EMD Coalbed Methane Committee Report
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Brian Cardott (Chair; Oklahoma Geological Survey)

Vice Chairs:
   Maria Mastalerz (Government Vice Chair; Indiana Geological Survey)
   Jack Pashin (Academic Vice Chair; Oklahoma State University)

EXECUTIVE SUMMARY

Coalbed methane (CBM; also known as coal-bed methane, coalbed natural gas, coal seam gas) is a type of unconventional natural gas generated and stored in coal beds. Sorbed gas is released and produced from coal following the reduction of hydrostatic pressure with the removal of water from coal cleats and other fractures during drilling. Coal mine methane (CMM), on the other hand, is gas produced in association with coal mining operations.

Production and reserves of natural gas from coal beds in the United States continued to decline in 2016. CBM is still an important resource globally. Research on CBM remains active, however, as indicated by >50 technical papers published in 2017.

Mastalerz (2014, figure 7.3) included a map showing world CBM resources, production, and exploration activities as summarized below, modified by data from Kelafant (2016).

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<tr>
<td>Russia</td>
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<tr>
<td>China</td>
<td>1,100</td>
<td>1,300</td>
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<tr>
<td>Alaska</td>
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<tr>
<td>U.S. (minus Alaska)</td>
<td>700</td>
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<td>Australia</td>
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</tr>
<tr>
<td>Southern Africa</td>
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</tr>
</tbody>
</table>
STATUS OF U.S. COALBED METHANE ACTIVITIES

The EIA (2009a) shows a map of U.S. lower 48 states CBM fields (as of April 2009). U.S. annual CBM production peaked at 1.966 trillion cubic feet (Tcf; 55.67 billion m$^3$) in 2008 (EIA, 2009b, 2010, 2018a). CBM production declined to 1.020 Tcf (28.88 billion m$^3$) in 2016 (EIA, 2018a), the lowest level since 1997, representing 3.8% of the U.S. total natural gas production of 26.7 Tcf (756.1 billion m$^3$; EIA 2018b; Figure 1).

Note that U.S. CBM production in EIA (2018a, their Table 15) is different than U.S. CBM gross withdrawals in EIA (2017a, their Table 1). According to EIA (2018a, their Table 15), the top 7 CBM-producing U.S. states during 2016 (production in billion cubic feet, Bcf; or million m$^3$) were Colorado (352; 9.97), New Mexico (253; 7.16), Wyoming (143; 4.05), Virginia (102; 2.89), Alabama (45; 1.27), Oklahoma (43; 1.22), and Utah (39; 1.10). Annual CBM production decreased for each state over the previous year (EIA 2018a, c; Figure 2). Cumulative U.S. CBM production from 1989 through 2016 was 35.7 Tcf (1.01 trillion m$^3$).


| Annual CBM Production by Country (2010 data) (from Mastalerz, 2014) |
|------------------------|------------------|
| **Country** | **Production, Bcf** |
| U.S. (minus Alaska) | 1,886 |
| Canada | 320 |
| Australia | 190 |
| China | 50 |
| Alaska | 1 |
| Russia | 0.5 |
| India | 0.4 |
| Kazakhstan | 0.4 |
Figure 1. United States CBM production (1989–2016; compiled from EIA, 2018a).

Figure 2. Annual CBM production of the top 7 U.S. states during 2016 (1989–2016; compiled from EIA, 2018a, c).

According to the Potential Gas Committee Press Release (2017), the United States has 158.7 Tcf (4.5 trillion m³) CBM resources (15.0 Tcf, 0.4 trillion m³ probable resources [current fields], 48.0 Tcf, 1.4 trillion m³ possible resources [new fields], and 95.7 Tcf, 2.7 trillion m³ speculative resources [frontier]) for 2016, an increase of 0.6 Tcf (17.0 billion m³) CBM resources since 2014. By region, 152.3 Tcf (4.3 trillion m³) “most likely” CBM resources are distributed as follows: 57.0 Tcf (1.6 trillion m³), Alaska; 52.6
Tcf (1.5 trillion m³), Rocky Mountain; 17.3 Tcf (489.9 billion m³), Atlantic; 11.6 Tcf (328 billion m³), North Central; 7.8 Tcf (221 billion m³), Mid-Continent; 3.4 Tcf (96 billion m³), Gulf Coast; and 2.6 Tcf (74 billion m³), Pacific.

U.S. annual CBM proved reserves peaked at 21.87 Tcf (619 billion m³) in 2007 (EIA, 2009b, 2010, 2018d) and declined to 10.585 Tcf (300 billion m³) in 2016 (EIA, 2018d) representing 3.3% of the U.S. total natural gas reserves of 322 Tcf (9.1 trillion m³; EIA, 2018e; Figure 3). Annual CBM proved reserves by U.S. state (through 2016) are available at EIA (2018d).

![U.S. CBM Proved Reserves (1989-2016)](image)

Figure 3. United States CBM proved reserves (1989-2016; compiled from EIA, 2009b, 2010, 2018d).

The EPA Coalbed Methane Outreach Program ([https://www.epa.gov/cmop](https://www.epa.gov/cmop)) has information on U.S. coal mine methane, including a map of CMM recovery at active and abandoned U.S. coal mines.

**STATUS OF INTERNATIONAL COALBED METHANE ACTIVITIES**

**Australia.** Stark and Smith (2017) indicated the Walloon CBM play in the Bowen-Surat Basin (discovered in 2009) has gas resources of 503 million barrels of oil equivalent (MMBOE) while the Walloon CBM play in the Kumbarilla Ridge Basin (discovered in 2001) has gas resources of 535 MMBOE.

commercial reserves at 114 Tcf (62% conventional natural gas, 38% coal bed methane (CBM), and less than 1% tight gas) as of 2014." “CBM resources, equivalent to about 43 Tcf, are primarily located in the northeastern Queensland Province in the Bowen Basin and the Surat Basin. Geoscience Australia anticipates the resource distribution of natural gas will shift from the offshore traditional gas production to CBM or other sources in the next few decades because key CBM developers are aggressively exploring and drilling in several areas.” “Commercial production from CBM, which began in 1996, rose to 424 Bcf in 2015, 50% higher than in 2014. This production increase corresponds with the commencement of the country’s first CBM-to-LNG export terminals in Queensland over the past two years”.


An interactive map of coal seam gas wells in New South Wales is available at http://www.resourcesandenergy.nsw.gov.au/landholders-and-community/coal-seam-gas/facts-maps-links/map-of-csg-wells. Relatively few wells are producing gas, while most of the wells are either “permanently sealed” or “not producing gas”.

China. Stark and Smith (2017) indicated the Taiyuan CBM play in the Qinshui Basin (discovered in 2007) has gas resources of 717 MMBOE.

By the end of August 2017, the CBM production in China was 4.46 billion m$^3$ with a growth of 3.3%, of which the production in August alone was 0.59 billion m$^3$ with a growth of 7.2%, as reported by the China Coal Bed Methane Industry Market Research Report (http://www.china5e.com/news/news-1004285-1.html). Shanxi province has the most CBM production of 2.92 billion m$^3$ in the eight months of 2017, of which in August 2017 the CBM production was 0.41 billion m$^3$, accounting for 70% of the total production in the whole country. According to the news from the Shanxi province Land and Resources Department of August 23, 2017, the Yushe-wuxiang coalbed methane resource survey project made breakthrough progress with a new discovery of CBM and shale gas resources of 181.2 billion m$^3$ in an area of 388.51 km$^3$. Ignition tests show that daily production is up to 1000 m$^3$. Burial depth of the coal bed in this area is more than 1300 m. The project shows a great innovation in production technology of deeply buried CBM (http://www.inengyuan.com/2017/nynews_0825/3338.html). By the end of August 2017, North China Petroleum Company drilled 107 CBM wells and is planning to drill 157 more wells. By 2020, annual CBM production in North China Petroleum Company is estimated to be 20 billion m$^3$.


Canada. Canada contains diverse CBM resources, which are concentrated chiefly in the Carboniferous strata in the intermontaine basins of the Canadian Maritime Provinces, Mesozoic-Cenozoic strata in intermontaine basins of British Columbia, and in Cretaceous strata of the Western Canada Sedimentary Basin of the Cordilleran foreland
in Alberta. The vast majority of the resource and reserve base are in Alberta, where the Alberta Geological Survey estimates OGIP on the order of 500 Tcf. The bulk of the production comes from the Horseshoe Canyon play, and development is active in a variety of Cretaceous coal-bearing formations. Early production operations focused on vertical wells completed in multiple coal seams, and expansion of the industry between 2005 and 2007 was buoyed by the advent of lateral and multilateral drilling in single seams.

Remaining reserves in Alberta are estimated to be about 2 Tcf according to the Alberta Energy Regulator, indicating that, although development is widespread, potential exists for a major expansion of the industry given a favorable economic climate. Development activity, however, has decreased significantly in recent years in response to low natural gas prices. According to the International Energy Agency, Canadian CBM production peaked at 8.9 Bcm (315 Bcf) in 2010. Production was 7.2 Bcm (254 Bcf) in 2014, and the annual rate of decline has increased from 3.7% in 2011 to 6.8% in 2014 (Figure 4). Accordingly, the current economic climate remains challenging for the development of new CBM reserves in Canada.


![Figure 4. Canadian unconventional gas production, 2000-2014 (source: International Energy Agency). Coalbed methane production peaked in 2010, and the rate of decline has been increasing since 2011 as Canadian natural gas markets are challenged by decreasing natural gas prices.](image)

**India.** Bhattacharya (2016, p. 51) reported that “India contains 60.6 billion tonnes of coal…could contain up to 4.6 trillion m³ of gas.” Of 33 CBM exploration blocks awarded
since 2001, only three blocks are producing gas. “The lack of commercial production stems from factors including the lack of detailed reservoir characterization, the lack of professional training for domestic companies, and the lack of equipment and advanced CBM technology in the most productive basins” (Bhattacharya, 2016, p. 51).

**Russia.** Information on prospects for CBM production in Russia is at [http://www.gazprom.com/about/production/extraction/metan/](http://www.gazprom.com/about/production/extraction/metan/) (accessed February 16, 2018).

**References Cited**


Bhattacharya, G., 2016, Natural gas, unconventional resources can assist India in meeting future energy demand: Oil & Gas Journal, v. 114.11, p. 46-51.


([http://www.eia.gov/naturalgas/crudeoilreserves/index.cfm](http://www.eia.gov/naturalgas/crudeoilreserves/index.cfm))

EIA, 2018b, U.S. dry natural gas production: U.S. Energy Information Administration,  
([http://www.eia.gov/dnav/ng/ng_prod_sum_a_EPG0_FPD_mmcf_a.htm](http://www.eia.gov/dnav/ng/ng_prod_sum_a_EPG0_FPD_mmcf_a.htm)) (accessed February 16, 2018).


Potential Gas Committee Press Release, 2017, Potential supply of natural gas in the United States (December 31, 2016). (accessed February 16, 2018) https://urldefense.proofpoint.com/v2/url?u=http-3A__r20.rs6.net_tn.jsp-3Ff-3D0011zlK7N4K4reARd1jxRQ-5FJ8QSQHOIAJBxC9Ye8v-2D6e9WaTSs0SSH7HUZoJ82J2TLxCMeT0-5FOCsEIksA-2DbnCwziTujiN9R1sVhTdOp4Q9SO1iDy7sH1T-5FeRrKz9UtN-2DftVHnynFETcp-5Fm2h93JwQ2sm1LFSUeMBJtCNRMnNJVnmmDl-5FpWWFKhCl-5F40Zd4xtcRo-5F47-2Dct8NQAjePBOGWXK58CCF4J-5F6jiDl5jOWg-3D-26c-3DpRACQcbsIqRQHpUUMwkFDW1gf2JufW-2D5lrl6NnAGtJTL36-2DfXJlJpXw-3D-3D-26ch-3DPXhQPnPlQdAXV23XwulC2HEdqGoleb0y1qOQAy7yoRFzTALR4OWwzoA-3D-3D&d=DwMFaQc&c=qKdtBuuu6dQK9MsRUVJ2DJPXW60ayO8fu4TfEHS8sGNk&r=qBMxFLM6DvXO2RTbLAPC9Q&m=aqwxW6NIKBs8F4nJy5h5NIhQeAXahwyWWy2FDTd3g&s=62TVuKEBxndJjpy?howo-tAvjWBqljs6SThNQVktCwE&e


Coalbed Methane Calendar


EMD Coalbed Methane Committee Web Links

General


Data


Government

U.S. EPA Coalbed Methane Outreach Program: [https://www.epa.gov/cmop](https://www.epa.gov/cmop)

U.S. EIA Coalbed Methane Maps: [http://www.eia.gov/maps/maps.htm#coalbed](http://www.eia.gov/maps/maps.htm#coalbed)


U.S. Geological CBM Fact Sheets:
- Coal-bed methane: Potential and concerns: [http://pubs.usgs.gov/fs/fs123-00/](http://pubs.usgs.gov/fs/fs123-00/)
- Water produced with coal-bed methane: [http://pubs.usgs.gov/fs/fs-0156-00/](http://pubs.usgs.gov/fs/fs-0156-00/)

U.S. EIA CBM Reserves and Production (Table 15): [http://www.eia.gov/naturalgas/crudeoilreserves/index.cfm](http://www.eia.gov/naturalgas/crudeoilreserves/index.cfm)

U.S. EIA CBM Production: [http://www.eia.gov/dnav/ng/NG_ENR_COALBED_A_EPG0_R52_BCF_A.htm](http://www.eia.gov/dnav/ng/NG_ENR_COALBED_A_EPG0_R52_BCF_A.htm)

U.S. EIA CBM Reserves: [http://www.eia.gov/dnav/ng/ng_enr_coalbed_a_EPG0_R51_Bcf_a.htm](http://www.eia.gov/dnav/ng/ng_enr_coalbed_a_EPG0_R51_Bcf_a.htm)

Oklahoma coalbed methane: http://www.ou.edu/content/ogs/research/energy/coal.html

Wyoming Oil & Gas Conservation Commission CBM: http://wogcc.state.wy.us/


Alberta Department of Energy: http://www.energy.alberta.ca/


Education/Information

Coalbed Methane Association of Alabama: http://coalbed.com/

Coalbed Methane Education (British Columbia): http://www.empr.gov.bc.ca/Mining/Geoscience/Coal/CoalBC/CBM/Pages/default.aspx


World Coal Association: http://www.worldcoal.org/coal/coal-seam-methane/coal-bed-methane/

Montana Earth Science Picture of the Week: http://formontana.net/coalbed.html