

# 3 Botswana



## 3.1 Summary of Coal Industry

### 3.1.1 ROLE OF COAL IN BOTSWANA

Botswana possesses huge coal resources estimated at greater than 200 billion tonnes. However, only three to five billion tonnes can be economically mined (Mmegi, 2009). The quality of coal is suitable for power generation and is the feedstock for 99.4 percent of electricity generated in the country (eStandards Forum, 2009). Table 3-1 quantifies total recoverable reserves and recent coal production in Botswana.

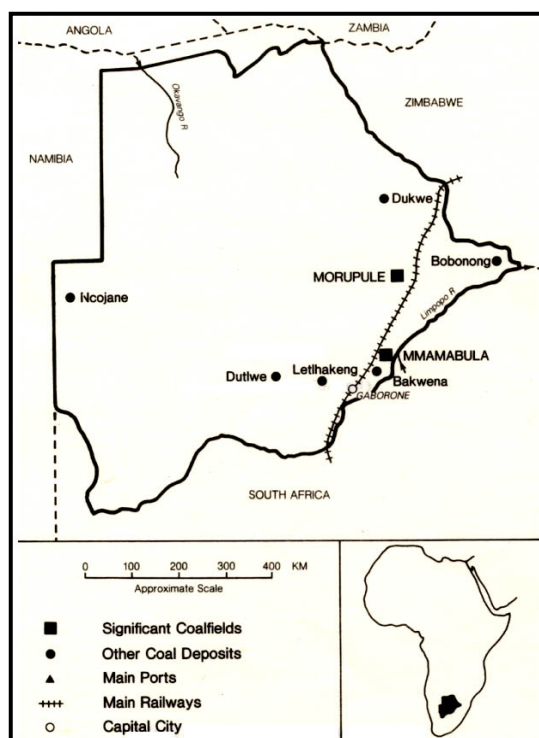
**Table 3-1. Botswana's Coal Reserves and Production**

Indicator	Anthracite & Bituminous (million tonnes)	Sub-bituminous & Lignite (million tonnes)	Total (million tonnes)	Global Rank (# and %)
Estimated Proved Coal Reserves (2011)	39.99	0	40	67 (0.0045 %)
Annual Coal Production (2012)	0.740	0	0.740	47 (0.02%)

Source: EIA (2013)

In 2012, coal represented 21.6 percent of Botswana's total primary energy supply (IEA, 2014). At present, all coal mined is used domestically for power production, but studies are under way to explore the possible exportation of coal mined at the Morupule mine, the country's only operating mine (Mining Journal, 2005). The Morupule mine has completed Phase I of its expansion and is investigating reserves in the northern boundary of its mining lease to establish an open pit mine to meet additional demand as a part of Phase II (BCM, 2014). The Morupule Mine is located in the Morupule coalfield near the town of Serowe (Figure 3-1) and is the most thoroughly explored of Botswana's coal fields. The only other major coal field to be explored in some detail is Mmamabula, situated about 81 miles south of Morupule (IEA, 2010).

Figure 3-1. Botswana Coalfields Map



Source: IEA Coal Research (1983)

### 3.1.2 STAKEHOLDERS

Table 3-2 identifies potential key stakeholders in Botswana’s coal mine methane (CMM) and coal bed methane (CBM) development.

Table 3-2. Key Stakeholders in Botswana’s CMM Industry

Stakeholder Category	Stakeholder	Role
Developers	Kalahari Energy	Project developer
	Tlou Energy Limited (TLOU)	
	Anglo Thermal Coal (formerly Anglo Coal Botswana)	
	Jindal Power & Steel	
	Many other small developers	
	See <a href="http://www.epa.gov/coalbed/networkcontacts.html">http://www.epa.gov/coalbed/networkcontacts.html</a>	
Engineering, Consultancy and Related Services	Scales & Associates	Technical assistance
	Advanced Resources International	
		See <a href="http://www.epa.gov/coalbed/networkcontacts.html">http://www.epa.gov/coalbed/networkcontacts.html</a>
	Botswana Development Corporation	Research

### 3.1.3 STATUS OF COAL AND THE COAL MINING INDUSTRY

The Morupule Mine is 93 percent owned by Debswana (a joint venture of DeBeers and the Government of Botswana) and supplies coal to Botswana’s only coal-fired power station.

Production from the mine is relatively stable (0.7-1 Mt per year) as it is essentially a captive mine for the Morupule Power Station. The mine also supplies coal to hard rock mining operations at Selebi-Phikwe and to the Sua Pan soda ash plant, and coal is exported to Zimbabwe, Zambia and the Democratic Republic of the Congo.

Debswana has completed Phase I of its coal production expansion at the Morupule Mine and raised production capacity to 3.4 million tonnes per year (Mmt/yr) to accommodate Botswana Power Corporation’s (BPC) plans to add four 150 MW coal-fired power stations alongside the existing four 33 MW units currently at Morupule (eStandards Forum, 2009).

CIC Energy Corporation, which for several years had been trying to develop the Mmamabula coal mining and energy project, was acquired in 2012 by Jindal Steel & Power, one of India’s major steel producers with a significant presence in the mining, power generation, and infrastructure sectors. The initial Mmamabula efforts included a proposed export coal project, one or more power projects, and a potential coal-to-hydrocarbons project. The acquisition makes Jindal Africa the frontrunner for building a 1,200-MW power plant in Botswana to supply power to South Africa (ESI-Africa, 2012).

## **3.2 Overview of CMM Emissions and Development Potential**

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

### **3.2.1 CMM EMISSIONS FROM OPERATING MINES**

Methane emissions in Botswana were estimated at 18.9 million cubic meters (m<sup>3</sup>) in 2000, and are projected to increase to 22.4 million m<sup>3</sup> by 2015, and then to 26.6 million m<sup>3</sup> by 2030 (see Table 3-3).

**Table 3-3. Botswana’s CMM Emissions (million cubic meters)**

<b>Emissions</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2015 (projected)</b>
Total CH <sub>4</sub> Emitted	18.9	18.9	21.7	22.4

Source: USEPA (2012)

### **3.2.2 CMM EMISSIONS FROM ABANDONED COAL MINES**

There are no reported emissions from abandoned mines in Botswana.

### **3.2.3 CBM FROM VIRGIN COAL SEAMS**

A CBM feasibility study conducted for the Botswana Department of Geological Study estimated that Botswana contains about 5.6 trillion cubic meters (Tcm) of CBM reserves in the Central Kalahari Karoo Basin (ARI, 2003). However, these estimates are tenuous as they were derived from only a

few core holes drilled into the coals of the basin. Helping Botswana meet growing domestic and regional demand for low-cost, clean and efficient fuel for power plants was the goal of a USTDA grant awarded to the Botswana Development Corporation (BDC). The grant funded a feasibility study on a CBM project that was estimated to have 1.7 Tcm in CBM reserves with some of the most prospective areas being found in the eastern portions of the basin (ARI, 2008). Following the completion of the study, the project was successfully implemented and yielded more than \$52 million in U.S. exports for power generation units, drilling equipment, compressors, and hydraulic fracturing equipment (USTDA, nd).

In recent years, there has been a tremendous increase in interest in developing CBM projects in Botswana. The Department of Geological Survey (DGS) reported a 50 percent increase in the number of exploration licenses issued between January and December 2009 for various energy minerals, which includes coal and CBM (UGC, 2010). This interest is being driven by the favorable investment climate in Botswana, coupled with an increasingly dire power situation in the region. However, out of more than 50 companies that have taken out CBM leases in the country, very few carried out any substantial resource assessment work to date.

The main companies that have carried out significant CBM exploration activity in Botswana are Kalahari Energy (now Karoo Sustainable Energy), Anglo Thermal Coal (formerly Anglo Coal Botswana) and Tlou Energy (TLOU). Kalahari Energy (KE) has been actively pursuing CBM development since 2000, and in 2008 drilled a five-well pilot program that is currently in the production testing phase. This was financed with a U.S. Overseas Private Investment Corp (OPIC) \$8.5 million investment guarantee for the purchase of equipment and the drilling of wells. In 2009, KE formed a joint venture with Exxaro Resources to perform ongoing exploration work and completed a five-well production test in late 2010 (KE, 2010). KE, which continues to pioneer energy growth in Botswana through coal-based methane exploitation, currently operates the small 90-MW Orapa power plant and is in the process of developing a new 180-MW power project in the country (EN, 2012).

Anglo Thermal Coal embarked on a major CBM exploration drive, which started in late 2008, with the aim of delineating gas reserves totaling at least 110 billion m<sup>3</sup> (Bcm), sufficient to justify construction of a dedicated synfuels plant. In March 2013, Anglo Thermal Coal emerged the winner of some 23 applicants for the coal blocks – the Mmamabula South and Central blocks – which are adjacent to the Mmamabula East property owned by Jindal Steel & Power, the company that recently bought CIC Energy (MiningMx, 2013). The former Saber Energy drilled over 80 exploratory holes on their lease areas from 2008 to 2010 to test coal gas content and permeability. Saber Energy was acquired by TLOU, which merged with Talon Metals Corporation in 2010. Following acquisition, TLOU performed pilot horizontal well drilling and in the coming years will prepare updated reserve/resource statements, complete marketing and commercialization arrangements (i.e., contracts), and continue to consolidate/upgrade the resource classification through additional exploration drilling (TLOU, 2013).

### 3.3 Opportunities and Challenges to Greater CMM Recovery and Use

Botswana, a non-Annex I country, has signed and ratified the UNFCCC and Kyoto Protocol as shown in Table 3-4.

**Table 3-4. Botswana’s Climate Change Mitigation Commitment**

Agreement	Signature	Ratification
UNFCCC	June 12, 1992	April 27, 1994
Kyoto Protocol		August 8, 2003

Source: UNFCCC (2014)

In 2013, the Government of Botswana—with support from the Common Market for Eastern and Southern Africa (COMESA) and the United Nations Development Programme (UNDP)—commissioned a team of consultants to develop a National Climate Change Policy, Strategy and Action Plan. Botswana’s national climate change policy was expected to be ready in 2014, while the strategy and action plan will follow (UNDP, 2013).

### 3.3.1 MARKET AND INFRASTRUCTURE FACTORS

It is doubtful whether Botswana will have significant CMM emissions in the foreseeable future. This is because there are abundant reserves of coal at relatively shallow depths and the overall demand for coal in the country is limited. Currently, the prospects for exporting coal are not good, given the distances to available ports in South Africa and limited rail infrastructure. However, in cooperation with the government of Namibia, Botswana is considering the construction of a \$6 billion, 1500-mile rail link between the Mmamabula Coalfields of southeastern Botswana to either the ports of Walvis Bay or Luderitz in Namibia (Mmegi, 2009).

Since there is negligible domestic demand and support infrastructure for natural gas, the market for methane in Botswana is fairly limited (EIA, 2013).

However, CBM projects may see increased attention thanks to a report titled, *Botswana Technology Needs Assessment on Climate Change*, jointly produced by several Ministries and the UNDP. The report acknowledges Botswana’s CBM reserve potential, and advises that Botswana determine such resource potential. CBM, it concludes, may be used to provide fuel for cars and power generation, and alleviate potential power crises. CBM may also be exported to Mozambique through the Maputo pipeline and to the Secunda Sasol Plant in South Africa (TNA, 2004), although this option is probably not viable now given the large offshore gas reserves recently discovered by Anadarko, ENI, and others.

To support more domestically driven power production, Kalahari Sustainable Energy (KSE) has been active in converting the 90-MW diesel turbines at the Orapa power plant over to natural gas and negotiating the development of the 180-MW Mmashoro power station. Both projects would be supplied from domestic CBM resources (CR, 2013).

### 3.3.2 REGULATORY INFORMATION

As there are no operating CMM projects, a legal framework regulating them does not exist.

## 3.4 Profiles of Individual Mines

### Morupule

Morupule is located along the eastern margin of the Kalahari Basin. Production began in 1973, and the mine has a production capacity of 1 Mmt/yr.

#### General Information

Total mineable reserves (thousand tones)	44,000
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#### General Geologic Information

Coal seams (thickness)	Morupule Main (6.5-9.5 m) Lotsane (0.6-4.5 m) Serowe Bright (average 1.8 m)
Faults?	Yes, minor. Some dolerite dyke intrusives.

#### Geologic and Mining Conditions

Ash content, % (coal in place, run of mine)	40 – 50%
Moisture, % (coal in place, run of mine)	5 – 10%

#### Coal Production, Methane Emissions, and Degasification (and Use) Statistics

	2006	2007	2008	2009	2010	2011	2012
Coal Production (million tonnes)*	0.962	0.828	0.910	0.737	0.987	0.787	0.740
Degasification	None	None	None	None	None	None	None

Source: \*EIA (2013)

## 3.5 References

ARI (2003): Results of the Central Kalahari Karoo Basin Coalbed Methane Feasibility Study, prepared for the Department of Geologic Survey, Botswana, Lobatse, by Advanced Resources International, Arlington, Virginia, USA, 2003.

ARI (2008): Technical and Economic Feasibility Study for Coalbed Methane Development in Eastern Botswana, prepared for Botswana Development Corporation and U.S. Trade and Development Agency by Advanced Resources International, Arlington, Virginia, USA, 2008.

BCM (2014): Morupule Coal Mine Ltd Overview, Botswana Chamber of Mines, website accessed June 2014. [http://www.bcm.org.bw/members\\_morupule.html](http://www.bcm.org.bw/members_morupule.html)

CR (2013): Botswana Resource Sector Overview 2013/2014, Capital Resources (PTY) Limited, February 2013.

<http://www.capconferences.com/files/2013/06/BOTSWANA-RESOURCE-SECTOR-OVERVIEW-2013.pdf>

EIA (2013): International Energy Annual 2012, U.S. Energy Information Administration, Washington, DC, table posted in 2013. <http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=1&pid=7&aid=1> (production) <http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=1&pid=7&aid=6> (reserves)

EN (2012): Botswana can become major energy corridor – Kalahari Energy, Engineering News – Mining Weekly, 26 June 2012. <http://www.engineeringnews.co.za/article/botswana-can-become-major-energy-corridor-kalahari-energy-2012-06-27>

- ESI-Africa (2012): "Jindal acquisition a boost for Mmamabula energy project," ESI-Africa, 11 September 2012. <http://www.esi-africa.com/jindal-acquisition-a-boost-for-mmamabula-energy-project/>
- eStandards Forum (2009): Country Brief Botswana, 27 August 2009.
- GMI (2014): International Coal Mine Methane Projects Database, Global Methane Initiative, accessed October 2014. <https://www.globalmethane.org/coal-mines/cmm/index.aspx>
- IEA (2010): Coal Online, International Energy Agency Clean Coal Center, website accessed June 2010. <http://www.coalonline.org/site/coalonline/content/browser/81343/Coal-resources>
- IEA (2014): Energy Statistics: Share of Total Primary Energy Supply in 2012 – Botswana, International Energy Agency, Paris, France, 2014. [www.iea.org/stats/WebGraphs/BOTSWANA4.pdf](http://www.iea.org/stats/WebGraphs/BOTSWANA4.pdf)
- IEA Coal Research (1983): Concise Guide to the World Coalfields, Cope, J.H.R., Duckworth, N.A., Duncan, S.V., Holtom, J.E.B., Leask, A.L., McDonald, K.A. and Woodman, S.P., compiled by Data Bank Service, World Coal Resources and Reserves, IEA Coal Research, London, England, 1983.
- KE (2010): Kalahari Energy's Joint Venture – Exploration Progress, Kalahari Energy, 9 July 2010. <http://www.kalaharigas.com/news.php?id=36>
- Mining Journal (2005): "A message from MC Tibone, Minister of Minerals, Energy and Water Resources," *Mining Journal: Special Publication*, London, October 2005.
- MiningMx (2013): "Anglo swoops on Botswana's Mmamabula coal," MiningMx.com, 14 March 2013. <http://www.miningmx.com/page/news/energy/1547459-Anglo-swoops-on-Botswana-s-Mmamabula-coal#.U7086GdOWM8>
- Mmegi (2009): "Botswana Sees Coal Alternative to Diamonds." Mmegionline, Vol. 26, No. 20, 9 February 2009. <http://www.mmegi.bw/index.php?sid=4&aid=20&dir=2009/February/Monday9>
- TNA (2004): "Botswana Technology Needs Assessment on Climate Change," Botswana Ministry of Environment, Wildlife, and Tourism; Botswana Department of Meteorological Services, UN Development Programme, 2004.
- TLOU (2013): Botswana CBM Project Update, Botswana Resource Sector Conference, TLOU Energy, June 2013. <http://www.tlouenergy.com/pdfs/130611%20BRSC%20Presentation.pdf>
- UGC (2010): "Botswana Energy Minerals Most Sought After in 2000," Unconventional Gas Center, 5 February 2010.
- UNDP (2013): "Botswana gears up for climate change; embarks on preparing a Policy, Response Strategy and Action Plan," United Nations Development Programme, 28 August 2013. <http://www.bw.undp.org/content/botswana/en/home/presscenter/pressreleases/2013/08/28/botswana-gears-up-for-climate-change-embarks-on-preparing-a-policy-response-strategy-and-action-plan/>
- UNFCCC (2014): Ratification Status – Botswana, United Nations Framework Convention on Climate Change, accessed September 2014. <http://maindb.unfccc.int/public/country.pl?country=BW>
- USEPA (2012): *Global Anthropogenic Non-CO<sub>2</sub> Greenhouse Gas Emissions: 1990 - 2030*, U.S. Environmental Protection Agency, Office of Atmospheric Programs, Climate Change Division, December 2012. <http://www.epa.gov/climatechange/EPAactivities/economics/nonco2projections.html>
- USTDA (nd): Botswana Coalbed Methane Power Generation Project, *Traditional Energy & Power Sector Brief*, U.S. Trade and Development Agency, not dated.