Botswana

Figure 1: Energy profile of Botswana

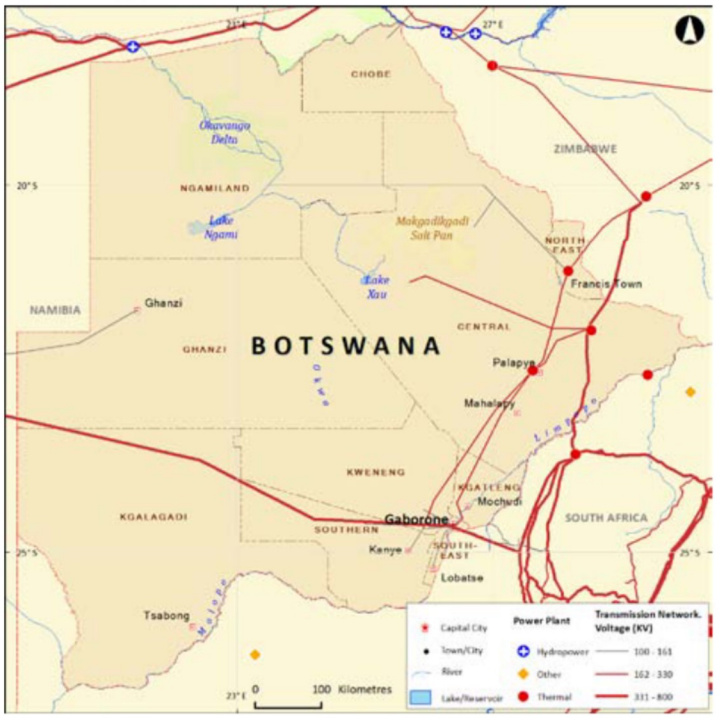
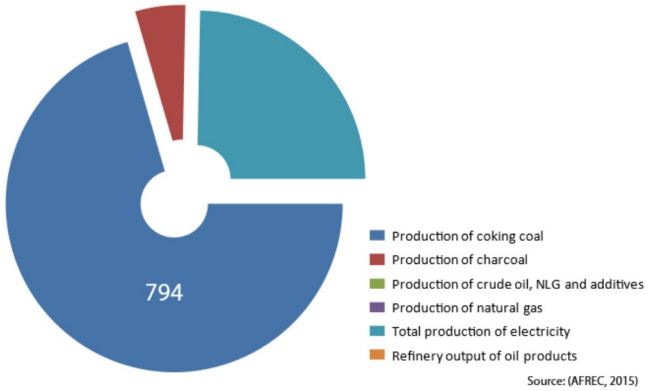
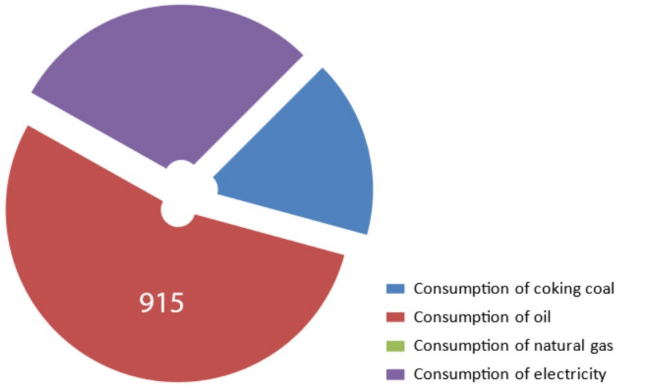


Figure 2: Total energy consumption, (ktoe)



Source: (AFREC, 2015)

Figure 3: Total energy consumption, (ktoe)



Source: (AFREC, 2015)

Energy Consumption and Production

By 2013, Botswana had a small population of only 2.02 million people (Table 1) (IEA, 2016). According to the African Energy Commission (AFREC, 2015), total electricity produced in 2015 was 278 ktoe with 99.6 per cent of it produced from fossil fuels. Industry consumed 25.1 per cent of all electricity consumed in 2015 (Table 2). Botswana's energy capacity is thermal, produced mostly in coal-fired plants with a few small diesel generators in rural areas. The 132 MW Morupule coal-fired station generates most of the domestic electricity supply. More than 50 per cent of Botswana's power requirements are imported from South Africa and Zambia. Key consumption and production statistics are shown in Figures 2 and 3.

Table 1: Botswana's key indicators

Key indicators	Amount
Population (million)	2.02
GDP (billion 2005 USD)	14.20
CO2 emission (Mt of CO2)	5.48

(IEA, 2016)

Energy Resources

Biomass

Wood fuel is the main source of energy for rural households. It accounts for about 30 per cent of the country's primary energy supply and 38 per cent of total final energy consumption. Biomass supplies 46 per cent household energy nationally, increasing to 77 per cent at the rural level (Nachmany, et al., 2015).

Oil and natural gas

Botswana meets its energy demand mainly by importing petroleum products to supply thermal power stations since internal electricity generation is insufficient to meet demand (REEEP, 2014). South Africa supplies all the country's refined oil needs but limited supply routes lead to intermittent shortages in fuel supply. Insufficient internal strategic storage capacity and the huge travel distances required to supply the entire country exacerbate the situation. Improving energy security in terms of energy supply is one of Botswana's policy objectives.

About 70.7 per cent and 40.5 per cent of households in urban and rural areas respectively use LPG for cooking (Unpublished, 2015). The sector is liberalized and private sector control of supply and pricing has led to a large market for LPG. Although the government subsidizes kerosene to

Table 2: Total Energy Statistics (ktoe)

Category	2000	2005	2010	2015 P
Production of coking coal	484	503	505	794
Production of charcoal	0	0	0	54
Production of crude oil, NLG and additives	-	-	-	-
Production of natural gas	-	-	-	-
Production of electricity from biofuels and waste	0	0	0	0
Production of electricity from fossil fuels	81	83	37	277
Production of nuclear electricity	-	-	-	-
Production of hydro electricity	-	-	-	-
Production of geothermal electricity	-	-	-	-
Production of electricity from solar, wind, Etc.	0	0	0	1
Total production of electricity	81	83	37	278
Refinery output of oil products	-	-	-	-
Final Consumption of coking coal	158	112	332	284
Final consumption of oil	542	656	818	915
Final consumption of natural gas	-	-	-	-
Final consumption of electricity	137	222	274	498
Consumption of oil in industry	87	87	157	182
Consumption of natural gas in industry	-	-	-	-
Consumption of electricity in industry	85	109	116	125
Consumption of coking coal in industry	134	110	152	182
Consumption of oil in transport	398	498	649	683
Consumption of electricity in transport	-	-	-	-
Net imports of coking coal	48	1	2	1
Net imports of crude oil, NGL, Etc.	-	-	-	-
Net imports of oil product	561	658	971	927
Net imports of natural gas	-	-	-	-
Net imports of electricity	70	151	257	304

(AFREC, 2015)

- : Data not applicable
0 : Data not available
(P): Projected

increase access for low-income groups, uptake as a cooking fuel is still low.

Peat

The area of peatland in 2011 was 2,625 km^2 (WEC, 2013).

Coal

The country is overly dependent on coal, mainly because it is abundant and cost effective. The proven recoverable reserves at the end of 2011 was 40 million tonnes and total production of coal in 2011 was 0.9 million tonnes (WEC, 2013). Although coal reserves are found in various locations around the country, only the one at Morupule Colliery is currently being mined. However other coal-to-electricity generation plants are being considered. The Morupule reserve accounts for 80 per cent of domestic production. Since 2012, the government has been actively exploring the prospects for coal-bed methane extraction.

Wind

Average wind speeds are lower than 4 m/s, the minimum for wind energy to be viable. However, studies show that there may be superior wind speeds at higher altitudes. For instance, there are signs that at heights over 80 m, wind speeds have the potential to reach between 5-7 m/s. However, more research is needed. Kwai Pan has the highest winds speeds recorded to day, with wind velocities between 6 to 9 m/s (Unpublished, 2015).

Solar

Botswana has one of the highest levels of solar insolation worldwide, with direct normal irradiation (DNI) of 3,000 kwh/m^2/year. It is estimated that using less than 1 per cent of the country area, Botswana could meet its current electricity consumption (GOB, 2010). Global irradiation is highest in the west, averaging 2,350 kWh/m^2/year near a place called Kang and around Kalahari Gemsbok National Park. The lowest potentials are on the northeastern side of the country.

The first solar power generation plant opened in September 2012 and solar is currently used for domestic water heating, home lighting, electricity supply for telecommunications equipment and in rural areas where access to conventional electricity is difficult. The potential for business in the manufacture and assembly of solar energy equipment is huge.

Tracking progress towards sustainable energy for all (SE4All)

In 2012, just over half of Botswana's population (53.2 per cent) had access to electricity, with rural and urban access at 23.9 per cent and 71 per cent , respectively (World Bank, 2016) (Table 3 and Figure 4). The national target for access to electricity by 2016 is 82 per cent while the goal for 2030 is 100 per cent . Access to non-solid fuels is at 62.47 per cent of the population with 39 per cent in rural areas and 90 per cent in urban areas (World Bank, 2013). The National Development Plan target is to reach an electrification rate of 80 per cent nationwide and 60 per cent rural by 2016.

Electricity access is partially constrained by inadequate supply in South Africa, which during the 2008 to 2012 period reduced its power sale commitments to importing countries. including Botswana. As a result, since 2008, Botswana has been experiencing load shedding.

Botswana's energy intensity (the ratio of the quantity of energy consumption per unit of economic output) was 4.6 MJ per US dollar

Table 3: Botswana's progress towards achieving SDG7 - Ensure access to affordable, reliable, sustainable and modern energy for all

Target	Indicators	Year					
		1990	2000	2010	2012	2000-2010	2011-2015
7.1 By 2030, ensure universal access to affordable, reliable and modern energy services	7.1.1 Per cent of population with access to electricity	37	40	43	53.2		
	7.1.2 Per cent of population with primary reliance on non-solid fuels	37	51	61	62.47		
7.2 By 2030, increase substantially the share of renewable energy in the global energy mix	7.2.1 Renewable energy share in the total final energy consumption	47.1	35.7	26.4	23.85		
7.3 By 2030, Double the rate of improvement of energy efficiency	7.3.1 GDP per unit of energy use (constant 2011 PPP $ per kg of oil equivalent)			11.9	12.9 (2011)		13.66 (2013)
	Level of primary energy intensity(MJ/$2005 PPP)	4.6		3.5	3.1	3.23	3.12

Sources: (World Bank, 2015); (World Bank, 2016)

Figure 4: SDG indicators

Percentage of population with access to electricity	Access to non-solid fuel (% of population)	GDP per unit of energy use (PPP $ per kg of oil equivalent) 2013	Renewable energy consumption (% of total final energy consumption), 2006-2011, 2012
53.2%	62.47%	14.11	23.85%

Resevoir of Gaborone Dam, Botswana

Table 4: Botswana's institutional and legal framework

Basic Elements	Response
Presence of an Enabling Institutional Framework for sustainable energy development and services (Max 5 institutions) most critical ones	• Ministry of Minerals, Energy and Water Resources (MMEWR) • Botswana Power Corporation • Botswana Power Corporation Leased • Rural Industries Innovation Centre (RIIC) • Botswana Technology Centre (BOTEC) • Ministry of Environment, Wildlife and Tourism (MEWT) • Ministries of Local Government (MLG) and Ministry of Education and Skills Development (MoESD)
Presence of a Functional Energy Regulator	Botswana's Energy and Water Regulatory Agency
Ownership of sectoral resources and markets (Electricity/power market; liquid fuels and gas market)	Botswana Power Corporation
Level of participation in regional energy infrastructure (Power Pools) and institutional arrangements	
Environment for Private Sector Participation	
Whether the Power Utility(ies) is/are vertically integrated or there is unbundling (list the Companies)	Not unbundled (vertically integrated)
Where oil and gas production exists, whether upstream services and operations are privatized or state-owned, or a mixture (extent) e.g., licensed private exploration and development companies)	
Extent to which Downstream services and operations are privatized or state-owned, or a mixture (extent)	
Presence of Functional (Feed in Tariffs) FIT systems	
Presence Functional IPPs and their contribution	
Legal, Policy and Strategy Frameworks	
Current enabling policies (including: RE; EE; private sector participation; & PPPs facilitation) (list 5 max) most critical ones	• A National Energy Policy • Botswana Energy Master Plan 2004-19 • Renewable Energy Fund for off-grid solutions • 10th National Development Plan 2009-2016 (NDP10) • National Photovoltaic Rural Electrification Programme • Public Notice on electricity supply act requiring generation license - May 2012
Current enabling laws/pieces of legislation (including: RE; EE; private sector participation; & PPPs facilitation) – including electricity/grid codes & oil codes (5 max or yes/no) most critical ones	• Electricity Supply Act 2007 • Petroleum (Exploration and Production) Act

This table was prepared with material from (REEEP, 2012), (MINEA, 2016) and (MINEA and UNDP, 2015)

(2005 dollars at PPP) in 1990, decreasing to 3.1 in 2012. The government target is to achieve 10 per cent power savings through energy efficiency schemes by 2020. The compound annual growth rate (CAGR) between 1990 and 2010 was -1.34 and between 2010 and 2012 was -5.37 (World Bank, 2015).

The share of renewable energy in the total final energy consumption was 47.1 per cent in 1990 decreasing to 23.85 per cent in 2012 (World Bank, 2016); (World Bank, 2015).

Intended Nationally Determined Contributions (INDC) within the framework of the Paris climate Agreement

In October 2015, the government articulated its energy-related Intended Nationally Determined Contributions (INDC). The overall aim is to achieve an emissions reduction of 15 per cent by 2030, from the energy sources categorized as stationary and mobile sources.

Institutional and Legal Framework

The Ministry of Minerals, Energy and Water Resources (MMEWR) is in charge of the energy sector. The energy regulator is the Botswana Energy and Water Regulatory Agency (BEWRA). The electricity sector is vertically integrated and is managed by Botswana Power Corporation. On a regional level, the country is a member of the Southern Africa Power Pool. The legal framework is provided by the Electricity Supply Act 2007.

There is a national energy policy, which aims to provide 80 per cent access to the country as a whole and 60 per cent access in rural areas by 2016 through the increased use of renewable energy. This would reduce the dependence on coal, which is a greenhouse gas emitter.