6 Canada

6.1 Summary of Coal Industry

6.1.1 Role of Coal in Canada

Coal is the most abundant fossil fuel in Canada, comprising 61 percent of all its fossil fuel reserves (CCPC, 2010). Coal accounted for 10 percent of Canada's total energy consumption in 2010 (EIA, 2012). Canada exports more than 40 percent of its tonnage as coking coal for steelmaking to Asian countries and some to Europe and Latin America. Conversely, Canada imports coal for electricity generation—estimated at about 11.2 million tonnes (Mmt) in 2012 (EIA, 2014)—largely from the United States, with smaller volumes from Colombia, Venezuela, and Russia (NRC, 2014). About 89 percent of the coal consumed in Canada is for thermal power generation and the remainder is used in the steel (7 percent), cement, and other industries.

The recoverable coal reserves in the country are estimated at 6.6 billion tonnes and Canada's coal production has been declining, dropping from 78.7 Mmt in 1997 to 66.5 Mmt by 2012 (EIA, 2014).

Table 6-1 quantifies recoverable reserves and recent coal production in Canada.

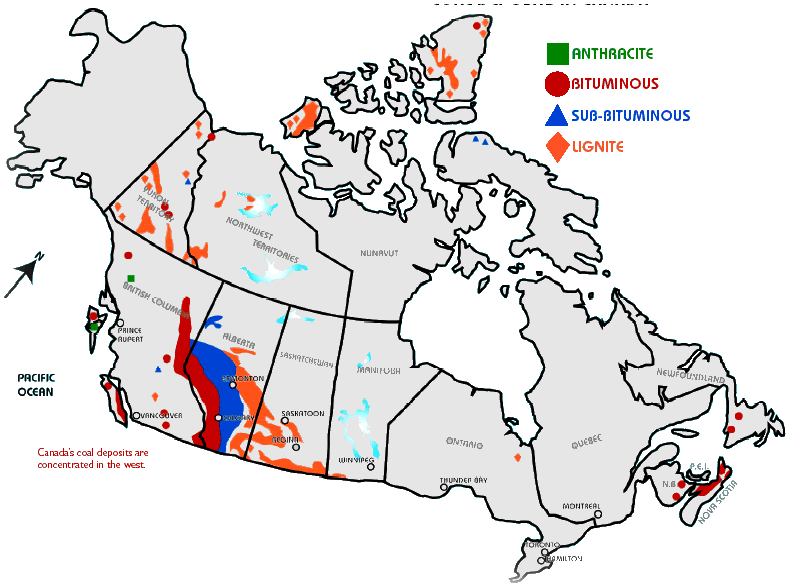
Table 6-1. Canada's Coal Reserves and Production

Indicator	**Anthracite & Bituminous** (million tonnes)	**Sub-bituminous & Lignite** (million tonnes)	**Total** (million tonnes)	**Global Rank** (# and %)
Estimated Proved Coal Reserves (2011)	3,474	3,108	6,582	15 (0.74%)
Annual Coal Production (2012)	57.0	9.5	66.5	13 (0.84%)

Source: EIA (2014)

Production occurs mainly in Alberta (43 percent), British Columbia (BC) (35 percent), and Saskatchewan (11 percent), as shown in Figure 6-1. Coal mines in eastern Canada, New Brunswick, and Nova Scotia are small operations.

Figure 6-1. Canada's Coal Fields



Source: CAC (2006)

6.1.2 STAKEHOLDERS

Table 6-2 identifies potential key stakeholders in coal mine methane (CMM) development in Canada.

Table 6-2. Key Stakeholders in Canada's CMM Industry

Stakeholder Category	Stakeholder	Role
Mining Companies	▪ The three giants in the coal industry (Luscar Ltd., Teck Cominco Ltd., and Fording Inc.) have merged to form the Elk Valley Coal Corp., with Teck Cominco as the managing partner. ▪ Western Canadian Coal Corp. ▪ Grande Cache Coal Corp. ▪ Encana ▪ MGV Energy Inc. ▪ Apache Canada Ltd. ▪ Trident Exploration Co. ▪ Burlington ▪ Nexen ▪ Anadarko ▪ Talisman ▪ CDX ▪ Thunder ▪ Dominion ▪ APF ▪ Vectren ▪ Walter Energy Inc.'s Canadian Operations ▪ Winsway Coking Coal Holdings Ltd ▪ Marubeni Corporation ▪ Anglo American Plc's Peace River Coal Inc.	Project hosts

Table 6-2. Key Stakeholders in Canada's CMM Industry

Stakeholder Category	Stakeholder	Role
	▪ Sherritt International Corporation	
Mining Companies (con't)	▪ Vitol Group's Hillsboruough Resourced Ltd. ▪ NB Power (power-producing company that also mines coal) ▪ TransAlta Corporation (power-producing company that also mines coal)	Project hosts
Developers	▪ VWVulcan Energy of Canada, Ltd. ▪ Trident Exploration ▪ Husky Energy ▪ Nexen ▪ Red Willow ▪ See http://www.epa.gov/coalbed/networkcontacts.html	Project opportunity identification and planning
Engineering, Consultancy, and Related Services	▪ See http://www.epa.gov/coalbed/networkcontacts.html	Technical assistance
Universities, Research Establishments	▪ University of Montana (Water Quality Management) ▪ Alberta Research Council ▪ Natural Resources Canada ▪ Canadian Mineral and Energy Technologies (CANMET)	Technical assistance
Government Groups	▪ Natural Resources Canada ▪ Alberta Ministry of Energy ▪ British Columbia Ministry of Energy, Mines, and Petroleum Resources	Permitting and licensing
Professional Associations	▪ Canadian Association of Petroleum Producers (CAPP) ▪ The Mining Association of Canada ▪ Coal Association of Canada ▪ Saskatchewan Mining Association	Technical assistance

Sources: AAPL (2005); NRC (2014)

6.1.3 STATUS OF COAL AND THE COAL MINING INDUSTRY

Canada has 24 coal mines. Practically all coal mined in Canada (97 percent) is extracted by surface mining methods, specifically open-pit mining in the mountainous regions of Alberta and BC and strip mining in BC and the Prairies of central and southern Alberta and southern Saskatchewan. Nova Scotia also hosts two surface pits. There are only two operating underground mines in Canada, the Quinsam mine on Vancouver Island in BC and the Grande Cache mine in Alberta, which has both surface and underground operations (NRC, 2012). However, several underground mines are in various stages of planning, and it is likely that the number of underground mines and their contribution to total coal production will grow in the future. Table 6-3 provides statistics on Canadian coal mining as of 2012.

Table 6-3. Canada's Most Recent Statistics for Coal Mining

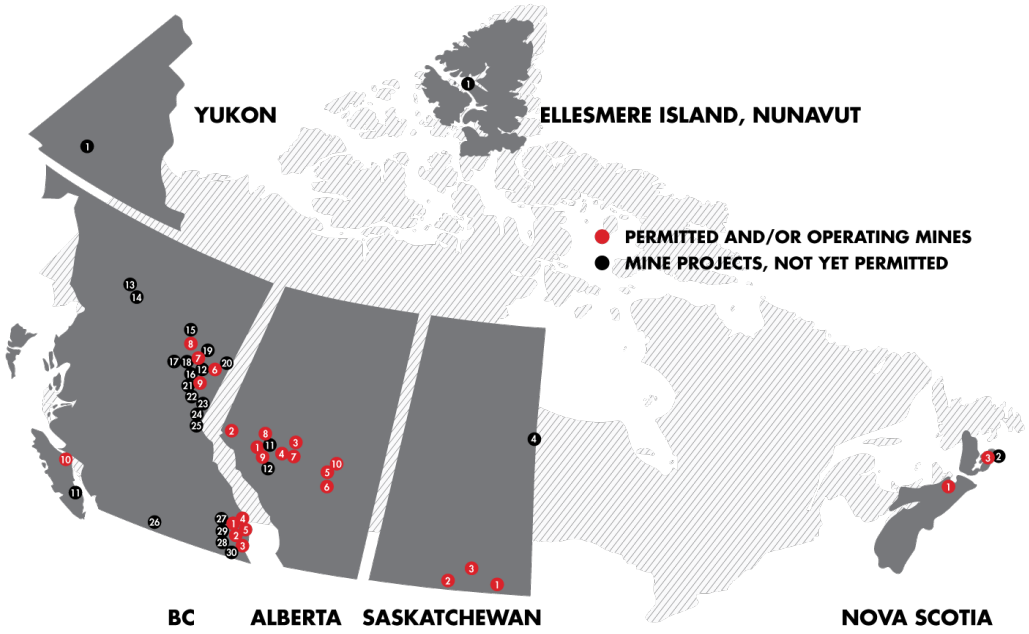
Type of Mine	Production (million tonnes)	Number of Mines
Underground (active) mines – total	*0.5 (2012)	1 (2012)
Surface (active) mines – total	66 (2012)	20 (2012)

Source: *NRC (2012)

The country largely produces bituminous coal, which accounted for 48 percent of its entire coal production in 2001. Sub-bituminous coal, mined in Alberta, forms the next largest component in Canada's coal production at 35 percent. No anthracite currently is mined in Canada, although some has been discovered in BC. Lignite occurs in Saskatchewan and Alberta and is used to produce 65 percent of Saskatchewan's electricity.

The operational status of Canadian coal mines is illustrated in Figure 6-2, while Table 6-4 lists mine status by region.

Figure 6-2. Status of Canada's Coal Mines



Source: CAC (2014)

Table 6-4. Status of Canada's Coal Mines

Region	Permitted and/or Operating Mines (operated by)	Mine Projects, Not Yet Permitted (owned*/operated by)
Alberta	1. Gregg River (Sherritt International) 2. Grande Cache (Grande Cache Coal) 3. Highvale Mine (TransAlta and SunHills Mining Partnership) 4. Coal Valley (Sherritt) 5. Paintearth Mine (Sherritt) 6. Sheerness Mine (Sherritt) 7. Genesee Mine (Sherritt) 8. Obed Mountain (Sherritt) 9. Cheviot (Teck) 10. Ryley (Dodds Coal)	11. Vista (Coalspur) 12. Palisades (Altitudes Resources Ltd.)
Nova Scotia	1. Stellarton Mine (Pioneer Coal Limited) 3. Point Aconi *(currently in reclamation phase)*	2. Donkin Mine Project (Morien Resource Corporation)
Saskatchewan	1. Boundary Dam (Sherritt) 2. Poplar River Mine (Sherritt) 3. Bienfait Mine (Sherritt)	4. Border Mine (GoldSource Mines)
Yukon		1. Division Mountain coal deposit (Pitchblack Resources)
Ellesmere Island, Nunavut		1. Fosheim Property (Canada Coal Inc.)
British Columbia	1. Fording River Mine (Teck) 2. Greenhills Mine (Teck) 3. Line Creek Mine (Teck) 4. Coal Mountain Mine (Teck) 5. Elkview Mine (Teck) 6. Wolverine Mine (Walter Energy Inc.) 7. Brule Mine (Walter Energy Inc.) 8. Willow Creek Mine (Walter Energy Inc.) 9. Trend Mine (Anglo American) 10. Quinsam Mine (Hillsborough Resources)	11. Raven (Compliance Energy Corporation 12. Quintette (Teck) 13. Arctos (Arctos Anthracite Joint Venture)* 14. Groundhog (Atrum Coal) 15. Carbon Creek (Cardero Resource Corp.) 16. Sukunka (Xstrata Coal Canada) 17. Suska (Xstrata Coal Canada) 18. Mt. Hudette/Brazion (Walter Energy's Canadian Operations 19. Gething (CKD Mines Co. Ltd.) 20. Echo Hill (Hillsborough Resources Limited) 21. Murray River (HD Mining Ltd.) 22. Roman Mountain (Anglo American) 23. Belcourt (Walter Energy's Canadian Operations) 24. Huguenot (Colonial Coal International Corporation) 25. Saxon (Walter Energy's Canadian Operations) 26. Basin (Coalmont Energy Corp) 27. Bingay (Centermount Coal Limited) 28. Marten-Wheeler (Teck) 29. Crown Mountain (Jameson Resources) 30. Coal Creek (Crows Nest Pass Coal Mining)

Note: *Number by mine name indicates location on Figure 6-2*
Source: CAC (2014)

The coal deposits in central and southern parts of Alberta and Saskatchewan lie in blankets of uniform thickness close to the surface, while the coal around the BC/Alberta border run into mountainous terrain and the seams can be as thick as 15 meters, deeply buried and inclined, making mining a challenge. In eastern Canada, Nova Scotia contains the largest coal deposits. The largest one, Sydney coalfield, has 11 seams that are 1.0 to 4.5 meters thick and is located under the ocean. Economics posed challenges to extracting that coal, however, and the mines were closed. Furthermore, the mining conditions are quite difficult and dangerous in the region as evidenced by an explosion and fatalities at the Westray mine. The coal in Ontario has a low-heat value and is not exploited. Finally, the potential of coal deposits in the northern half of the country have yet to be explored (CAC, 2003).

The Canadian coal industry has undergone major restructuring recently with the consolidation of mining companies starting in 2003. The three giants in the coal industry—Luscar Ltd., Teck Cominco Ltd., and Fording Inc. —merged to form the Elk Valley Coal Corp. (EVCC), with Teck Cominco as the managing partner of EVCC. As part of the deal, Luscar Energy Partnership bought the thermal coal assets of Fording to become the largest producer of thermal coal in Canada. Luscar's assets include the undeveloped coalfields, royalty interests, mining service contracts, and an interest in a joint mining venture. With these mergers, Luscar Coal Ltd. and EVCC are in charge of 99.5 percent of the entire Canadian coal production, operating all 15 large-scale mining operations (>1 Mmt/yr) (NRC, 2005). In 2008, Teck bought out the Fording Canadian Coal Trust (Mining Exploration News, 2008). In 2011, Anglo American acquired an additional 25.17 percent interest of Peace River Coal Limited Partnership thus making Anglo American the 100 percent owner of PRC. PRC operates the Trend mine in the Rumbler rage of BC and is conducting future exploration studies. Also in 2011, Xstrata plc took over First Coal Corporation through its subsidiary, Xstrata Coal Canada Ltd, while Walter Energy acquired Western Coal Corporation and GCC entered an acquisition agreement with Winsway and Marubeni through the partnership "1629835 Alberta Ltd." (NRC, 2011).

Although domestic consumption of coal has declined recently, coking coal exports are on the rise with an increasing demand for metallurgical coal worldwide, especially as China turns into an importer of coking coal. Canada was the world's third largest exporter of coking coal in 2012 when coking coal exports reached 30.7 Mt, an 11-percent increase from 2011 to 2012. EVCC has increased metallurgical coal production and opened the Cheviot Creek Pit near Hinton, Alberta, which has a production capacity of 1.7Mt/y. Walter Energy, Winsway Coking Coal Holdings Ltd., and Marubeni Corp also produce coking coal for export. In recent years, six more mining projects have been or are under development by individual companies, five of which are in BC (i.e., Carbon Creek, Murray River, Echo Hill, Bingay, and Sukunka). Four of the mines plan to produce coking coal while the other mine plans to produce bituminous thermal coal for export (NRC, 2012). In eastern Canada, Nova Scotia is taking steps to restart coal mining, although a contract has not yet been assigned.

6.2 Overview of CMM Emissions and Development Potential

The Global Methane Initiative (GMI) International CMM Projects Database currently identifies no projects in Canada, in operation or under development (GMI, 2014). Updates on future CMM projects in Canada can be found at https://www.globalmethane.org/coal-mines/cmm/index.aspx.

6.2.1 CMM EMISSIONS FROM OPERATING MINES

There are no CMM utilization projects in Canada. Methane emissions in Canada were estimated at 67.9 million cubic meters (m^3) in 2000, are expected to increase slightly to 68.6 million m^3 by 2015, and then anticipated to further increase to 76.3 million m^3 by 2030. Table 6-5 summarizes the country's CMM emissions.

Table 6-5. Canada's CMM Emissions (million cubic meters)

Emissions	2000	2005	2010	2015 (projected)
Total CH_4 Emitted	67.9	70.0	65.8	68.6

Source: USEPA (2012)

6.2.2 CMM EMISSIONS FROM ABANDONED COAL MINES

Closed coal mines on Cape Breton Island in Nova Scotia may hold the greatest promise for abandoned mine methane (AMM) recovery in Canada. Four closed mines on Cape Breton Island near New Waterford (the Phalen and Lingan collieries), Glace Bay (No. 26 mine) and at the northeastern tip of Boularderie Island (Prince colliery) were large, high production longwall operations when operating. The No. 26 colliery opened in 1944, and the other three mines began operations between 1972 to1975. At their peak, the No. 26 produced 900,000 tonnes, the Lingan mine produced nearly 2 Mmt of raw coal and the Prince colliery produced nearly 1 million tonnes of coal (Nova Scotia Department of Mines, 1985). The No. 26 colliery operated until 1984 when it closed due to a fire. The Lingan colliery closed in 1992, the Phalen closed in 1999 and the Prince colliery closed in 2001. A fifth mine, the Donkin mine on Cape Breton Island began development in 1987 and operated for several years in the 1990s, but also closed in the 1990s. However, a significant effort is underway to reopen the Donkin mine, with several permitting steps already accomplished. Although information on methane emissions is limited, the Phalen mine was considered a gassy mine. However, a significant challenge with AMM recovery from any of these mines is that they are submarine mines extending underneath the surface of Atlantic Ocean requiring an offshore production system or use of horizontal drilling from the surface. Flooding of the mine workings is also a potential problem.

In addition to these mines, several other smaller mines have operated in Nova Scotia (Nova Scotia Department of Mines, 1985).

6.2.3 CBM FROM VIRGIN COAL SEAMS

Assessing the extent of coal bed methane (CBM) prospects in Canada started within the last decade. The results are illustrated in Figures 6-3, 6-4, and 6-5 on following pages. According to the Canadian Gas Potential Committee, however, they could be anywhere between 5.3 and 13 trillion m^3. These estimates are from exploration mainly in the Western Canada Sedimentary Basin. Table 6-6 lists the major Canadian CBM exploration sites.

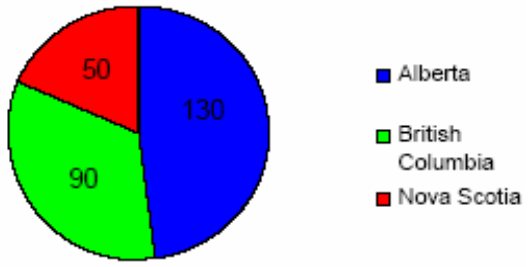
Table 6-6. Canada's Major CBM Reserves

Location	Reserves (trillion cubic meters)
Horseshoe Canyon	1.04
Pembina (including Ardley)	0.84
Mannville	4.76
Alberta/BC Foothills (Gates/Mist Mtn)	3.7

Source: AAPL (2005)

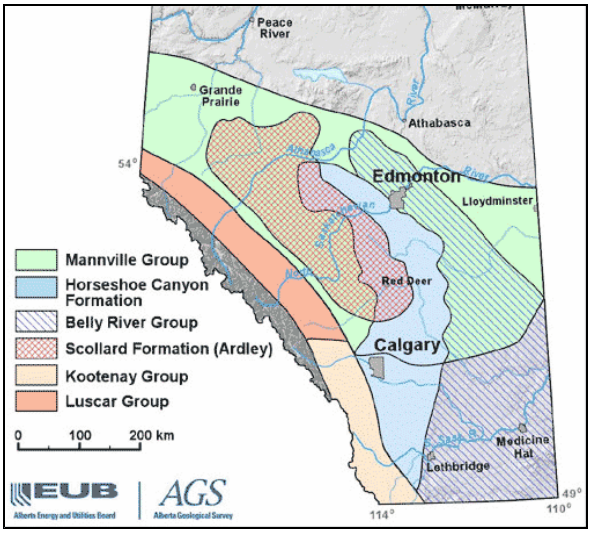
Canadian coal seams with CBM potential are found beneath much of Alberta, especially in the southern and central regions, in which the Alberta Geological Survey (AGS) have estimated there could be as much as 14 trillion m^3 (about 500 trillion cubic feet or Tcf) of CBM held in Alberta coal (AGS, 2013). The primary CBM potential areas in Alberta are the Ardley, Horseshoe Canyon, and the Mannville coal zones, with the Upper Manville being the gassiest zone. Alberta offers particularly favorable conditions for CBM development as the geology of CBM deposits are relatively simple and uniform over a wide area (Amazouz, 2006). Within BC, the major concentration is in the northeast and to a much lesser extent in the southeast of the province, amounting to a total of 2.5 trillion m^3 (BC, 2002). Nova Scotia forms the third largest portion of the Canadian CBM reserve.

Figure 6-3. Location of Probable Economically Recoverable CBM Reserves in Canada (trillion cubic feet)



Source: AEUB (2004)

Figure 6-4. Primary CBM Potential Areas in Alberta



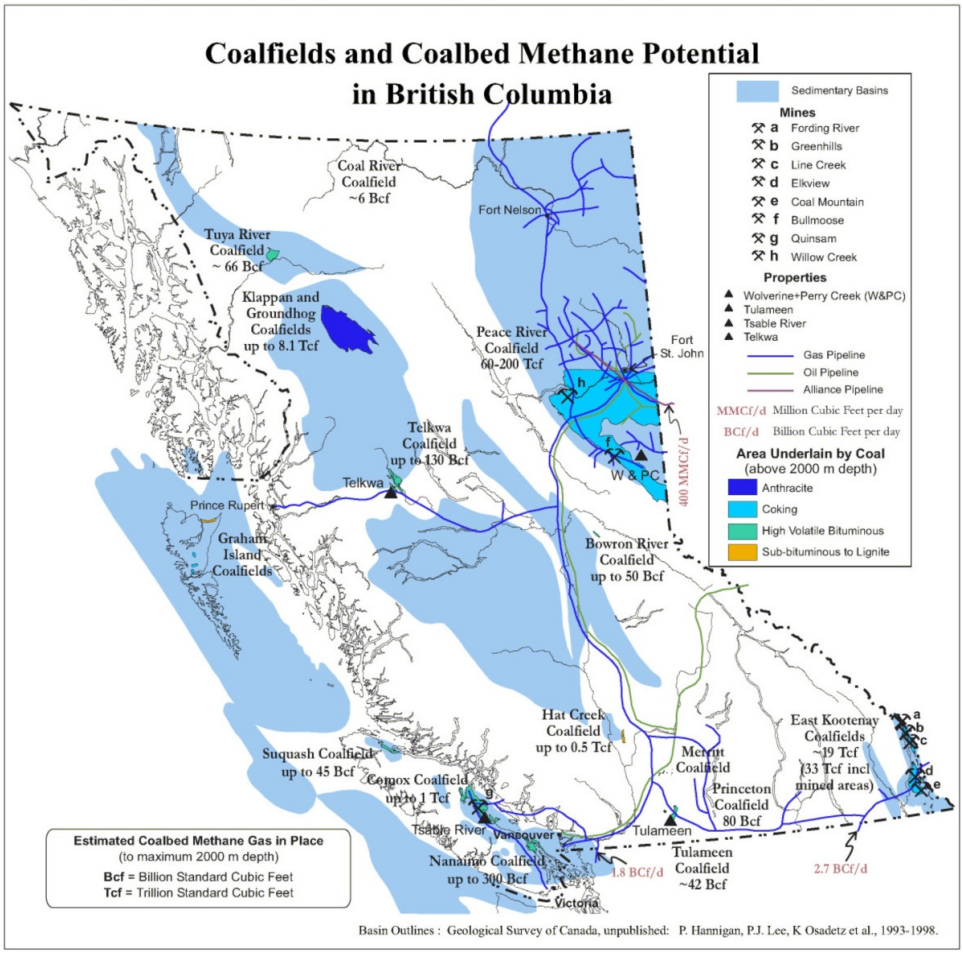
Source: AEUB (2004)

The CBM industry is relatively new in Canada compared to its neighbor, the United States. However, in Alberta alone, there were more than 3,500 CBM wells in place by 2004, with most of these

concentrated in Alberta and BC (Snyder, 2005). A forecast report projected annual CBM production of 14.5 billion m^3 by 2015 for all of Canada (NAEWG, 2005; Amazouz, 2006).

The first Canadian methane production began in 2002 in the Horseshoe Canyon region in Alberta. The Horseshoe Canyon coals are dry and relatively close to the surface, enabling easy gas recovery. Therefore, these fields accounted for 90 percent of the producing wells in Alberta in 2005 (Snyder, 2005), generating more than 2.8 million m^3 per day of methane. Alberta's CBM production in 2005 totaled 2.5 billion m^3 (Amazouz, 2006). By 2008, there were 6000 wells producing 5.2 billion m^3 per year, all located in Alberta (International, 2008). By 2010, a total of 14,000 wells had been drilled (not all of which are active) and production is approximately 7.2 billion m^3 per year (Ember, nd).

Figure 6-5. CBM Potential in British Columbia



Source: BC (2002)

Additional CBM Exploration and Production

A number of companies have explored CBM projects on Vancouver Island where the coal rank is bituminous with cumulative coal seam thickness of 23 feet. Priority Ventures Ltd. conducted some test drilling in 2001, while Quinsam Coal Corporation allied with CornerStone Gas to explore CBM development on the island (BC, 2009).

Trident Exploration worked with Husky Energy to develop CBM in the Fenn Rumsey area. The joint venture started in 2002, was extended in 2004, and planned to drill some 400 exploratory wells by 2006 (Husky, 2005). In a second project, Trident worked with Nexen and Red Willow to start the first CBM venture in the Mannville formation in Alberta (BennettJones, 2005), and by 2008, they had completed 650,000 meters of drilling in Mannville (Trident, 2008). Royal Dutch Shell had licenses for tenure to explore for CBM in the Klappan area of northwest BC, but a four-year moratorium has been declared on development of CBM resources in that region (Shell, 2008) and the BC government officially ruled the Klappan region off-limits for further gas exploration (Vancouver Sun, 2012). BP had tenure at its CBM project at Mist Mountain in southeast BC, but later sold its Western Canadian upstream gas assets to Apache Corporation (BP, 2010).

By mid-2008, approximately 60 CBM exploration wells had been drilled outside of Alberta but no commercial production existed. The BC and Nova Scotia coals generally exhibited low permeability, and coals in Ontario and Saskatchewan showed insufficient gas for commercial production (International, 2008). But by December 2008, GeoMet Inc. began the first commercial delivery of CBM from the Peace River project in BC (GeoMet Inc., 2009). By January 2009, Nova Scotia also had three CBM projects, two of which are Stealth Ventures Inc. projects in Cumberland and Stellarton basins. The third project is in the Sydney basin of northern Nova Scotia (Prospect Profile, 2009).

In April 2012, Toyota Tsusho Corp. invested more than $600 million to acquire a share of Encana Corporation's extensive CBM reserves in southern Alberta, and the Japanese company will acquire a 32.5 percent royalty interest in about 5,500 existing and future Encana CBM wells (Encana, 2012).

6.4 Opportunities and Challenges to Greater CMM Recovery and Use

Canada is a signatory to both the UNFCCC and the Kyoto Protocol (see Table 6-7). As an Annex I Party, its emissions target under the Kyoto Protocol is to achieve a 6 percent reduction of 1990 greenhouse gas emission levels by 2010.

Table 6-7. Canada's Climate Change Mitigation Commitment

Agreement	Signature	Ratification
UNFCCC	June 12, 1992	December 4, 1992
Kyoto Protocol	April 29, 1998	December 17, 2002

Source: UNFCCC (2014)

Canada has demonstrated its commitment to addressing climate change by providing international climate finance in support of mitigation actions by developing countries and support for adaptation by the poorest and most vulnerable countries. This included Canada's fast-start financing contribution of $1.2 billion (from 2010 to 2012) to support a range of climate change projects in more than 60 developing countries, as announced in Durban (Government of Canada, 2014).

Canada withdrew from the Kyoto Protocol agreement in 2012, and began extending its efforts beyond the UNFCCC by working with other countries through complementary forums such as the Arctic Council, for which Canada has assumed the two-year chairmanship through 2015, and the Climate and Clean Air Coalition (CCAC) to develop practical and collaborative initiatives to reduce

GHG emissions and short-lived climate pollutants (Government of Canada, 2014). In 2013, Canada announced its commitment of an additional $10 million—on top of its $10 million commitment in 2012—to the CCAC. Canada, together with the United States and Mexico, is also leading international efforts to use the expertise and institutions of the Montreal Protocol to phase out hydrofluorocarbons production and consumption.

6.4.1 MARKET AND INFRASTRUCTURE FACTORS

The major issues that concern the Canadian CBM industry are geology, land consolidation and access, freehold leases, water disposal (both brine and fresh), regulatory matters, and CBM technology (Ziff, 2004). In general, all CBM projects are private-industry-driven in Canada, with companies typically forming partnerships (i.e., joint ventures) to commercially develop CBM projects.

Canada joined the Global Methane Initiative (formerly the Methane to Markets Partnership) in July 2005. Canada's efforts thus far, however, have been largely limited to the oil and gas industry (Canada is a member of the GMI Oil and Gas Subcommittee). Long-term consumption of natural gas is expected to grow steadily in Canada, while domestic production of conventional natural gas is believed to have peaked in 2003 (Amazouz, 2006). The expected shortfall will be met by a number of alternative natural gas resources:

- Mackenzie Delta and Beaufort Sea fields
- Other remote gas fields (north of 60th parallel)
- Liquefied natural gas importation
- Offshore East Coast and West Coast gas fields
- CBM reserves estimated at 4.7 trillion m^3 (CAPP, 2004)

Canada is also pursuing other avenues of alternative gas resources. In 1996, Natural Resources Canada's Canmet Energy Technology Centre –Varennes initiated the development of a catalytic reactor that could, both technically and economically, recover the methane of coal mine ventilation air. The technology, called CH4MIN, recovers the energy of the dilute ventilation air methane, with an efficiency varying between 40 and 95 percent, depending on the methane concentration in the ventilation air (Amazouz, 2006). The CH4MIN was tested at bench scale at the CANMET lab in Quebec and large pilot-scale at the now closed Phalen Coal Mine in Nova Scotia. CANMET has licensed the technology to several companies including the current global license holder, Sindicatum Sustainable Resources. Sindicatum built and operated a commercial-scale 15 m^3/sec (32,000 cfm) demonstration reactor to test the CH4MIN technology under field conditions. The company is exploring the economic viability of the CH4MIN technology in China (Talkington, 2014).

Further on R&D front, the Alberta Research Council (previously known as the Alberta Chamber of Resources) has been collaborating with the American, Canadian, and other international governments to improve CBM recovery efficiency (ACR, 2003). Non-nuclear government R&D spending is managed by Natural Resources Canada. The Program of Energy Research and Development (PERD), managed by Natural Resources Canada's Office of Energy Research (OERD15), is the major source of government funding for non-nuclear public and private research and development. Natural Resources Canada's Energy Technology Branch (ETB), which includes three laboratories in the Canada Centre for Mineral and Energy Technology, is the largest federal participant in, and manager of, non-nuclear science and technology programs. ETB receives a large share of PERD funds.

Canadian infrastructure is also being adapted to keep in step with its growing CBM/CMM industry. The Alberta Energy and Utilities Board (AEUB) recently approved Canada's major pipeline network for natural gas transportation, TransCanada PipeLines, to reconfigure its system to allow the low-pressure intake of CBM (BennettJones, 2005). CBM has to compete with other sources of Canadian gas in order for it to be purchased by pipelines that transport the gas to the U.S. or Canadian consumers.

6.4.2 REGULATORY INFORMATION

Initially, there was controversy regarding the ownership of CBM rights in Canada since coal and natural gas come under different jurisdictions. CBM rights in both BC and Alberta now follow the legal framework for natural gas. The provinces own and can sell the rights to develop CBM at their discretion. The *Coalbed Gas Act* clearly attributes all CBM rights to the owners of natural gas mineral rights and none to the owner of coal rights (ASB, 2004). This was upheld by the Alberta courts in 2011 (Canadian Energy Law, 2011). Canadian regulations enforce consultation with affected stakeholders and governments before development begins (CAPP, 2003). In BC, a potential producer must get Petroleum and Natural Gas tenure rights before production (BC, nd). In Nova Scotia, the *Petroleum Resources Act* recognizes coal gas as a distinct resource but has included it with the definition of petroleum as "coal gas, existing in its natural condition in strata." A specific coal gas agreement is also required before exploration, development, or production of CBM (Blakes, 2006). In Saskatchewan, CBM is defined by The Petroleum and Natural Gas Regulations of 1969 and is administered just like any other petroleum or natural gas development (Saskatchewan, nd).

Canada does not have federal tax credit incentives in place to stimulate investment in CBM technologies because legislative power rests largely with provincial governments. BC relies on a royalty incentive program to encourage CBM production. Recent amendments to the BC Petroleum and Natural Gas Royalty Freehold Production Tax Regulation allow water treatment costs to be included in the producer's cost of service allowances for CBM wells, place the production threshold at 17,000 m^3/day before a royalty is imposed on a CBM well, and raise the royalty credit on each well to $50,000 (BC Royalty, nd).

In the *Petroleum and Natural Gas Act*, CBM projects are not subject to well-spacing regulations (more wells are often required per field compared to natural gas resources) and CBM production data can stay confidential for an extended period (ASB, 2004).

CBM producers are subject to strict rules that apply at every stage of project development. All the federal and provincial wildlife and environmental laws and the elaborate industry-specific regulations apply to the CBM producers as well (CAPP, 2003).

6.5 Profiles of Individual Mines

Ardley and Lower Edmonton Mines, Alberta

General Overview

Total mining area, km²	Several hundreds
No. of coal seams	1-30
Total methane resource	0.84 trillion cubic meters
Rank of coal	Sub-bituminous, high-volatile
Cumulative thickness	Up to 25 meters
Depth of mining	200 to 700 meters
Moisture	Dry
Gas content average	1.87 m3/tonne
Mining method	Surface

Upper Mannville Mines, Alberta

General Overview

No. of coal seams	2-5
Total methane resource	4.76 trillion cubic meters
Rank of coal	Bituminous
Cumulative thickness	Up to 20 meters
Depth of mining	800 to 1500 meters
Moisture	High (dewatering required)
Gas content average	9.4 – 15.6 m^3/tonne
Mining method	Surface

Source: Sproule (2004)

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