

# Experiences and Developments in the Energy Production Botswana

Hans-Josef Sandkaul (CEO)

1. December 2014

Energy workshop Technology Centrum Dresden





## **Part 1 General information**

- Botswana economy at a glance
- Botswana national coal production
- Botswana electricity grid

## **Part 2 Experience Power Sector Botswana**

- Morupule A Power Plant
- Morupule B Power Plant
- Mmamabula Projects

## **Part 3 Countryside**

- Okavango
- Chobe
- Victoria Falls, Zimbabwe



# Botswana geographic



# Botswana economy at a glance

## Republic of Botswana

Country: Democratic country,  
since independence 30 September 1966

Capital City: Gaborone (est. 230.000 Population, April 2014)

President: Ian Khama (since 1<sup>st</sup> April 2008)

Area: 581.730 sq km

Population: 2.155.784 (June 2014)

GDP: \$13.6 bn (2013 est.)

GDP growth rate: 5.4% (2013 est.)

GDI (per capita in \$): 16.400 (in 2013)

WGI (2013): 1,06 (References: GER = 0,93 ; RSA = -0,06)

CPI: Country rank 30 from 177, References: GER = 12; RSA = 72) Index 2013

Energy market: Process of demonopolisation of the energy sector. Electricity prices  
on the daily-hour market have recently remained at a low level.

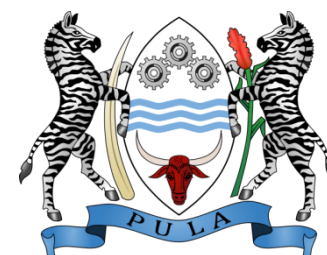
GDI = Gross domestic income

GDP = Gross domestic product

WGI = Worldwide Governance Indicators (Estimate of governance (ranges from approximately -2.5 (weak) to 2.5 (strong) governance performance)

CPI = Corruption Index that annually ranks countries by their perceived levels of corruption, as determined by expert assessments and opinion surveys

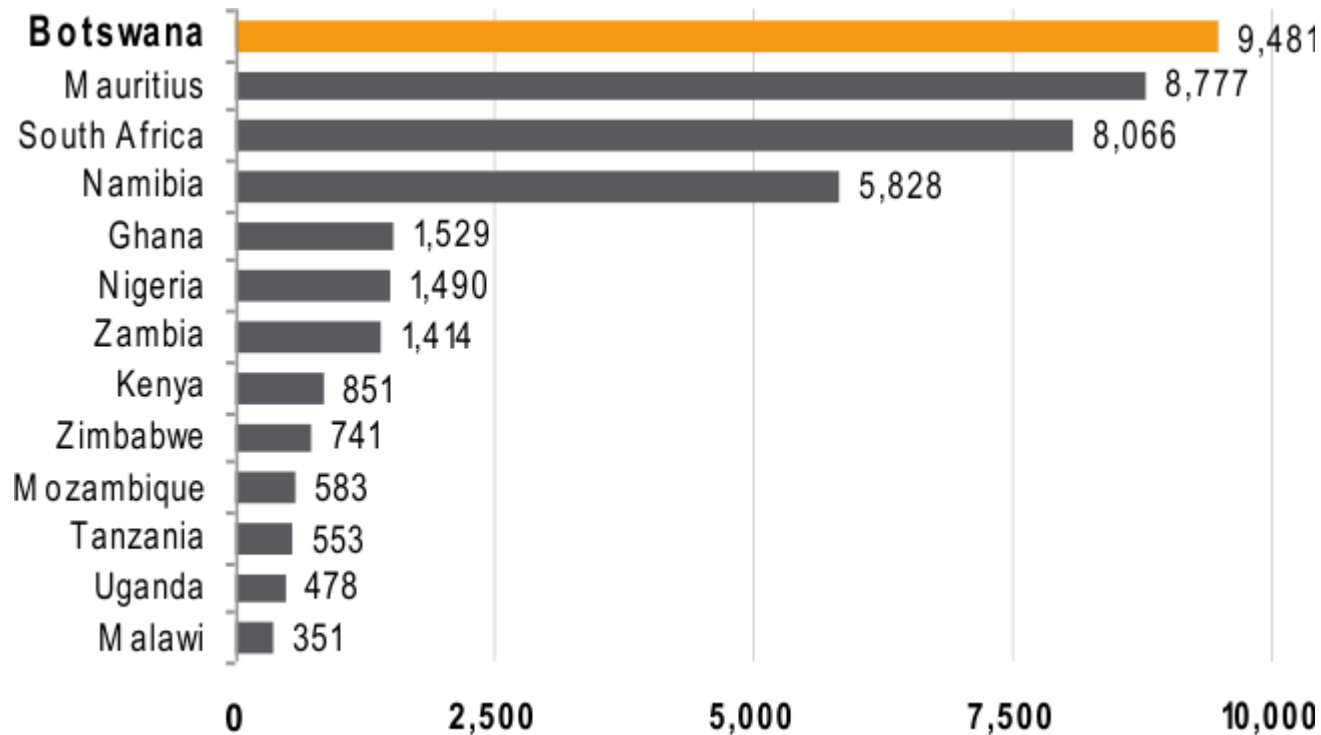
Source: CIA – The world factbook, <https://www.cia.gov/library/publications/the-world-factbook/geos/bc.html>; Worldbank ,  
<http://data.worldbank.org/indicator/NY.GNP.PCAP.CD>, Transparency International, [http://cpi.transparency.org/cpi2012/in\\_detail/](http://cpi.transparency.org/cpi2012/in_detail/),  
Auswärtige Amt: <http://www.auswaertiges-amt.de>



# Botswana economy



Botswana real GDP per capita 2011 in US\$



Source: IMF, World Economic Outlook Database, April 2012

GDP = Gross domestic product

# Botswana economy - overview



- Botswana has maintained one of the world's highest economic growth rates
- Economic growth was negative in 2009, after the global crisis reduced demand for Botswana's diamonds.
- Botswana transformed itself from one of the poorest countries in the world to a middle-income country with a per capita GDP of \$16,400 in 2013.
- Two major investment services rank Botswana as the best credit risk in Africa.
- Diamond mining has fueled more than one-third of GDP, 70-80% of export earnings, and about one-third of the government's revenues.
- Tourism, financial services, subsistence farming, and cattle raising are other key sectors.
- A major international diamond company signed a 10-year deal with Botswana in 2012 to move its rough stone sorting and trading division from London to Gaborone by the end of 2013. The move may support Botswana's downstream diamond industry.

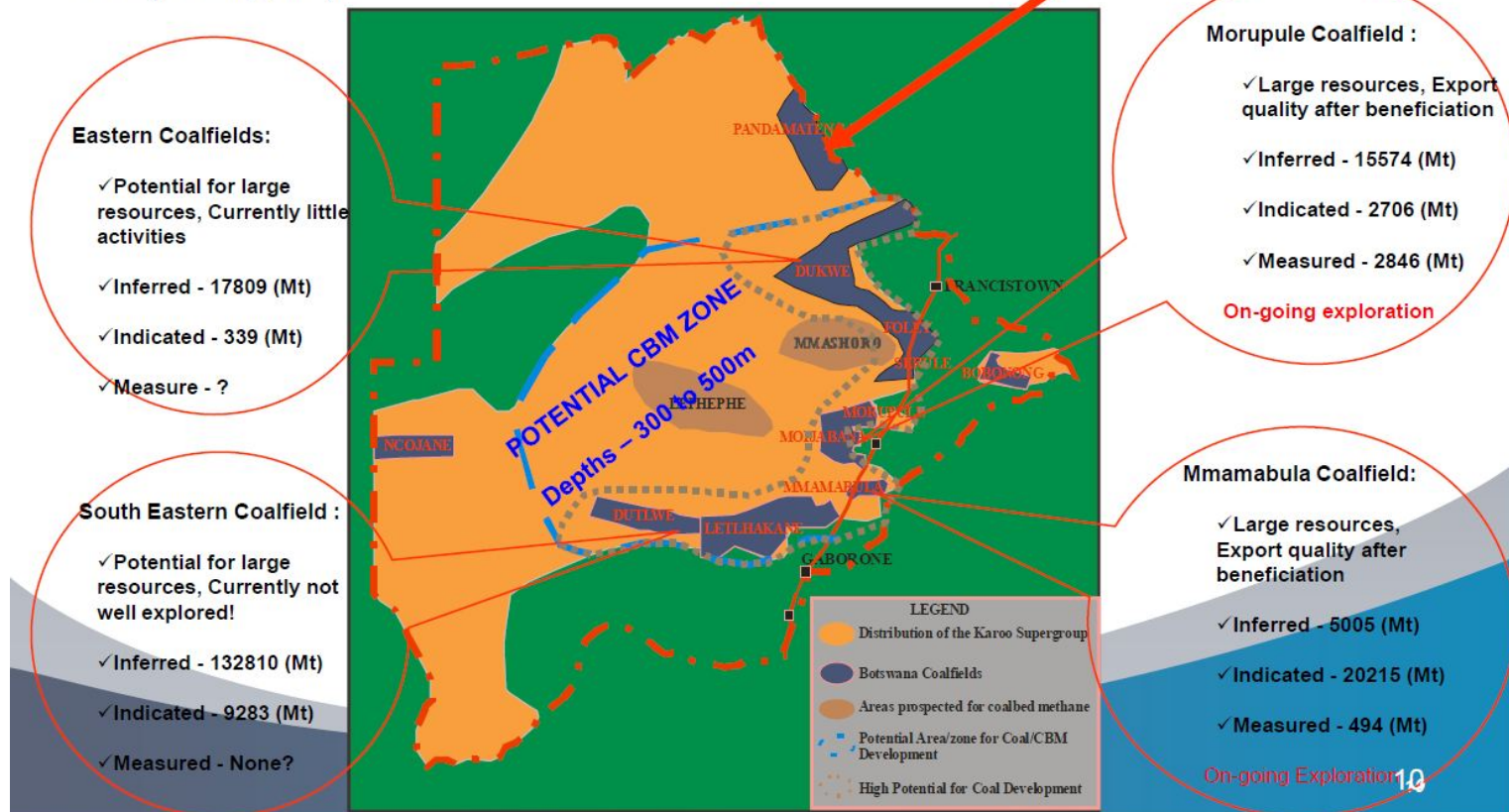
Source: <https://www.cia.gov/library/publications/the-world-factbook/geos/bc.html>



# Botswana national coal production

## Botswana's coal resources/ reserves and spatial distribution

- ❑ Botswana is endowed with significant coal resources which has been explored by a number of companies as far back as the 50's (see figure)

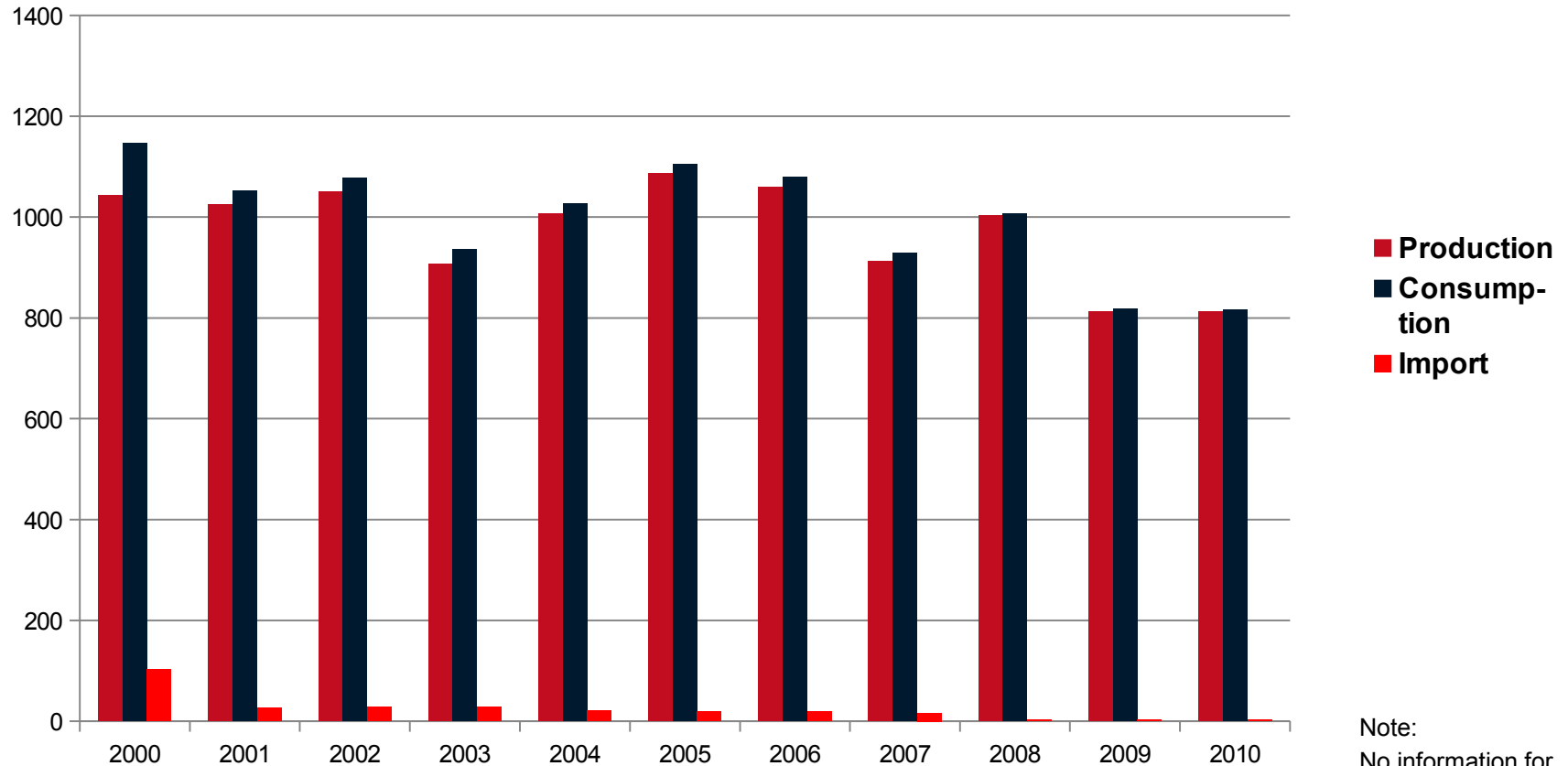


Source: BPC\_Presentations\_Energy\_Pitso\_210610

# Botswana national coal production



Tsd. tons

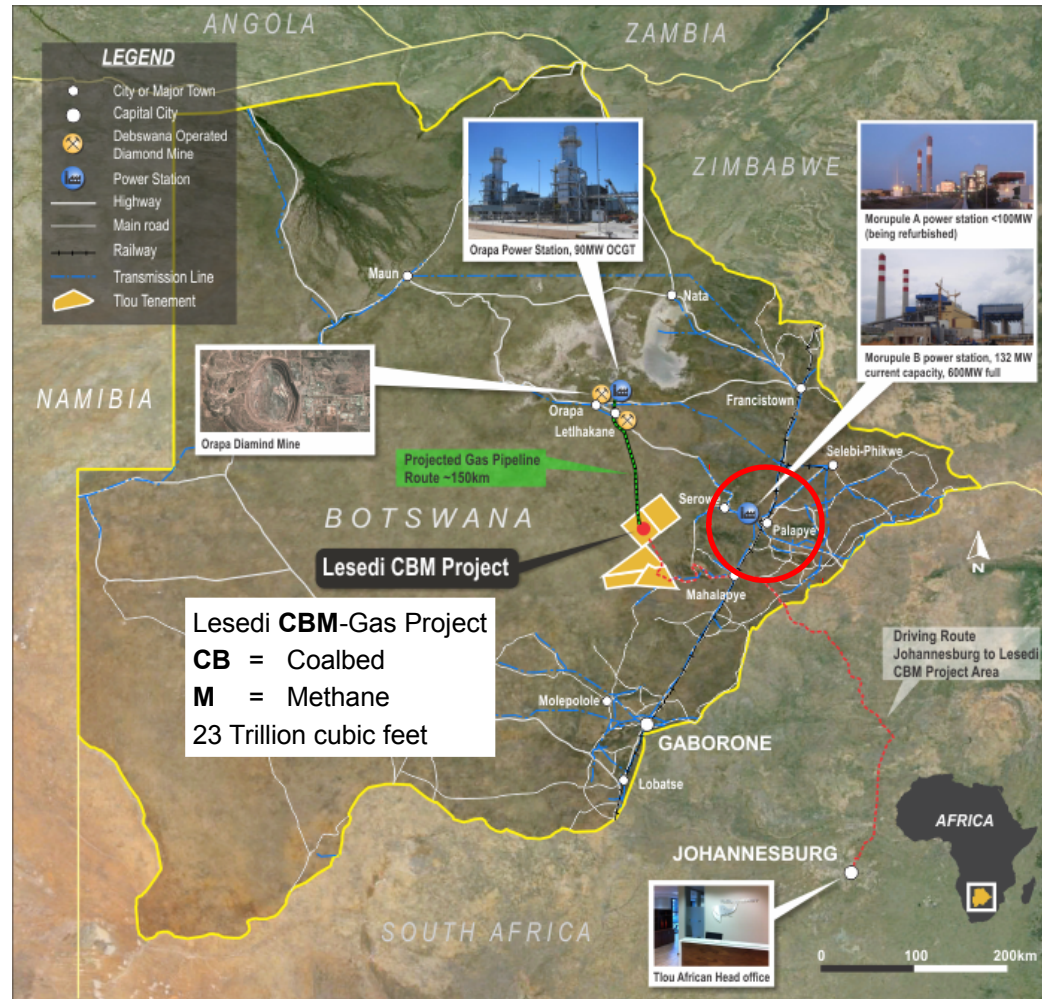


Note:  
No information for  
export available

Source: EIA, <http://www.indexmundi.com/energy.aspx?country=bw&product=coal&graph=production+consumption>



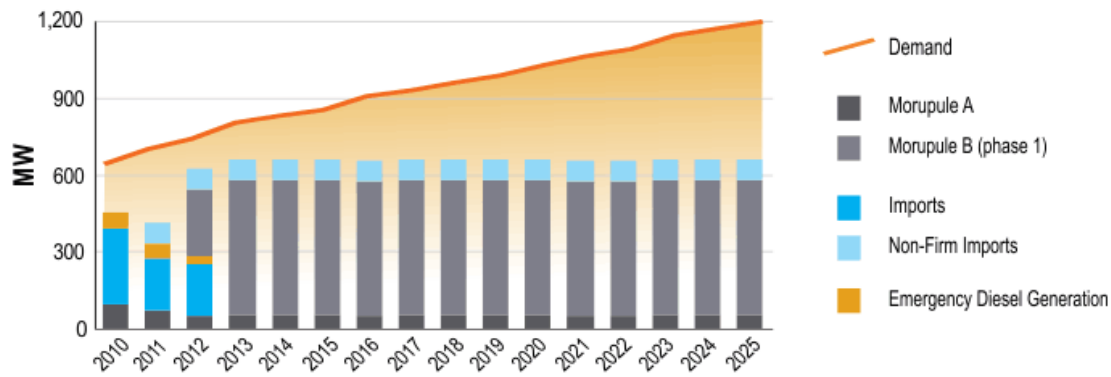
# Botswana electricity grid



Source: [http://tlouenergy.com/?page\\_id=252](http://tlouenergy.com/?page_id=252)



## Botswana Electricity Supply / Demand Estimate (MW)

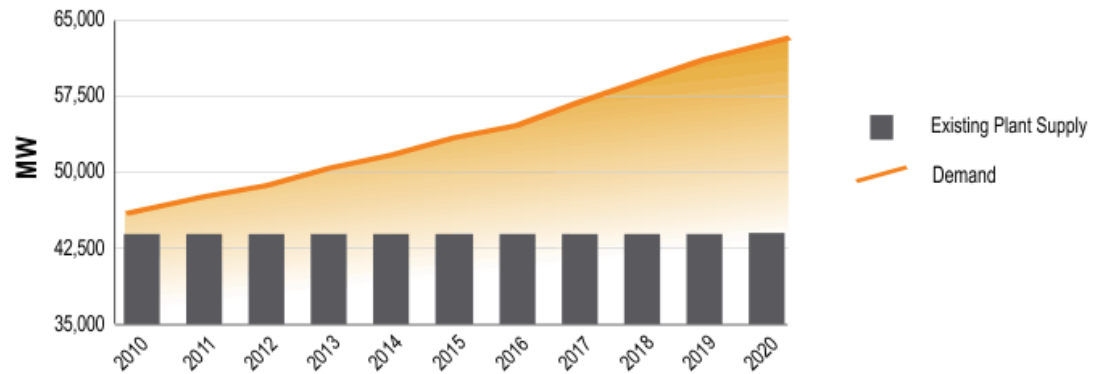


Source: Norconsult Market Report (Tlou Prospectus 2013)

## Commercialisation Opportunity

- Botswana power demand outstripping supply
- Potential to replace dependence on excessive diesel fueled generation
- Potential for additional gas fired generation plants to address regional shortage

## South Africa Electricity Supply / Demand Estimate (MW)



Source: Norconsult Market Report (Tlou Prospectus 2013)

- South African energy market under pressure to meet growing demand

Source: [http://tlouenergy.com/wp-content/uploads/2014/02/Botswana\\_Graph.gif](http://tlouenergy.com/wp-content/uploads/2014/02/Botswana_Graph.gif)  
[http://tlouenergy.com/wp-content/uploads/2014/02/SthAfrica\\_Graph.gif](http://tlouenergy.com/wp-content/uploads/2014/02/SthAfrica_Graph.gif)

## Part 1 General information

- Botswana economy at a glance
- Botswana national coal production
- Botswana electricity grid

## Part 2 Experience Power Sector Botswana

- Morupule A Power Plant
- Morupule B Power Plant
- Mmamabula Projects

## Part 3 Countryside

- Okavango
- Chobe
- Victoria Falls, Zimbabwe

# Morupule Power Station A



## Boiler arrangement/technical data's

Plant:	Coal fired Power Plant
Built up:	1986 for stage 1, boiler no's 1-3 1989 for stage 2, boiler no 4
Owner:	Botswana Power Corporation
Supplied by:	LENTJES, Duesseldorf, Germany
Actual situation:	plant out of operation since August 2012
Unit capacity:	33 MW <sub>el/boiler</sub>
Type of boiler:	natural-circulation
Boiler capacity:	160 t/h
Steam pressure:	90 barü
Steam temperature:	513 °C
Burner capacity:	120 MWth/Boiler
Type of burner:	low NOx-burner
Fuel:	Bituminous from local mine Fuel oil for start-up
No's burners:	6 x burners/unit





# Morupule Power Station A



## Cross section of the boiler plant

Boiler and boiler house

Boiler drum

Superheater and  
Economiser sections  
1st and 2nd pass

Flue gas ducts

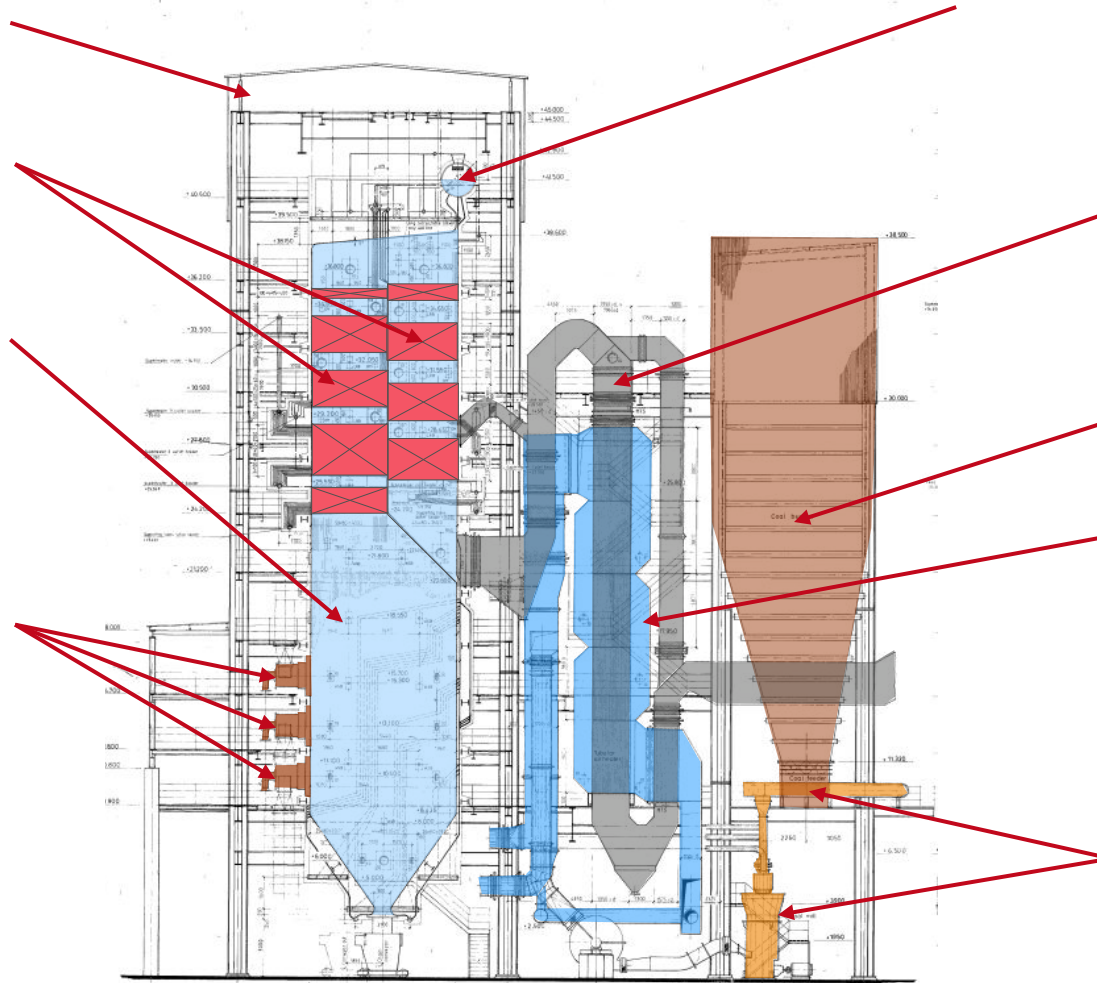
Furnace

Coal bunker

Combustion air ducts  
incl. air heater

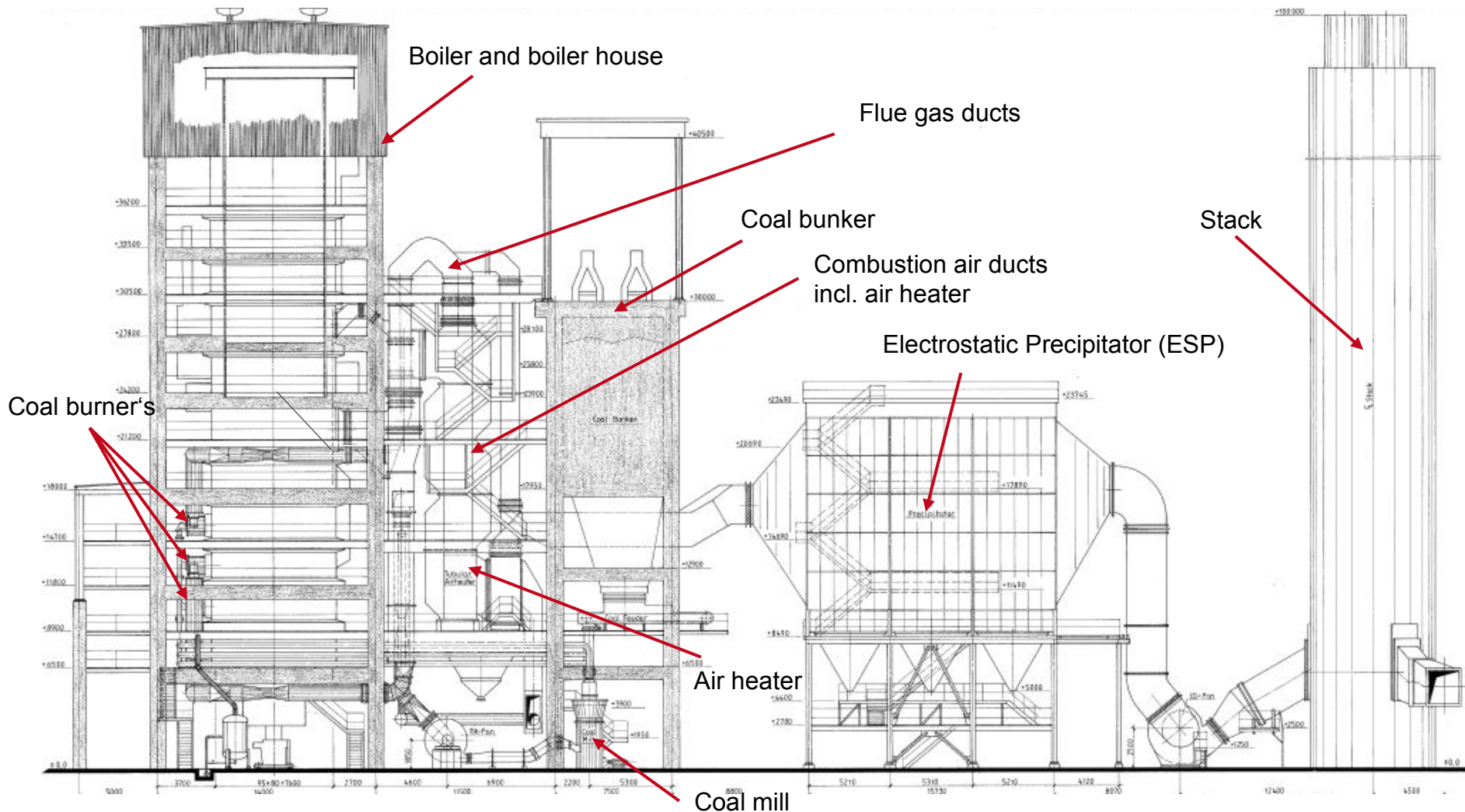
Coal burners

Coal feeder and  
coal mills



# Morupule Power Station A

## Cross section of the boiler plant



# Morupule Power Station B



## Boiler arrangement/technical data's

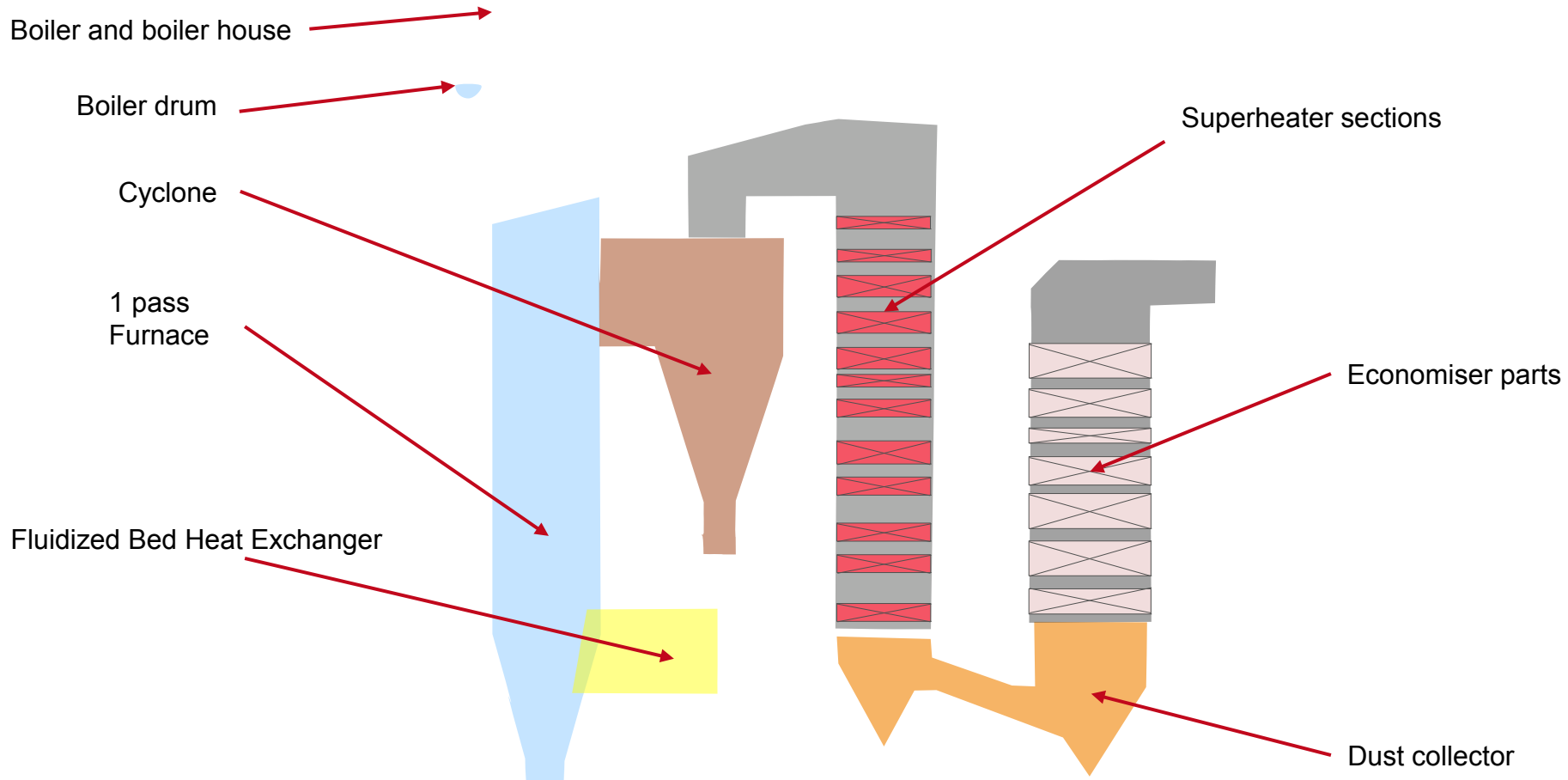
Plant:	Electrical Power Generation
Built up:	2013, boiler no's 1-4
Owner:	Botswana Power Corporation
Supplied by:	Chinese Company with Lurgi Lentjes Fluidised Bed Boiler Technology
Actual situation:	Technical problems and poor quality prevent currently high plant availability
Unit capacity:	150 MW <sub>el/boiler</sub>
Type of boiler:	natural-circulation with 2 x Fluidized Bed Heat Exchanger/boiler
Boiler capacity:	520 t/h
Steam pressure:	136 bar <sub>ü</sub>
Steam temperature:	540 °C
Fuel:	Bituminous coal from local mine Fuel oil for start-up
No's burners:	4 x in-duct burners/boiler
No's mills:	2 x Ring hammer crusher/unit



# Morupule Power Station B



## Cross section of the boiler plant





# Mmamabula Power and Energy Projects



## Mmamabula Domestic Power Project (“DPP”), 300 MWeI

Location: Mmamabula, Botswana  
Plant: coal-fired Power Station  
Built up: expected 2018, boiler no’s 2  
Owner: Jindal Steel and Power, India  
Unit capacity: 150 MW<sub>el/boiler</sub>  
Fuel: Hard coal from local mine

## Mmamabula Energy Project (“MEP”), 3,600 MWeI

Location: Mmamabula, Botswana  
Plant: coal-fired Power Station’s  
Built up: on hold  
Owner: CIC Energy, Canada/Jindal Steel and Power, India  
Supplied by: Shanghai Electric Group (“SEC”), China  
EPC Contractor responsible for engineering, procurement and construction  
Unit capacity: 3,600 (gross) MW/1,200 (net) MW  
Fuel: Hard coal from local mine



Mmamabula Coal field

- 1<sup>st</sup> step 2 units 300 MW/each
- 2<sup>nd</sup> step 2 units 300 MW/each
- 3<sup>rd</sup> step 3 units 800 MW/each

## Part 1 General information

- Botswana economy at a glance
- Botswana national coal production
- Botswana electricity grid

## Part 2 Experience Power Sector Botswana

- Morupule A Power Plant
- Morupule B Power Plant
- Mmamabula Projects

## Part 3 Countryside

- Okavango
- Chobe
- Victoria Falls, Zimbabwe

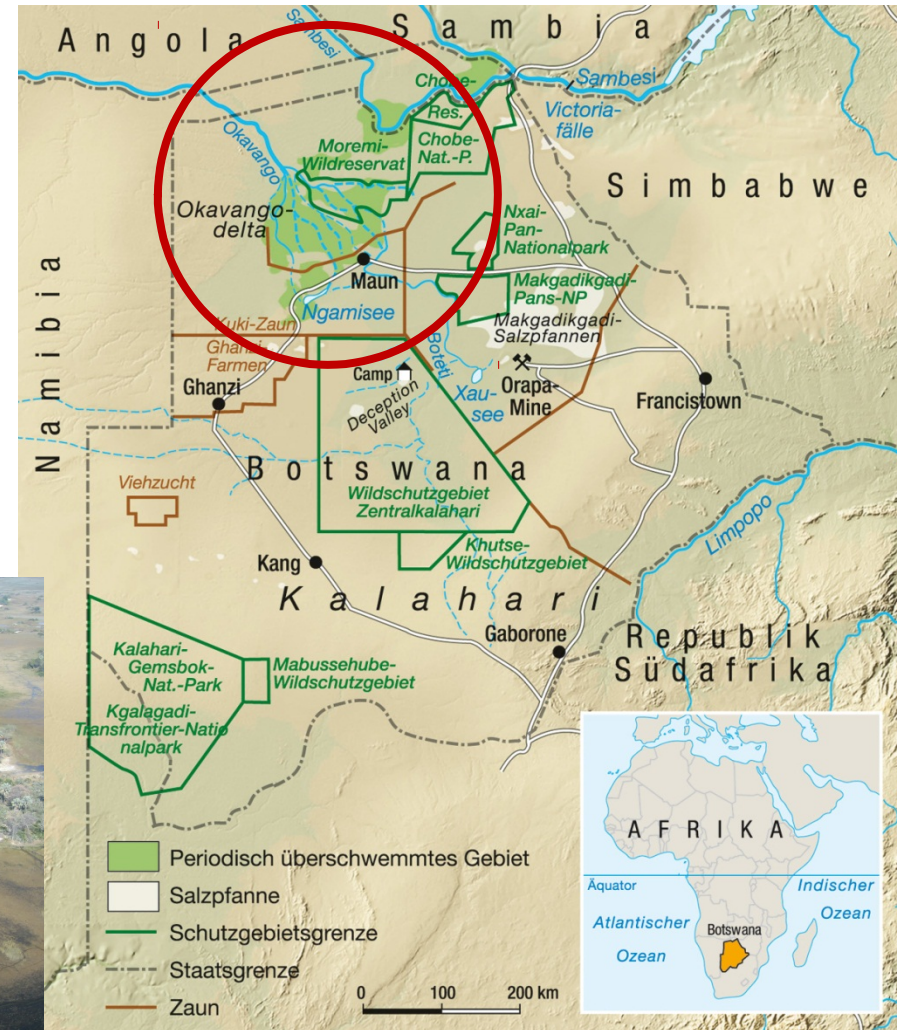
# Countryside

## Okavango Delta

- The Okavango Delta is a very large inland delta in the north of Botswana.
- Area approximate 20,000 km<sup>2</sup>
- One of the Seven Natural Wonders of Africa
- Okavango river, also named Okavango or Kavango, is approximately 1,200 Kilometer long and passed the countries Angola, Botswana and Namibia.



Source: mr-kartographie\_Bostwana3  
Wikipedia





# Countryside

## Chobe

- The Chobe National Park is in the north of Botswana
- Named by the river Chobe
- Founded in 1967
- Area approximate 10,566 km<sup>2</sup>
- Widely known for its spectacular elephant population (estimated 500,000 elephants)



Source: mr-kartographie\_Bostwana3  
Wikipedia





# Countryside

## Victoria Falls, Zimbabwe

- Victoria Falls, or Mosi-oa-Tunya, is a waterfall in the southern Africa on the Zambezi River at the border of Zambia and Zimbabwe.
- David Livingstone, the Scottish missionary and explorer have been the first European to view Victoria Falls
- Width of 1,708 metres (5,604 ft)  
Height of 108 metres (354 ft)
- Average flow rate: 1,077 m<sup>3</sup>/s



Source: mr-kartographie\_Bostwana3  
Wikipedia





A photograph of a herd of elephants in a savanna. In the foreground, two large adult elephants are facing each other, their heads close together. Between them and in front of them are two smaller elephants, likely calves. The background shows more elephants and a line of trees under a bright sky. The text 'Thank you for your attention!' is overlaid in white, centered across the middle of the image.

Thank you for your attention!



**MH POWER SYSTEMS  
EUROPE SERVICE**