursing and residential care facilities; medical laboratories; child and senior care services
18	Food and Accommodation Service	Hotels; Recreational vehicle (RV) parks and recreational camps; food services and drinking places
19	Other Services	Public administration; arts, entertainment, and recreation; personal and laundry services; repair and maintenance services; waste management and remediation services; water and sewage systems

As is the case for standard I-O models, the impact of the coalbed methane industry is calculated by modelling the relationship between output and final demand as follows:

$$\Delta GO = [I - DNB]^{-1} \times DN\Delta F$$

Where:

$\Delta GO$	Change (or increase) in gross output due to construction and operation of the coalbed methane projects.
I	Identity matrix, a matrix with 1 for diagonal elements and zero for the rest.
B	The input coefficient matrix. An element of this matrix is derived dividing the value of a commodity used in a sector by the total output of that sector. The element represents requirements of a commodity in a sector to produce one unit of output from that sector.
N	Matrix of domestic shares in the total supply of a commodity. This matrix converts the input coefficient matrix [B] to an input coefficient matrix of domestically produced goods and services [NB].
D	Matrix of sectoral shares in the total commodity production; an element of this matrix is derived by dividing production of a commodity from a sector to the total production of that commodity in the economy. It represents the fraction of a commodity produced by a sector. This matrix is used to convert delivery of a commodity to delivery of a sectoral output <sup>26</sup> .
$\Delta F$	Change (or increase) in final demand of a commodity or commodity directly demanded (or purchased) for the construction & development of the coalbed methane projects and productions of bitumen and SCO from the new projects in the HC CBM play.

Once the impact on output (change in output) is calculated using the relationship mentioned above, the calculations of impacts on GDP, household income, and employment, are straightforward. These impacts are estimated at the industry level using the ratio of each (i.e., GDP, household) to gross output.

Investment and production data is discussed in more detail in the following sections.

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<sup>26</sup> Since the scope of the study is to assess economic impacts at the sectoral (or industry) level, an industry by industry requirement matrix is needed. An element of  $DNB_{ij}$  matrix represents demand for a good/service domestically produced by an industry i in order to produce one unit of output from industry j.

## CHAPTER 4 ANALYSIS OF SOCIO-ECONOMIC IMPACTS

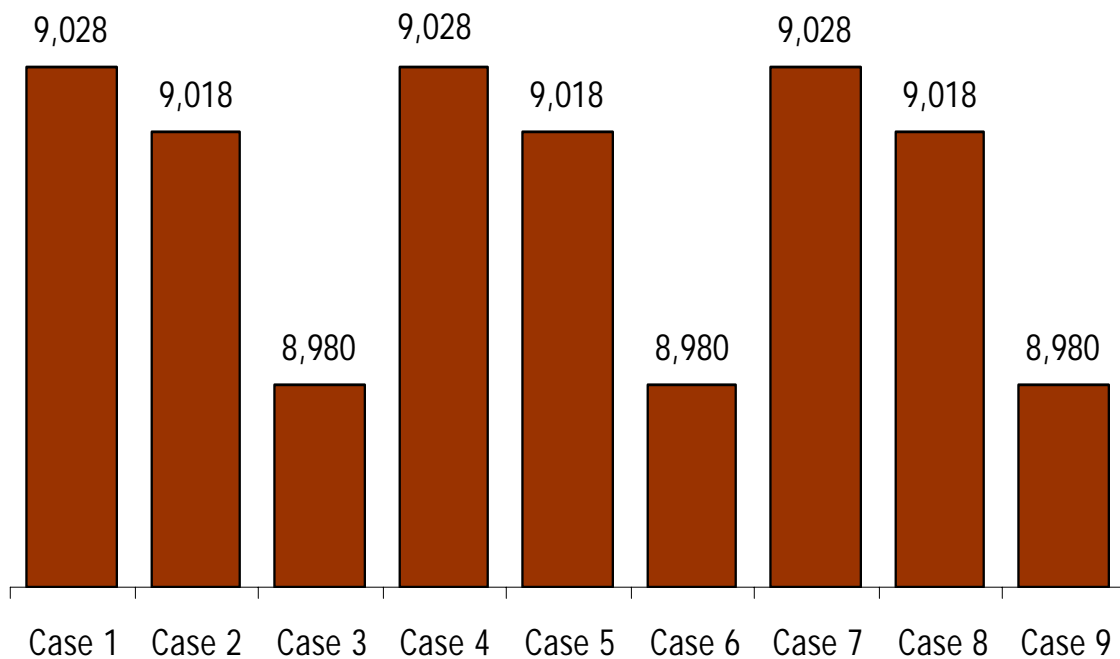
This Chapter presents and discusses the socio-economic impacts directly and indirectly resulting from the development of HC CBM play and natural gas production from the play. The socio-economic impacts included in this study are gross domestic products (GDP), employment and the tax and royalty revenues. These impacts are calculated by running the CERI I-O models. The impacts are measured at three levels: provincial, national and global. We first discuss impacts on GDP, followed by impacts on employment and revenues. Before discussing the economic impacts it would also be relevant to present the investment planned for the HC CBM play and revenue generated through the sale of natural gas that will be produced from the play. The investment and gas revenue are the impacts directly coming out of the play and hence also referred to as "direct impact" of the Horseshoe Canyon CBM play.

#### 4.1 The Direct Impact

Figure 4.1 illustrates cumulative investments in the Horseshoe Canyon CBM play planned for the 2006-2017 period. The cumulative investment varies from \$8.98 billion to \$9.03 billion depending upon the number of wells drilled. The cumulative investment would be \$8.98 billion if 2,500 wells were drilled per year (Cases 3, 6, 9). The investment would be \$9.02 billion and \$9.03 billion if the number of drilled wells were 3,500, and 5,000 per year, respectively. Since we assumed no effect of gas price on number of drilling wells, investments are the same for Cases 1, 4 and 7; similarly for Cases 2, 5 and 8 and so on. The rate of drilling is varied between the cases, along with the gas price, but the total number of wells drilled is approximately the same for all the cases

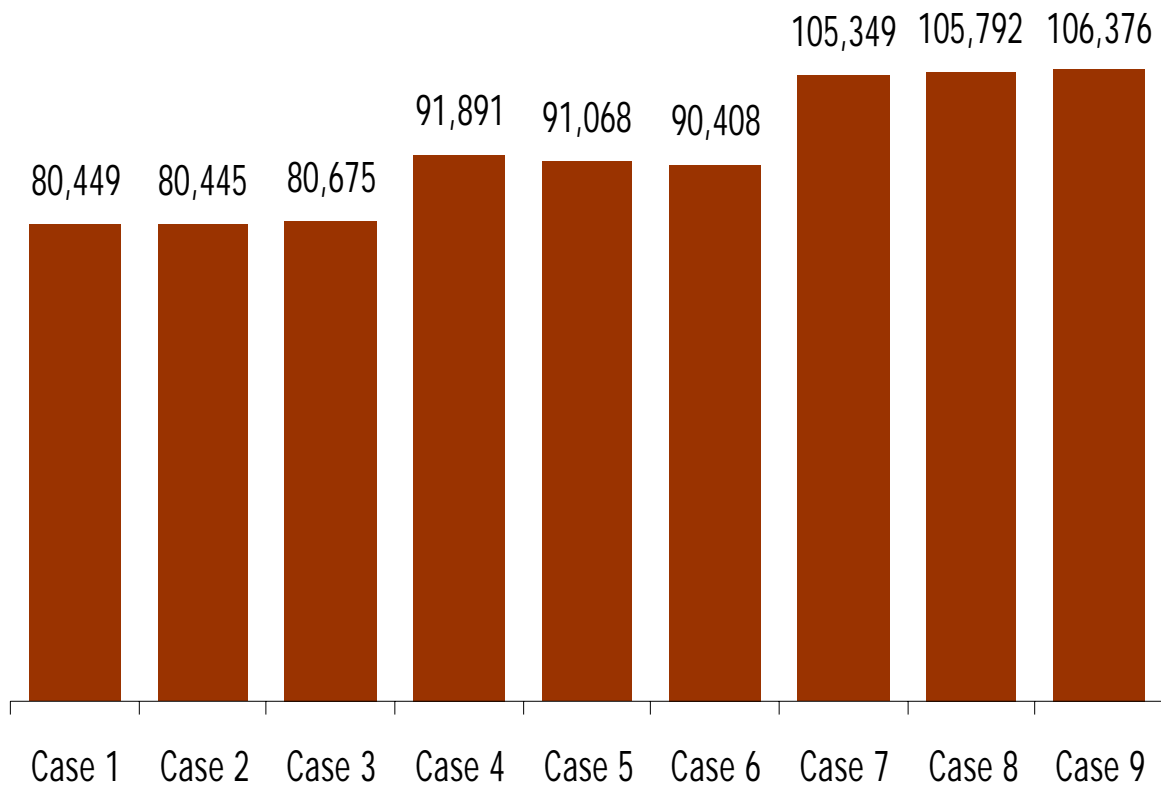
It could be interesting to compare the investments planned for the Horseshoe Canyon CBM play with that for oil sands development during the 2000 to 2020 time frame. According to the CERl study "Economic Impacts of Alberta's Oil Sands" released in September 2005, the oil sands industry is expecting to invest about \$100 billion during the 2000 to 2020 period. This means, the investment in the Horseshoe Canyon CBM play over 12 years, from 2006 to 2017, equals 10 percent of the total investment expected in the oil sands industry over 21 years, from 2000 to 2020.

**Figure 4.1**  
**Cumulative (2006-2017) Investment in Horseshoe Canyon CBM Play**  
**(Million 2004\$)**



The CBM wells planned to be drilled during the 2006-2017 period with the investments of \$8.98 billion to \$9.03 billion in Horseshoe Canyon CBM play are expected to produce natural gas until the year 2064. The cumulative value (i.e., sales revenue) of natural gas during the 2006-2064 period would vary from \$80.5 billion to 106.4 billion (see Figure 4.2) depending upon gas price. If 5,000 wells per year were drilled, and a "Low case" for natural gas (2004 constant dollar), the value of natural gas output from the HC CBM play during the 2000 to 2064 period would be \$80.45 billion (Case 1). On the other hand, if the natural gas price were to follow the "High case" path and 5,000 wells were to be drilled per year, the value of natural gas output would reach \$105.3 billion (Case 7).

**Figure 4.2**  
**Cumulative (2006-2064) Value of Natural Gas Production from the Horseshoe Canyon CBM Play (Million 2004\$)**



The CERI oil sands study "Economic Impacts of Alberta's Oil Sands" estimates that the oil sands industry would produce \$531 billion value of output at US\$32/bbl crude oil price. By comparison, the Horseshoe Canyon CBM play could produce 17 percent to 22 percent of the total monetary output that the oil sands industry is expected to produce during the 2000 to 2020 period. Note however, that the output from the Horseshoe Canyon CBM play considered in this study is for 59 years (2006-2064), whereas output value of the oil sands industry considered in the earlier CERI study was for 21 years (2000 to 2020)<sup>27</sup>. Care should be taken while comparing these two sets of numbers.

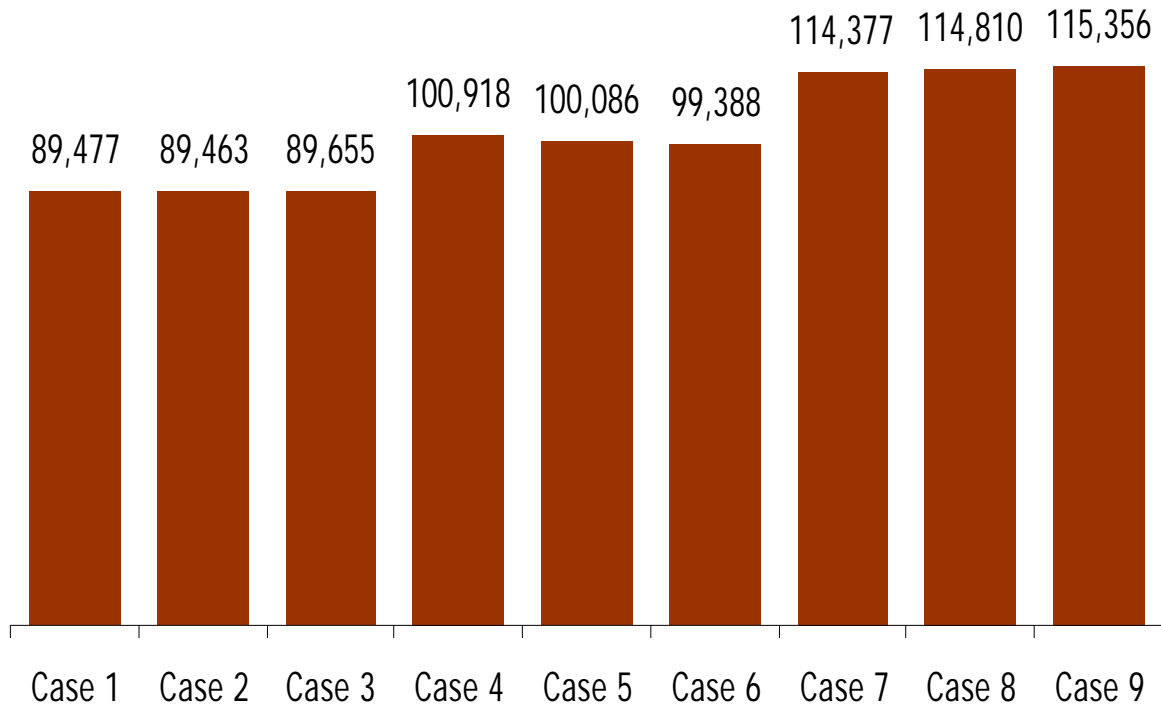
Another significant difference between the oil sands and the HC CBM development is the size of the geographical area being impacted. The oil sands are being developed in a relatively small area, with comparatively intense activity in the Ft. McMurray region. The HC development covers a much larger area, over 15,000 square miles, from south of Calgary to Edmonton in south central Alberta (see Figure 2.1). The intensity of this HC development is similar to that of the earlier shallow gas development in southeast Alberta, with more than 1 well per section. This is much less intense than oil sands, but in many cases, more than was previously experienced for conventional gas development in the affected region. As a result, stakeholders in this large development area are often unaccustomed to this type and level of activity and significant stakeholder interest and involvement is accompanying this development<sup>14</sup>.

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<sup>27</sup> It does not, however, mean that natural gas production from Horseshoe Canyon Coal Formation lasts only for 59 years. It could last more but this study has considered only 59 years. Similarly, bitumen production from Alberta's oil sands will continue way beyond 2020, but the CERI study analyzed impacts of production until 2020.

The investment and production activities together would produce economic outputs of the values varying from \$89.5 billion to \$115.4 billion depending upon the number of wells drilled per year and natural gas prices (see Figure 4.3). Hence the size of direct economic impacts of the HC CBM play ranges from \$89.5 billion to \$115.4 billion. Compared to the oil sands industry's direct impacts, these numbers represent 14 percent to 18 percent depending upon the number of wells drilled per year and natural gas prices.

**Figure 4.3**  
**Cumulative (2006-2064) Value of Investment and Natural Gas Production from the**  
**Horseshoe Canyon CBM Play**  
**(Million 2004\$)**



## 4.2 Total Impacts

In this section we present and analyze total impacts that would arise from the investment and production activities in the HC CBM play. The total impact consists of the following three components:

**Direct impacts:** the impacts directly related to the investment and production activities. These are represented by the investment and value of natural gas sale discussed above.

**Indirect impacts:** corresponds to those impacts created through other industries while supplying goods and services needed to support the CBM investment and production in the HC CBM play. These impacts, for example, include increased production of pipes, cements, and chemicals to meet the demand for these materials in the horseshoe canyon play.

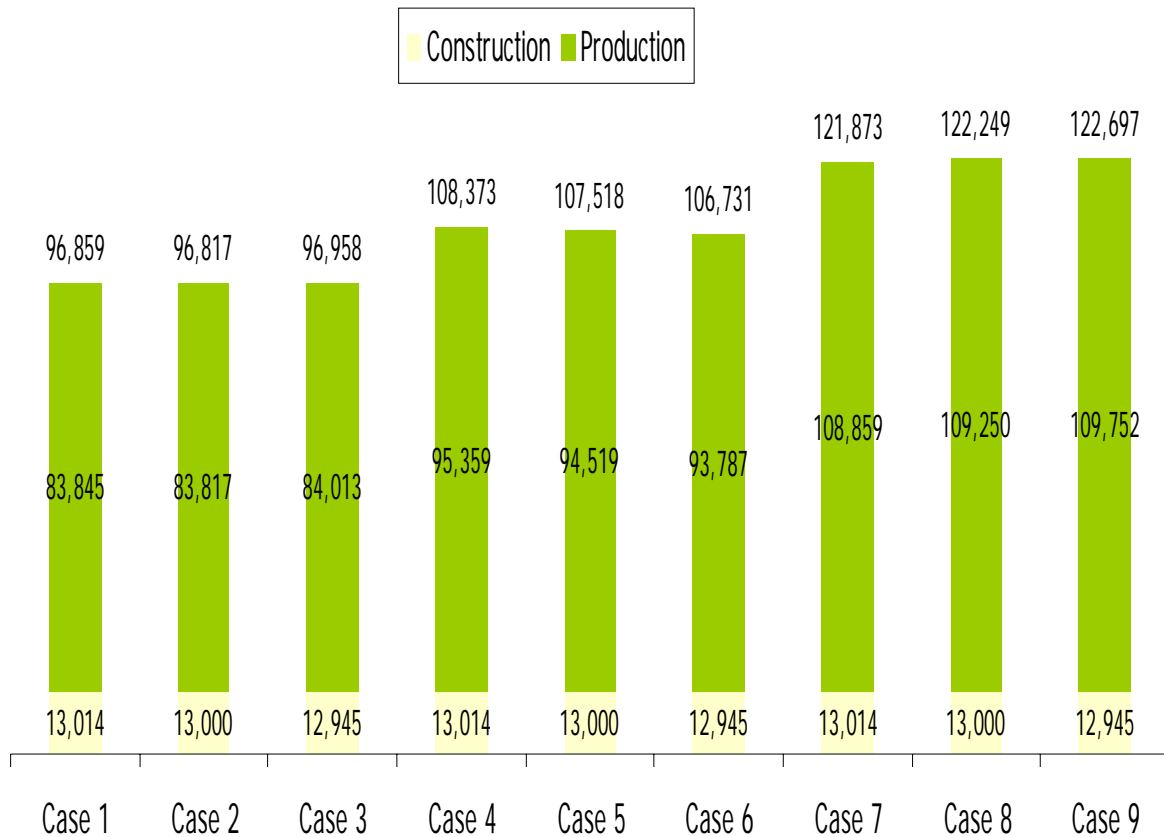
**Induced impacts:** investment and production activities in HC CBM play create employment. These increased labour require consumption goods such as food and beverage, cloths, furniture, etc. Industries need to produce these goods as well. These impacts are referred to as "induced impacts".

4.2.1 Impacts on GDP

Figure 4.4 shows the impact of CBM development on Alberta’s GDP over the 2006-2064 period for all the cases considered. The GDP impacts from the construction would vary from \$12.95 billion (Cases 3, 6 and 9) to \$13.01 billion (Cases 1, 4 and 7). Note that GDP impacts of construction are independent of changes in natural gas price as we assumed that the price of natural gas does not influence the number of wells drilled<sup>28</sup> for modeling purposes.

The GDP impacts on Alberta of natural gas production resulted from the CBM development in the HC play vary from \$83.8 billion to \$109.8 billion depending upon number of drilling wells per year and price of natural gas price.

**Figure 4.4**  
Impact on Alberta GDP  
(Million 2004\$)



In total (i.e., accounting for both construction and production), the GDP impacts of HC CBM development on Alberta over the 2006-2064 period would vary from \$96.8 billion to \$122.7 billion. If 5,000 wells were to be drilled per year and a “Low case” for natural gas pricing (2004

<sup>28</sup> In practice, natural gas price affects the number of wells drilling. However, to simplify the estimation of number of drilling wells, the study assumes number of drilling wells independent of natural gas price.

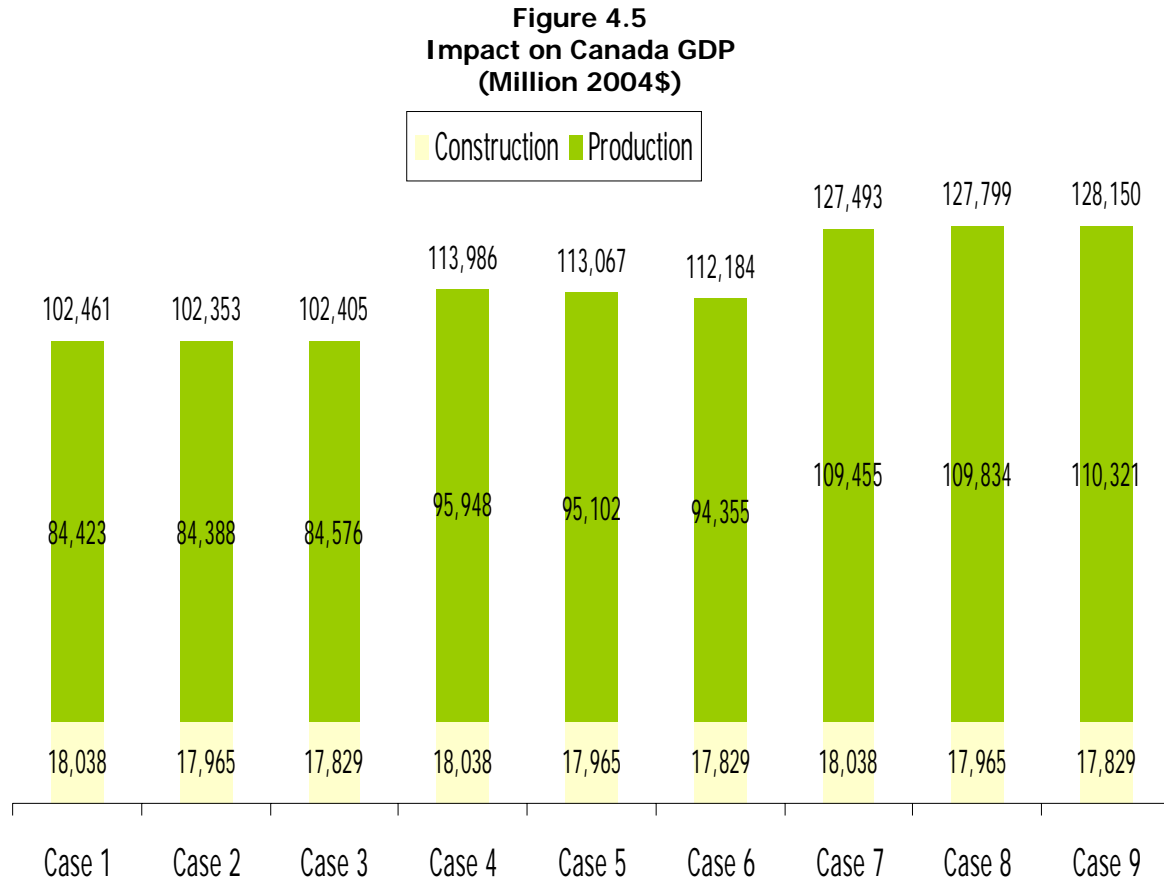
constant dollars)<sup>29</sup>, the GDP impact on Alberta over the 2006 to 2064 period, would be \$96.8 billion (Case 1). On the other hand, if the natural gas price were to follow a “High case” path and 5,000 wells were to be drilled per year, the GDP impact would be \$121.8 billion (Case 7).

Alberta GDP impacts of HC CBM development would be 15 percent to 19 percent of oil sands industry’s impacts on Alberta GDP depending upon the number of wells drilled per year and natural gas prices. Again, it should be noted that the GDP impacts considered in this study is for 59 years (2006-2064), whereas the GDP impacts of the oil sands study is for 21 years (2000 to 2020). Perhaps it would be more reasonable to compare average annual GDP impacts between this study and the oil sands study. The average annual GDP impact on Alberta of HC CBM development would vary from \$1.64 billion to \$2.08 billion, whereas the average annual GDP impact on Alberta of oil sands industry development would be \$30.2 billion. In terms of average annual GDP impacts, the impact of HC CBM development corresponds to 5.4 percent to 6.9 percent of oil sands industry’s impact on Alberta GDP.

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<sup>29</sup> Gas prices are expressed in 2004 constant dollars

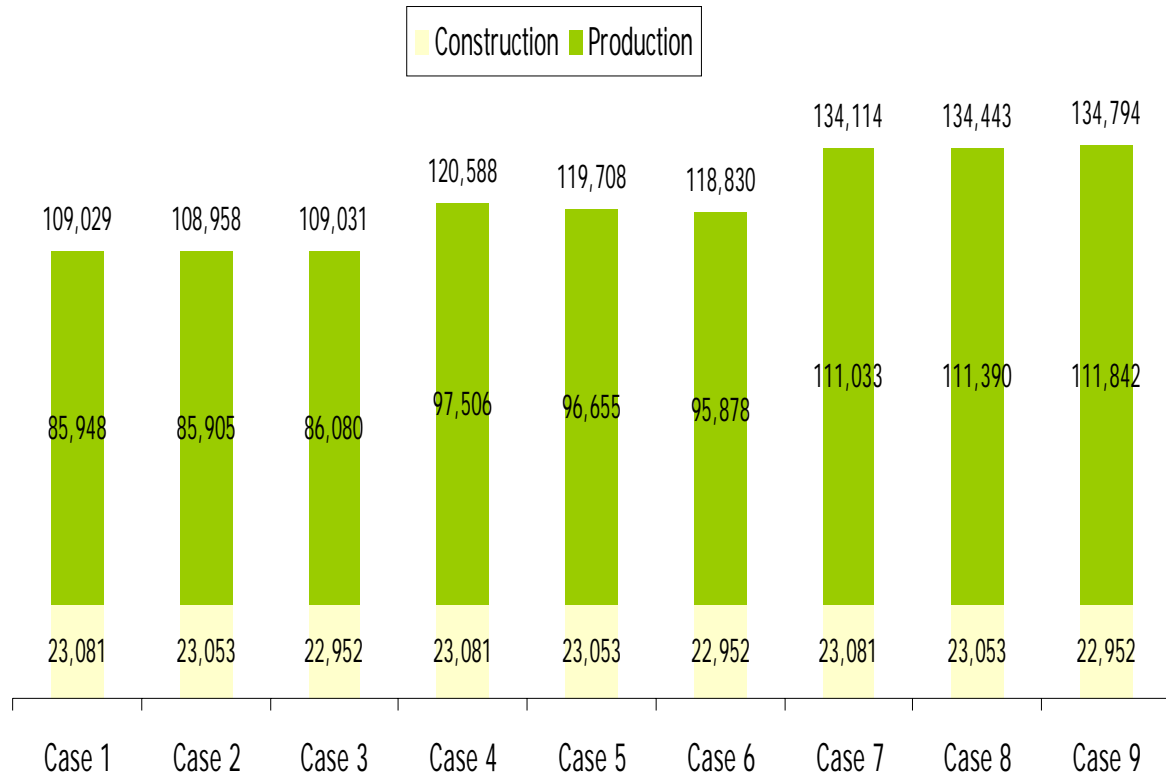
The HC CBM development affects not only the Alberta economy but also the economy outside Alberta and even outside Canada. This is because some goods and services needed for drilling and production in Horseshoe Canyon are supplied from outside Alberta. Figures 4.5 and 4.6 illustrates GDP impacts of HC CBM development at the national and global levels.



At the Canada level GDP impacts of the HC CBM development vary from \$102.4 billion to \$128.2 billion. The GDP impacts on Canada of the HC CBM development equal to 13 percent to 16.2 percent (depending upon the number of wells drilling per year and natural gas prices) of the corresponding impacts of oil sands industry.

The total GDP impacts (including GDP impacts to outside Canada) vary from \$109 billion to \$134.8 billion. Of the total impacts, 17 to 21 percent corresponds to construction (or investment) activities in the HC CBM play, whereas the remaining (79 – 83 percent) are related to natural gas production from the play. The total GDP impacts of the HC CBM development correspond to 12.2 percent to 15.3 percent of the total GDP impacts of Alberta's oil sands industry.

**Figure 4.6**  
**Impact on Total GDP**  
**(Million 2004\$)**



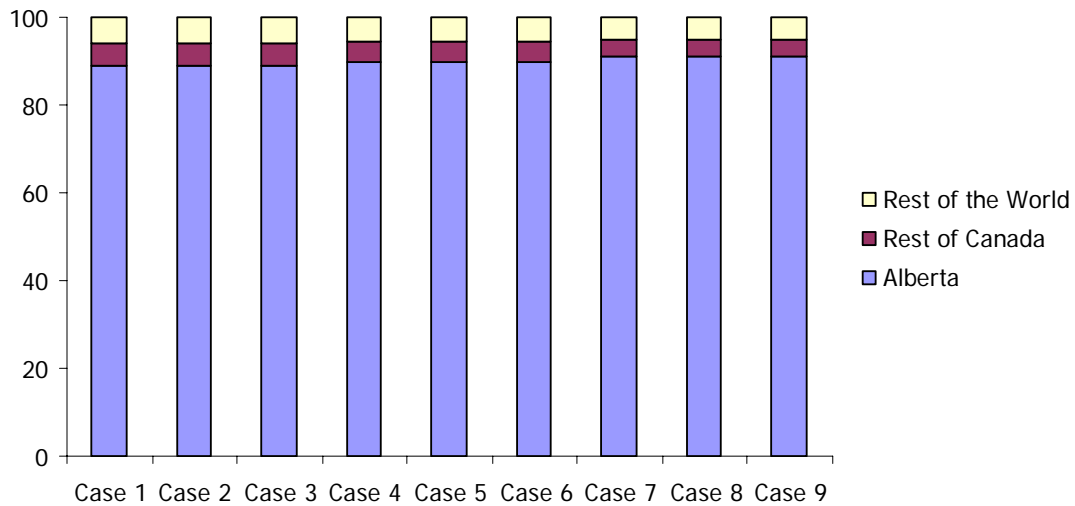
The differences in numbers between Figure 4.5 and Figure 4.4 represent the impacts in the rest of Canada (i.e., impacts outside Alberta but within Canada). Similarly, the differences in numbers between Figure 4.6 and Figure 4.5 represent the impacts in the rest of the World (i.e., impacts outside Canada). Table 4.1 presents GDP impacts on Alberta, Rest of Canada and Outside Canada of the HC CBM development. It is interesting to note that the investment activities would add value to economies outside Alberta at greater proportions than production activities would. This is intuitive because investment activities require more imported goods and services (e.g., pipes) than would the production activities.

**Table 4.1**  
**GDP Impacts by Jurisdiction**  
**(Billion Dollar in 2004 Price)**

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
<b>GDP Impacts on Alberta</b>									
Investment	13.01	13.00	12.94	13.01	13.00	12.94	13.01	13.00	12.94
Production	83.85	83.82	84.01	95.36	94.52	93.79	108.86	109.25	109.75
Investment & Production	<b>96.86</b>	<b>96.82</b>	<b>96.96</b>	<b>108.37</b>	<b>107.52</b>	<b>106.73</b>	<b>121.87</b>	<b>122.25</b>	<b>122.70</b>
<b>GDP Impacts on Rest of Canada</b>									
Investment	5.02	4.97	4.88	5.02	4.97	4.88	5.02	4.97	4.88
Production	0.58	0.57	0.56	0.59	0.58	0.57	0.60	0.58	0.57
Investment & Production	<b>5.60</b>	<b>5.54</b>	<b>5.45</b>	<b>5.61</b>	<b>5.55</b>	<b>5.45</b>	<b>5.62</b>	<b>5.55</b>	<b>5.45</b>
<b>GDP Impacts on Rest of the World</b>									
Investment	5.04	5.09	5.12	5.04	5.09	5.12	5.04	5.09	5.12
Production	1.53	1.52	1.50	1.56	1.55	1.52	1.58	1.56	1.52
Investment & Production	<b>6.57</b>	<b>6.60</b>	<b>6.63</b>	<b>6.60</b>	<b>6.64</b>	<b>6.65</b>	<b>6.62</b>	<b>6.64</b>	<b>6.64</b>
<b>Total GDP Impact</b>									
Investment	23.08	23.05	22.95	23.08	23.05	22.95	23.08	23.05	22.95
Production	85.95	85.90	86.08	97.51	96.65	95.88	111.03	111.39	111.84
Investment & Production	109.03	108.96	109.03	120.59	119.71	118.83	134.11	134.44	134.79

The GDP impacts on Alberta account for 89 percent to 91 percent of the total GDP impacts that would be generated by the CBM development in the HC basin (see Figure 4.7). Of the total GDP impacts, 4 to 5 percent incurs in the rest of Canada. The remaining (5 to 6 percent) leaks to economies outside Canada.

**Figure 4.7**  
**Regional Shares on Total GDP Impacts**  
**(%)**



One of the interesting results from an I-O analysis is to see how an activity in one sector (or industry) influences activities of other sectors (or industries). Tables 4.2, 4.3 and 4.4 present the impacts of HC CBM development on GDP to be generated from the various sectors of the economies at provincial, national and global levels.

**Table 4.2**  
**Cumulative (2006-2064) GDP Impacts by Sector at Alberta Level**  
**(Million 2004\$)**

Sector or Industry	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
Agriculture	325	324	321	330	329	324	333	329	324
Forestry	52	52	51	53	52	52	53	52	52
Other Mining	106	105	104	108	107	105	109	108	105
Crude Oil	827	822	816	839	836	823	847	837	822
Natural Gas	71,921	72,009	72,359	83,060	82,307	81,922	96,344	97,003	97,901
Coal	122	121	120	124	123	121	125	123	121
Manufacturing	2,518	2,505	2,484	2,555	2,545	2,505	2,577	2,549	2,504
Construction	759	756	751	765	763	755	768	763	754
Transportation & Communication	1,224	1,218	1,207	1,243	1,238	1,218	1,254	1,240	1,217
Electricity Utility	555	552	548	563	561	552	568	562	552
Gas Utility	773	768	761	787	783	769	795	785	768
Wholesale	1,313	1,306	1,294	1,334	1,328	1,306	1,346	1,330	1,305
Retail	1,666	1,658	1,645	1,689	1,683	1,658	1,703	1,685	1,657
Finance, Insurance and Real Estate	6,636	6,601	6,546	6,736	6,709	6,602	6,794	6,719	6,599
Business Services	2,327	2,313	2,292	2,367	2,356	2,315	2,390	2,360	2,313
Education	82	81	80	83	82	81	83	82	81
Health	582	579	575	590	588	579	595	589	579
Food and Accommodation	919	915	907	932	929	915	940	930	914
Other Services	4,152	4,130	4,096	4,214	4,197	4,131	4,249	4,203	4,128
<b>Total</b>	<b>96,859</b>	<b>96,817</b>	<b>96,958</b>	<b>108,373</b>	<b>107,518</b>	<b>106,731</b>	<b>121,873</b>	<b>122,249</b>	<b>122,697</b>

**Table 4.3**  
**Cumulative (2006-2064) GDP Impacts by Sector at Canada Level**  
**(Million 2004\$)**

<b>Sector or Industry</b>	<b>Case 1</b>	<b>Case 2</b>	<b>Case 3</b>	<b>Case 4</b>	<b>Case 5</b>	<b>Case 6</b>	<b>Case 7</b>	<b>Case 8</b>	<b>Case 9</b>
Agriculture	424	422	417	429	427	420	432	427	420
Forestry	116	115	113	116	116	114	117	116	114
Other Mining	148	146	144	150	149	146	151	149	146
Crude Oil	922	917	909	934	931	916	942	932	915
Natural Gas	72,312	72,400	72,747	83,451	82,697	82,310	96,735	97,393	98,290
Coal	141	140	139	143	142	140	144	142	140
Manufacturing	3,882	3,841	3,784	3,924	3,886	3,808	3,948	3,890	3,806
Construction	803	800	795	810	807	798	813	808	798
Transportation & Communication	1,459	1,450	1,437	1,478	1,471	1,448	1,489	1,473	1,447
Electricity Utility	674	669	663	682	678	667	687	679	667
Gas Utility	822	816	808	836	831	816	844	833	816
Wholesale	1,589	1,579	1,564	1,610	1,602	1,576	1,623	1,604	1,575
Retail	1,940	1,929	1,912	1,964	1,955	1,925	1,978	1,957	1,924
Finance, Insurance and Real Estate	7,763	7,717	7,646	7,864	7,827	7,703	7,923	7,836	7,700
Business Services	2,635	2,620	2,596	2,676	2,663	2,619	2,699	2,667	2,617
Education	92	91	90	93	92	91	93	92	91
Health	685	681	675	694	690	680	698	691	679
Food and Accommodation Service	1,064	1,058	1,048	1,078	1,072	1,056	1,085	1,074	1,055
Other Services	4,992	4,963	4,917	5,055	5,031	4,952	5,092	5,036	4,950
<b>Total</b>	<b>102,461</b>	<b>102,353</b>	<b>102,405</b>	<b>113,986</b>	<b>113,067</b>	<b>112,184</b>	<b>127,493</b>	<b>127,799</b>	<b>128,150</b>

**Table 4.4**  
**Cumulative (2006-2064) GDP Impacts by Sector at Global Level**  
**(Million 2004\$)**

Sector or Industry	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
Agriculture	624	623	619	630	629	623	634	630	622
Forestry	151	150	149	152	152	150	153	152	150
Other Mining	166	165	163	168	167	165	170	168	164
Crude Oil	1,504	1,503	1,497	1,520	1,520	1,506	1,530	1,522	1,506
Natural Gas	73,040	73,132	73,482	84,183	83,433	83,047	97,470	98,130	99,027
Coal	188	187	186	190	190	188	191	190	187
Manufacturing	5,908	5,879	5,832	5,961	5,937	5,861	5,991	5,941	5,859
Construction	844	841	836	850	848	839	854	849	839
Transportation & Communication	1,680	1,673	1,660	1,700	1,695	1,671	1,712	1,696	1,671
Electricity Utility	770	767	760	779	776	765	784	777	765
Gas Utility	891	886	878	905	902	886	914	903	886
Wholesale	1,823	1,814	1,800	1,845	1,838	1,812	1,858	1,841	1,812
Retail	2,145	2,135	2,118	2,170	2,162	2,132	2,184	2,164	2,131
Finance, Insurance and Real Estate	8,616	8,575	8,506	8,722	8,689	8,565	8,783	8,698	8,561
Business Services	2,896	2,881	2,857	2,938	2,926	2,880	2,962	2,930	2,879
Education	102	101	101	103	103	101	104	103	101
Health	766	763	757	775	772	762	780	773	761
Food and Accommodation Service	1,236	1,231	1,221	1,250	1,246	1,229	1,258	1,247	1,229
Other Services	5,679	5,653	5,609	5,745	5,724	5,646	5,783	5,730	5,643
<b>Total</b>	<b>109,029</b>	<b>108,958</b>	<b>109,031</b>	<b>120,588</b>	<b>119,708</b>	<b>118,830</b>	<b>134,114</b>	<b>134,443</b>	<b>134,794</b>

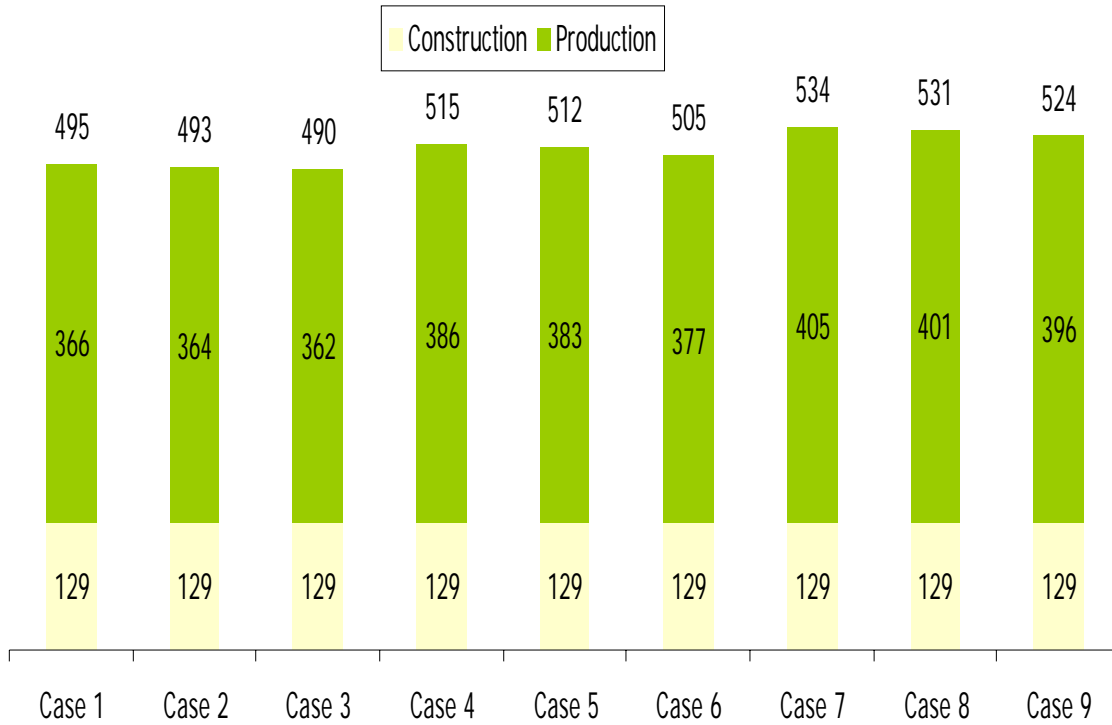
As expected, the HC CBM development would increase the GDP of the natural gas sector at the highest level as compared to that of other sectors. This is because the direct GDP impact, which is GDP associated with investment and value of production, are accounted for in this sector. The GDP impact on the natural gas industry accounts for 74 percent to 80 percent of the total GDP impacts on Alberta. At the Canada level, the natural gas industry GDP impact accounts for 71 percent to 77 percent. In total, the natural gas industry GDP impact accounts for 67 percent to 73 percent. In summary, the natural gas industry GDP impacts represent more than the two thirds of the total GDP impacts that would arise due to the HC CBM development. Other industries with significant GDP impacts are finance, insurance and real estate, manufacturing, business services, food and accommodation, etc.

#### **4.2.2 Impacts on Employment**

Like in the case of GDP impacts, the investment and production activities create employment directly and indirectly. The jobs related to well drilling, servicing, operating, etc. which are directly related to the HC CBM development (including natural gas production from the CBM play) are the direct employment impacts. On the other hand, the jobs, for example, created in hotels and restaurants due to the investment and production activities in the HC CBM play is called indirect employment impacts. Moreover, like in the case of GDP impacts, the employment impacts also include induced employment impacts. The induced employment impacts are, for example, employment created in a grocery store to sell goods to people working in the HC CBM projects. The employment impacts presented here are the total employment impacts that include direct, indirect and induced employment impacts.

Figure 4.8 shows the impact of CBM development on Alberta's employment over the 2006 to 2064 period for all the cases considered. The investment activities, such as construction and drilling are expected to create 128,738 to 129,421 person years of employment during the 2006 to 2017 period. On average, the investment activities would provide 10,728 to 10,785 employments per year in Alberta. The production of natural gas from the CBM play would provide 362 thousand person years to 405 thousand person years during the 2006 to 2064 period in Alberta. On average, the production activities would create 6,130 to 6,864 employments per year to the Alberta economy during the 2006 to 2064 period.

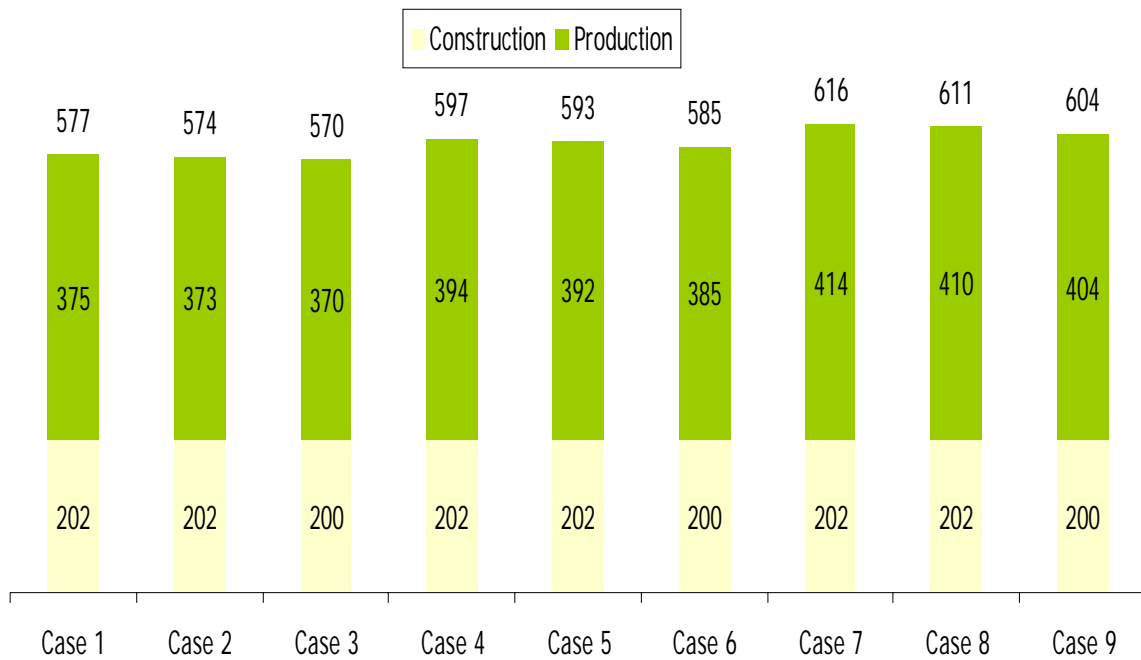
**Figure 4.8**  
**Impact on Alberta Employment**  
**(Thousand Person Years)**



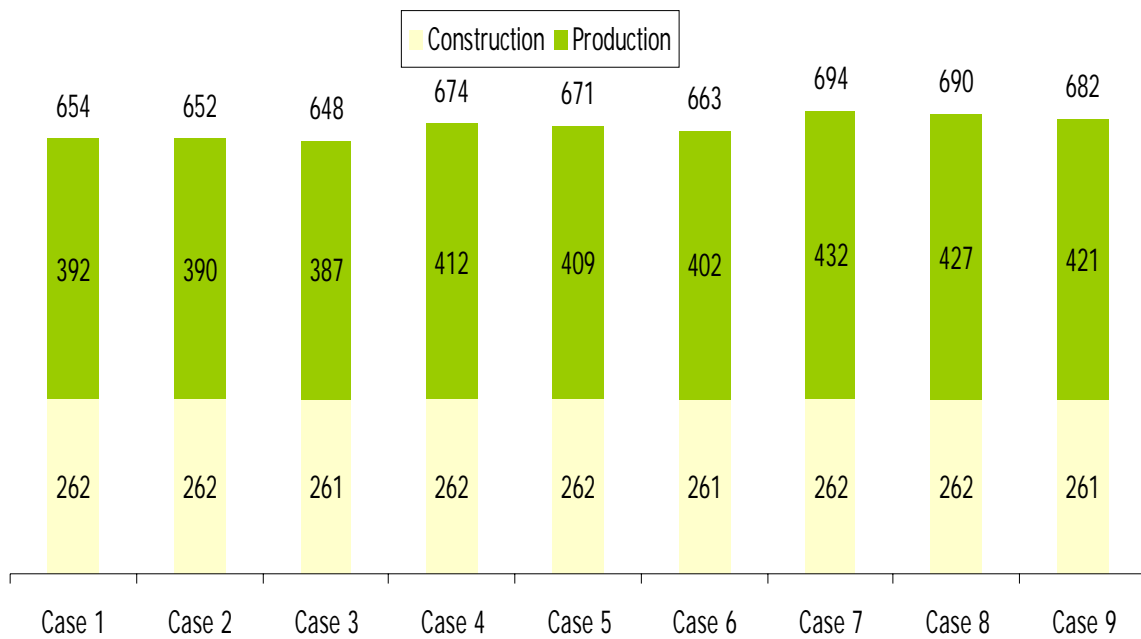
In total (i.e., accounting for both construction and production), the HC CBM development would provide 490 thousand person years to 534 person years of employment in Alberta over the 2006-2064 period. By comparison, the employment impact of the HC CBM development is equal to 13.4 percent to 14.6 percent of the oil sands industry’s employment impacts in Alberta.

The HC CBM development also provides employment outside Alberta and even outside Canada. This is because some goods and services needed for drilling and production in Horseshoe Canyon are supplied from outside Alberta. Industries producing those goods and services need the labour force. Figure 4.9 and 4.10 illustrates employment impacts of HC CBM development at the national and global levels.

**Figure 4.9**  
**Impact on Canada Employment**  
**(Thousand Person Years)**



**Figure 4.10**  
**Impact on Total Employment**  
**(Thousand Person Years)**



The HC CBM development would provide 570 thousand person years to 616 thousand person years of employment at the Canada level. It would provide 648 thousand person years to 694 thousand person years of employment in total (i.e., including outside Canada). During the 2006-2017 period, at which both construction and production activities will be undertaken, HC CBM play would create 28 to 29 thousand employment per year including Alberta, other parts of Canada and outside Canada. During the 2018-2064 period, at which only production activities will be undertaken, the CBM play would provide 6-7 thousand employments. Of the total employment impacts, 38 to 40 percent corresponds to construction (or investment) activities in the HC CBM play, whereas the remaining (60 – 62 percent) are related to natural gas production from the play. The total employment impacts of the HC CBM development is equal to 9.9 percent to 10.6 percent of the total employment impacts of the oil sands industry.

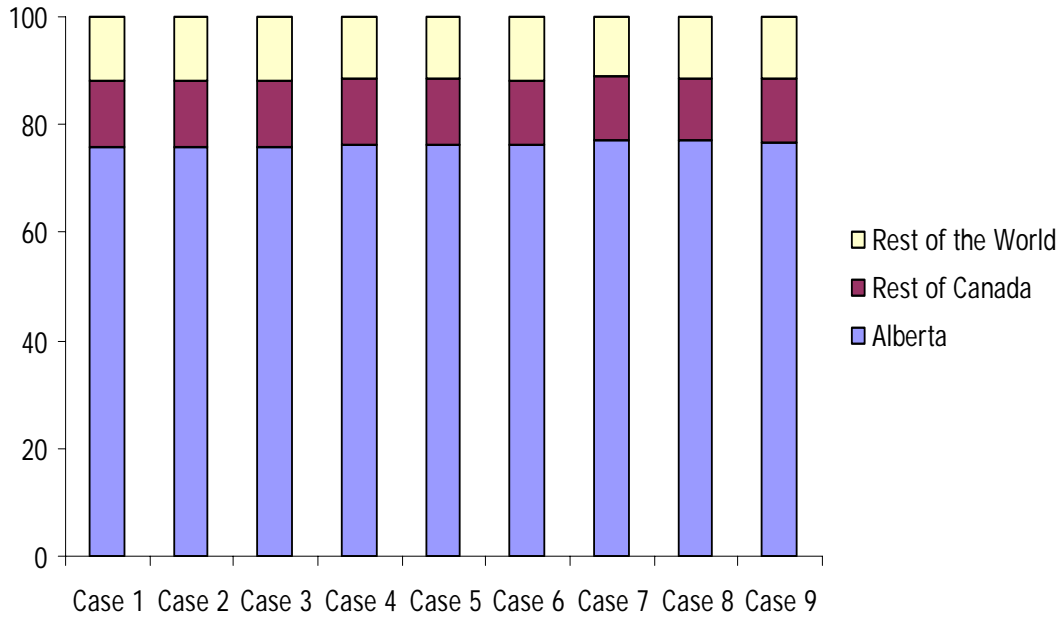
The differences in numbers between Figure 4.9 and Figure 4.8 represent the employment impacts for the rest of Canada (i.e., impacts outside Alberta but within Canada). Similarly, the differences in numbers between Figure 4.10 and Figure 4.9 represent the employment impacts for the rest of the World (i.e., impacts outside Canada). Table 4.5 presents employment impacts on Alberta, the rest of Canada and outside Canada of the HC CBM development. It is interesting to note that the investment activities would provide employments to economies outside Alberta at greater proportions than production activities would. This is intuitive because investment activities require more imported goods and services (e.g., pipes) than would the production activities.

**Table 4.5  
Employment Impacts by Jurisdiction  
(Thousand Person Years)**

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
<b>GDP Impacts on Alberta</b>									
Investment	129	129	129	129	129	129	129	129	129
Production	366	364	362	386	383	377	405	401	396
Investment & Production	495	493	490	515	512	505	534	531	524
<b>GDP Impacts on Rest of Canada</b>									
Investment	73	72	71	73	72	71	73	72	71
Production	8	8	8	9	9	8	9	9	8
Investment & Production	82	81	79	82	81	79	82	81	79
<b>GDP Impacts on Rest of the World</b>									
Investment	60	61	61	60	61	61	60	61	61
Production	17	17	17	18	18	17	18	18	17
Investment & Production	77	78	78	78	78	78	78	78	78
<b>Total GDP Impact</b>									
Investment	262	262	261	262	262	261	262	262	261
Production	392	390	387	412	409	402	432	427	421
Investment & Production	654	652	648	674	671	663	694	690	682

The employment impacts on Alberta accounts for 76 percent to 77 percent of the total employment impacts that would be generated by the CBM development in the HC CBM basin (please see Figure 4.11). Of the total employment impacts, 12 percents would be provided to the rest of Canada and rest of the world each.

**Figure 4.11**  
**Regional Shares on Total Employment Impacts**  
 (%)



Tables 4.6, 4.7 and 4.8 present the impacts of HC CBM development on employment to be created in the various sectors of the economies at provincial, national and global levels.

**Table 4.6**  
**Cumulative (2006-2064) Employment Impacts by Sector at Alberta Level**  
**(Thousand Person Years)**

<b>Sector or Industry</b>	<b>Case 1</b>	<b>Case 2</b>	<b>Case 3</b>	<b>Case 4</b>	<b>Case 5</b>	<b>Case 6</b>	<b>Case 7</b>	<b>Case 8</b>	<b>Case 9</b>
Agriculture	10	10	10	10	10	10	10	10	10
Forestry	1	1	1	1	1	1	1	1	1
Other Mining	1	1	1	1	1	1	1	1	1
Crude Oil	2	2	2	2	2	2	2	2	2
Natural Gas	113	113	114	127	126	125	143	144	144
Coal	0	0	0	0	0	0	0	0	0
Manufacturing	25	25	25	26	26	25	26	26	25
Construction	10	10	10	10	10	10	11	10	10
Transportation & Communication	18	18	18	19	18	18	19	18	18
Electricity Utility	3	3	3	3	3	3	3	3	3
Gas Utility	1	1	1	1	1	1	1	1	1
Wholesale	14	14	14	14	14	14	14	14	14
Retail	58	58	58	59	59	58	60	59	58
Finance, Insurance and Real Estate	28	27	27	28	28	27	28	28	27
Business Services	68	67	67	69	69	67	69	69	67
Education	32	32	32	33	33	32	33	33	32
Health	39	39	39	40	40	39	40	40	39
Food and Accommodation	33	33	33	34	34	33	34	34	33
Other Services	37	37	36	37	37	37	38	37	37
<b>Total</b>	<b>495</b>	<b>493</b>	<b>490</b>	<b>515</b>	<b>512</b>	<b>505</b>	<b>534</b>	<b>531</b>	<b>524</b>

**Table 4.7**  
**Cumulative (2006-2064) Employment Impacts by Sector at Canada Level**  
**(Thousand Person Years)**

<b>Sector or Industry</b>	<b>Case 1</b>	<b>Case 2</b>	<b>Case 3</b>	<b>Case 4</b>	<b>Case 5</b>	<b>Case 6</b>	<b>Case 7</b>	<b>Case 8</b>	<b>Case 9</b>
Agriculture	13	13	12	13	13	12	13	13	12
Forestry	2	2	2	2	2	2	2	2	2
Other Mining	2	1	1	2	2	1	2	2	1
Crude Oil	2	2	2	2	2	2	2	2	2
Natural Gas	115	115	115	129	128	127	145	146	146
Coal	0	0	0	0	0	0	0	0	0
Manufacturing	42	42	41	42	42	41	43	42	41
Construction	11	11	11	11	11	11	11	11	11
Transportation & Communication	22	22	22	23	23	22	23	23	22
Electricity Utility	4	4	4	4	4	4	4	4	4
Gas Utility	1	1	1	1	1	1	2	1	1
Wholesale	17	17	17	17	17	17	17	17	17
Retail	68	67	67	68	68	67	69	68	67
Finance, Insurance and Real Estate	33	33	32	33	33	32	33	33	32
Business Services	79	79	78	80	80	79	81	80	79
Education	37	37	37	38	38	37	38	38	37
Health	46	45	45	46	46	45	47	46	45
Food and Accommodation Service	39	39	38	39	39	38	40	39	38
Other Services	44	44	44	45	45	44	45	45	44
<b>Total</b>	<b>577</b>	<b>574</b>	<b>570</b>	<b>597</b>	<b>593</b>	<b>585</b>	<b>616</b>	<b>611</b>	<b>604</b>

**Table 4.8**  
**Cumulative (2006-2064) Employment Impacts by Sector at Global Level**  
**(Thousand Person Years)**

<b>Sector or Industry</b>	<b>Case 1</b>	<b>Case 2</b>	<b>Case 3</b>	<b>Case 4</b>	<b>Case 5</b>	<b>Case 6</b>	<b>Case 7</b>	<b>Case 8</b>	<b>Case 9</b>
Agriculture	19	19	19	19	19	19	19	19	19
Forestry	3	3	3	3	3	3	3	3	3
Other Mining	2	2	2	2	2	2	2	2	2
Crude Oil	4	4	4	4	4	4	4	4	4
Natural Gas	117	116	117	130	129	128	147	147	148
Coal	0	0	0	0	0	0	0	0	0
Manufacturing	62	62	61	63	63	62	63	63	62
Construction	12	12	12	12	12	12	12	12	12
Transportation & Communication	26	26	25	26	26	26	26	26	26
Electricity Utility	4	4	4	4	4	4	4	4	4
Gas Utility	2	2	2	2	2	2	2	2	2
Wholesale	19	19	19	19	19	19	20	19	19
Retail	75	74	74	76	75	74	76	75	74
Finance, Insurance and Real Estate	36	36	36	37	37	36	37	37	36
Business Services	87	86	86	88	88	86	89	88	86
Education	41	41	41	42	42	41	42	42	41
Health	51	51	51	52	52	51	52	52	51
Food and Accommodation Service	45	45	44	46	45	45	46	45	45
Other Services	50	50	50	51	51	50	51	51	50
<b>Total</b>	<b>654</b>	<b>652</b>	<b>648</b>	<b>674</b>	<b>671</b>	<b>663</b>	<b>694</b>	<b>690</b>	<b>682</b>

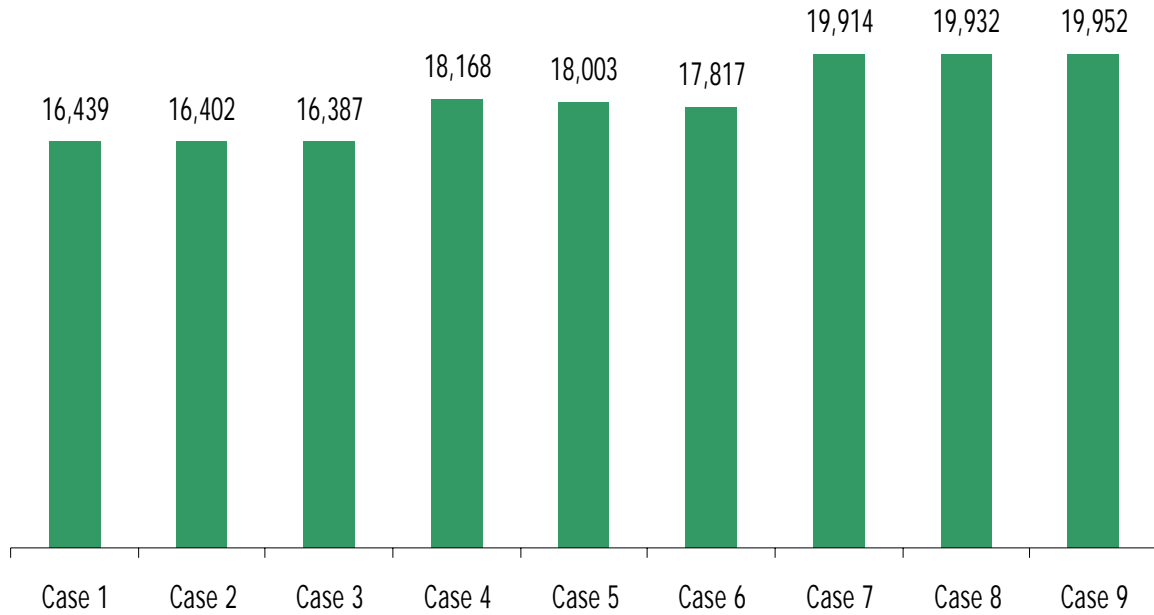
As expected, the HC CBM development would create the highest employment in the natural gas sector as compared to that of other sectors. This is because the direct employment impact, which is nothing but jobs directly created by the investment and production activities in the HC CBM play, is accounted for in this sector. The employment created in the natural gas industry accounts for 23 percent to 28 percent of the total employment created in Alberta. At the Canada level, the employment created in the natural gas industry accounts for 20 percent to 24 percent of the total employment created. In total, the natural gas industry accounts for 18 percent to 22 percent of the employment created due to the HC CBM development. Other industries with significant employment impacts are manufacturing, business services and retail services, etc.

#### **4.2.3 Tax & Royalty Revenue Impacts**

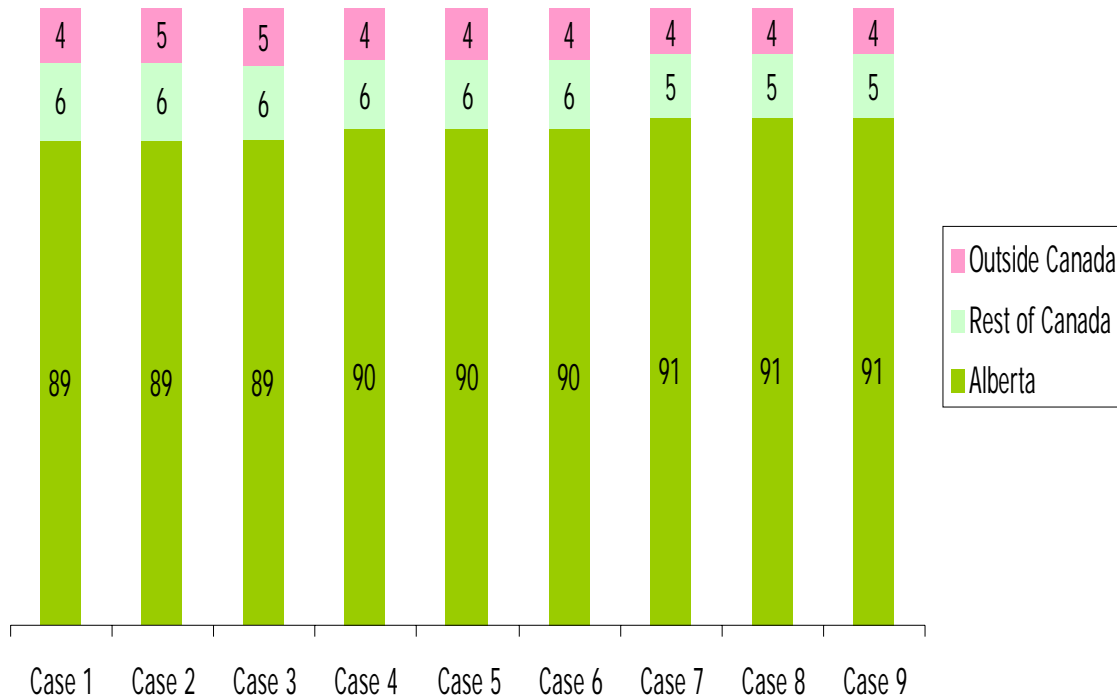
A notable impact of the development of a resource base industry is tax revenues. The HC CBM development would generate tax & royalty revenues in three ways. First, the project developers directly pay various taxes and royalties such as crown royalties, freehold royalty, income tax, property tax, GST, etc. Secondly, other industries whose activity (production) increases due to the HC CBM development, also pay GST, income tax and property tax. Thirdly, employees of CBM projects in the HC CBM basin as well as employees of others industries supplying to the CBM projects pay personal income tax to governments. All these tax and royalty revenues are included in this study.

Figure 4.12 illustrates the tax & royalty revenues that would be generated directly and indirectly due to the CBM development in the Horseshoe Canyon basin. Note that the impacts are not only limited to Alberta but also include the ones which would incur outside Alberta and even outside Canada. As can be seen from the figure, the cumulative tax and royalty revenue generated directly and indirectly due to the HC CBM development over the 2006-2064 period could vary from \$16.4 billion to about \$20 billion. About 95 to 96 percent of the revenues will stay within Canada (see Figure 4.13). In other words, the HC CBM development would generate \$15.64 to \$19.21 billion tax & royalty revenue in Canada. As compared to the total revenue generated in Canada through oil sands development in Alberta during the 2000 to 2020 period, the tax & royalty revenue generated in Canada by the HC CBM project corresponds to 13.3 – 16.2 percent.

**Figure 4.12**  
**Cumulative Tax & Royalty Revenue**  
**(Million 2004\$)**



**Figure 4.13**  
**Tax & Royalty Revenue Collected by Region**  
**(Percent)**

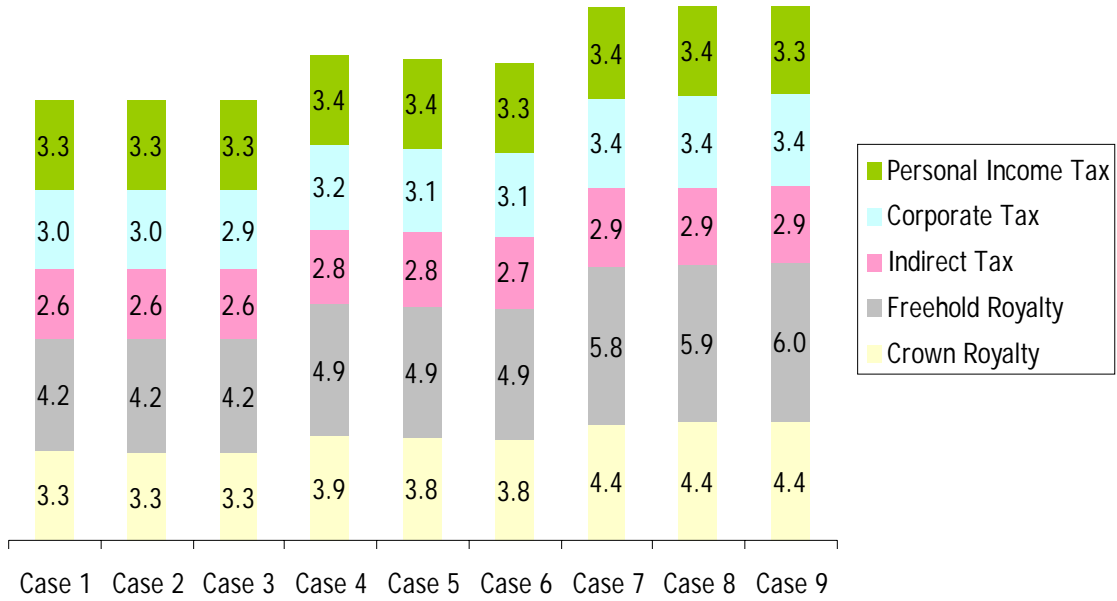


As mentioned, the tax & royalty revenue are collected through various sources. The key sources included here are the following:

- **Crown royalty:** royalties paid by the project developers to the provincial government.
- **Mineral tax:** taxes paid by the project developers to the provincial government for gas development on freehold land. Mineral tax is Included under crown royalty in this study.
- **Freehold royalty:** royalties paid by the project developers to land owners (e.g., farmers, Canadian Pacific Railway, schools, etc.) having minerals rights.
- **Indirect tax revenue:** revenues generated through GST, PST (for provinces other than Alberta) and property taxes directly (paid by the CBM projects directly) and indirectly (paid by other industries supplying goods and services to the CBM projects).
- **Corporate income tax revenue:** revenues generated through corporate income tax paid by the CBM projects and paid by other industries supplying goods and services to the CBM projects.
- **Personal income tax revenue:** revenues generated through personal income tax paid by the employees of the CBM projects and also paid by the employees of other industries supplying goods and services to the CBM projects.

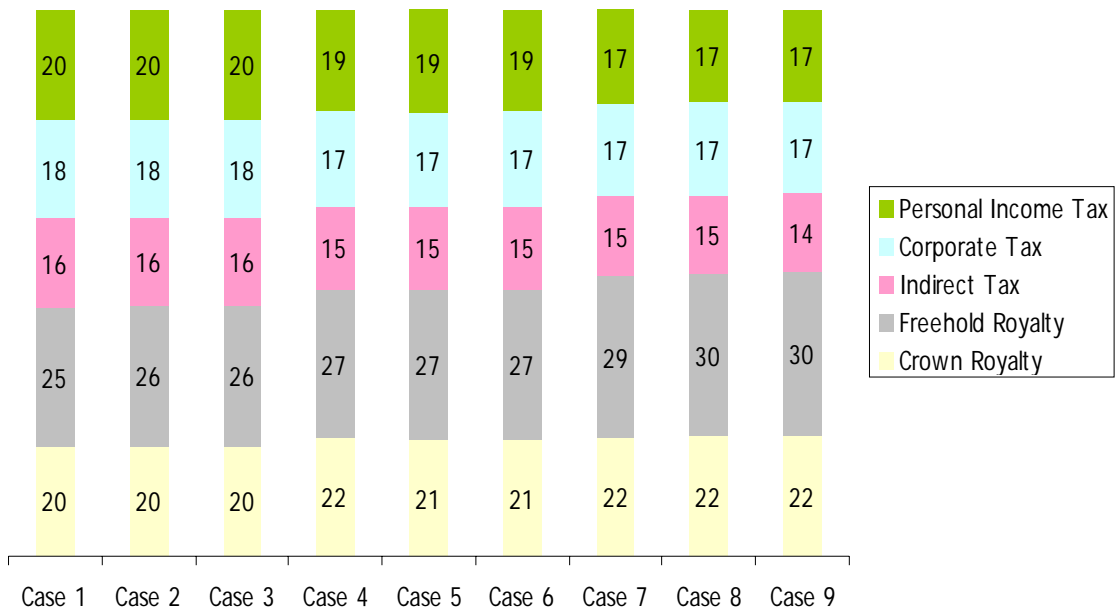
Figure 4.14 presents various tax & royalty revenues generated through various sources during the 2006-2064 period due to HC CBM development. As illustrated in the figure, the freehold royalty would be the highest among the various tax & royalty revenue considered in the study. It accounts for 25 to 30 percent of the total revenue generated (see Figure 4.15). This is followed by the crown royalty revenue, which varies from \$3.3 billion to \$4.4 billion and accounts for 20 to 22 percent of the total tax & royalty revenue.

**Figure 4.14**  
**Tax & Royalty Revenue Impacts by Type of Revenue**  
**(Billion 2004\$)**



Note: Crown royalty also includes mineral tax.

**Figure 4.15**  
**Shares of Various Sources in the Total Tax & Royalty Revenues**  
**(Percent)**



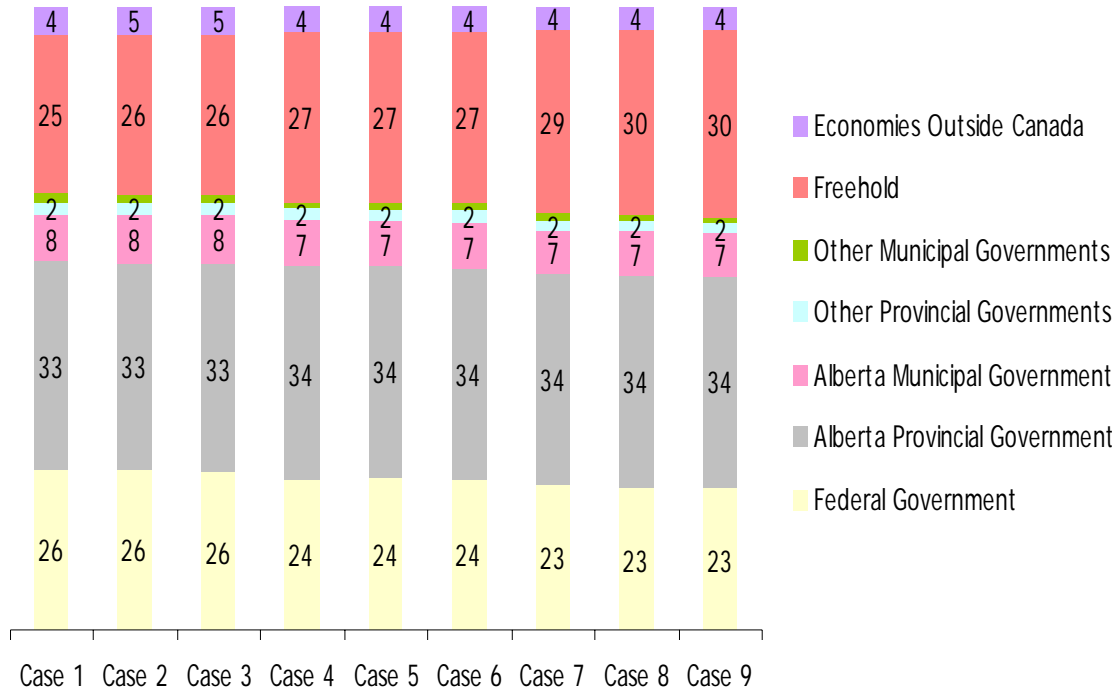
Note: Crown royalty also includes mineral tax.

It is interesting and also important to know who receives how much of the total tax & royalty revenues. Table 4.9 presents amounts of tax & royalty revenue that various governments and freeholders would receive. The Alberta provincial government would receive the highest tax & royalty revenues amounting from about \$5.5 billion to \$6.8 billion. The tax & royalty revenues received by the Alberta provincial government accounts for 33 to 34 percent or one third of the total tax & royalty revenue generated (see Figure 4.16). The federal government would receive \$4.2 billion to \$4.6 billion thereby registering 23 to 26 percents of the total tax & royalty revenue generated due to the Horseshoe CBM development. Similarly the freeholders would receive \$4.2 billion to \$6 billion accounting for 25 to 30 percent of the total revenue. Including the provincial government revenues, municipal revenues and the freehold revenue, Alberta, in fact, receives 66 to 71 percent (two thirds) of the total tax and royalty revenue generated directly and indirectly due to the HC CBM development. Some of the Alberta counties and municipal districts that benefit from the HC CBM development include: Kneehill, Lacombe, Mountainview, Ponoka, Red Deer, Rockview, Starland, Stettler, Wetaskiwin and Wheatland.

**Table 4.9**  
**Tax & Royalty Revenue Impacts by Recipient**  
**(Billion 2004\$)**

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
Federal Government	4.23	4.21	4.18	4.41	4.38	4.33	4.60	4.58	4.53
Alberta Provincial Government	5.47	5.45	5.44	6.18	6.10	6.02	6.75	6.75	6.76
Alberta Municipal Government	1.27	1.27	1.26	1.35	1.34	1.32	1.43	1.42	1.41
Other Provincial Governments	0.33	0.33	0.32	0.33	0.33	0.32	0.33	0.33	0.32
Other Municipal Governments	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Freehold	4.19	4.20	4.23	4.94	4.90	4.87	5.85	5.90	5.97
Economies Outside Canada	0.74	0.74	0.74	0.74	0.75	0.75	0.74	0.75	0.75
<b>Total</b>	<b>16.44</b>	<b>16.40</b>	<b>16.39</b>	<b>18.17</b>	<b>18.00</b>	<b>17.82</b>	<b>19.91</b>	<b>19.93</b>	<b>19.95</b>

**Figure 4.16**  
**Shares of Various Recipients in the Total Tax & Royalty Revenues**  
**(Percent)**



Note: Other municipal governments account about 1 percent of the total tax & royalty revenue.

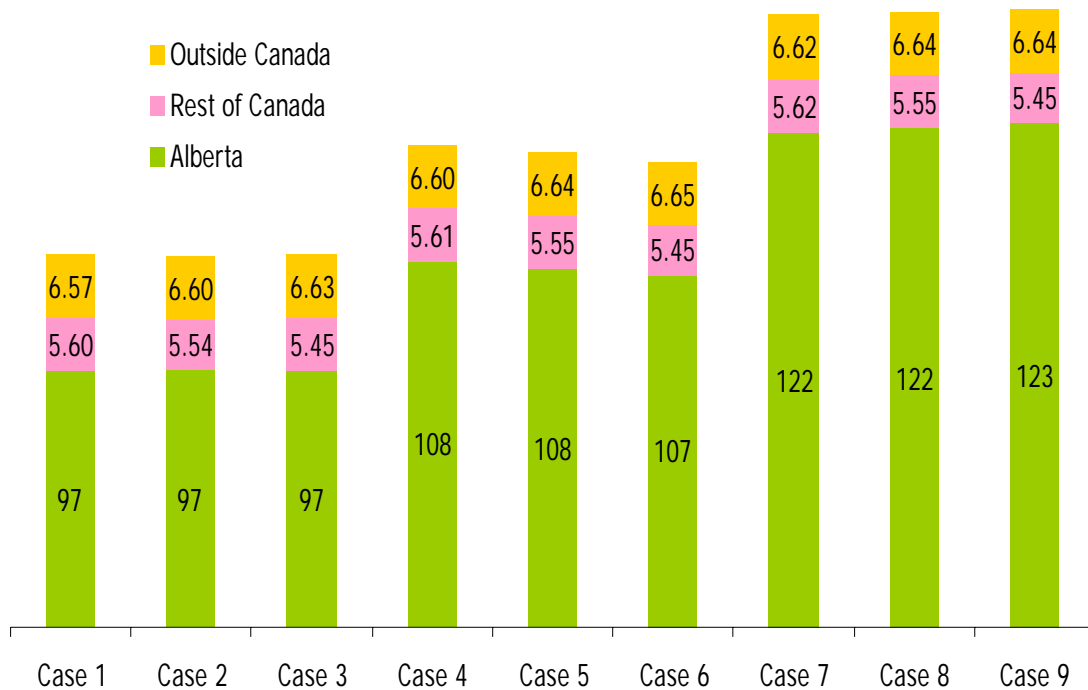
### 4.3 Summary of Results

This section will summarize the impacts of CBM development at provincial, national and international levels in the nine cases considered in this study.

#### GDP Impacts

- The total GDP impacts (including impacts outside Alberta) of the HC CBM development would vary from \$109 billion to \$134.8 billion depending on the number of drilled wells and natural gas price (see Figure 4.17).
- Of the total GDP impacts, 17 to 21 percent corresponds to construction (or investment) activities in the HC CBM play, whereas the remaining (79 – 83 percent) are related to natural gas production from the play.
- Of the total GDP impacts, 17 to 21 percents corresponds to construction (or investment) activities in the HC CBM play, whereas the remaining (79 – 83 percent) are related to natural gas production from the play.
- The total GDP impacts of the HC CBM development corresponds to 12.2 percent to 15.3 percent of the total GDP impacts of Alberta's oil sands industry.

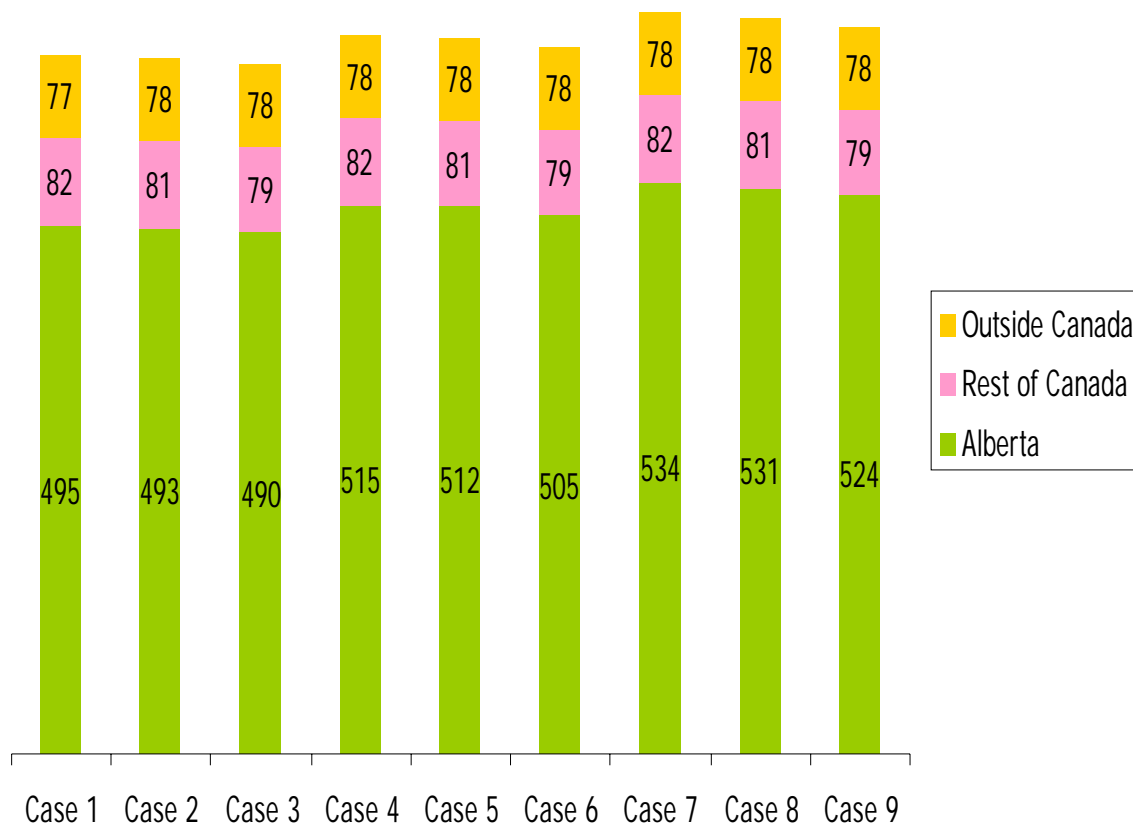
**Figure 4.17**  
**Cumulative (2006-2064) GDP impacts of HC CBM Development**  
**(Billion 2004\$)**



### **Employment Impacts**

- The HC CBM development would create 648 to 694 thousand person-years employment directly and indirectly during the 2006 to 2064 period (see Figure 4.18). During the 2006 to 2017 period, at which both construction and production activities will be undertaken, HC CBM play would create 28 to 29 thousand person year employment per year including Alberta, other parts of Canada and outside Canada. During the 2018 to 2064 period, at which only production activities will be undertaken, the CBM play would provide 6-7 thousand employments.

**Figure 4.18**  
**Cumulative (2006-2064) Employment impacts of HC CBM Development**  
**(Thousand Person Years)**



- Of the total employment impacts, 38 to 40 percent corresponds to construction (or investment) activities in the HC CBM play, whereas the remaining (60 – 62 percent) are related to natural gas production from the play.
- Of the total employment, 76 to 77 percent would be created in Alberta; 11 to 12 percent in other parts of Canada; the remaining 12 percent outside Canada.
- The total employment impact of the HC CBM development is equal to 9.9 percent to 10.6 percent of the total employment impacts of the oil sands industry.

### Tax & Royalty Impacts

The HC CBM development would generate tax & royalty revenues in three ways. First, the project developers directly pay various taxes and royalties such as crown royalties, freehold royalty, mineral tax, income tax, property tax, GST, etc. Secondly, other industries whose activity (production) increases due to the HC CBM development, also pay GST, income tax and property tax. Thirdly, employees of CBM projects in the Horseshoe Canyon basin as well as employees of others industries supplying to the CBM projects pay personal income tax to governments. The revenues will be generated not only in Alberta, but also other parts of Canada and also outside Canada.

- The cumulative tax and royalty revenue generated directly and indirectly due to the HC CBM development over the 2006 to 2064 period could vary from \$16.4 billion to about \$20 billion. About 95 to 96 percent of the revenues will stay within Canada.
- As compared to the total revenue generated in Canada through oil sands development in Alberta during the 2000 to 2020 period, the tax & royalty revenue generated in Canada by the HC CBM project corresponds to 13.3 – 16.2 percent.
- The freehold royalty would be the highest among the various tax & royalty revenue considered in the study accounting for 25 to 30 percent of the total revenue generated. The crown royalty (including mineral tax) accounts for 20 to 22 percent; personal income tax accounts for 17-20 percent, corporate tax revenue accounts for 17 to 18 percent and indirect tax revenue accounts 14 to 16 percent.
- The Alberta provincial governments received the highest portion (33 – 34 percent) of the total tax and royalty revenues that would be generated directly and indirectly due to the HC CBM development. If municipality's revenues and the freehold revenue are also included, Alberta receives about two thirds of the total tax and royalty revenue. The federal government would receive 23 to 26 percent of the total tax & royalty revenue.

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Notes Page



## About CERI

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The Canadian Energy Research Institute (CERI) is a co-operative research organization established through an initiative of government, academia, and industry in 1975. The Institute's mission is to provide relevant, independent, objective economic research and education in energy and related environmental issues. Related objectives include reviewing emerging energy issues and policies as well as developing expertise in the analysis of questions related to energy and the environment.

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