Disclosure of RESA

The Government of the Republic of Botswana and the Government of the Republic of South Africa have signed a Memorandum of Understanding (MoU) to carry out a Regional Environmental and Social Assessment (RESA), with support from the World Bank, to examine the cumulative environmental and socio-economic impacts of all the planned and existing energy sector investments on both sides of the border between Botswana and South Africa. In order to define the scope of work for a detailed RESA Study, an initial assessment was made which is included in the Phase-1 Report of the RESA hereby attached. The Phase-1 report includes an initial analysis of the scope of the cumulative environmental and socio-economic regional impacts that are likely to occur as a result of investments in coal-fired power and associated mines on either side of the Botswana – South Africa border over the next twenty years and proposes the terms of reference for a detailed RESA Study under Phase-2, as planned to be undertaken with support from the World Bank. The Terms of Reference (ToR) for the detailed RESA study to be undertaken as an element of World Bank support for the development of the energy sector in Botswana and South Africa is attached as Annexure A of the Phase-1 report below.

REGIONAL ENVIRONMENTAL AND SOCIAL ASSESSMENT OF COAL-BASED ENERGY PROJECTS ALONG THE BOTSWANA – SOUTH AFRICA BORDER:

PHASE 1 – PRELIMINARY ANALYSIS OF CUMULATIVE IMPACTS ANDTERMS OF REFERENCE FOR A DETAILED STUDY.

November2012 Version

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ACRONYMS AND ABBREVIATIONS

AsgiSA	Accelerated and Shared Growth Initiative for South Africa (AsgiSA)
BPC	Botswana Power Corporation
CO_2	Carbon dioxide
CtL	Coal to Liquids
DEA	Department of Environmental Affairs
DWMPC	Department of Waste Management and Pollution Control (Botswana)
DWA	Department of Water Affairs (South Africa)
EIA	Environmental Impact Assessment
EU	European Union
FGD	Flue gas desulphurisation
GDP	Gross domestic product
GEAR	Growth, employment and redistribution strategy
Gg	Gigagrams
GGP	Gross geographical product
GHG	Greenhouse gasses
GIS	Geographical information systems
HIV/AIDS	Human immunodeficiency virus/acquired immunodeficiency syndrome
HPA	Highveld Priority Area
IBRD	International Bank for Reconstruction and Development
IPCC	Inter-Governmental Panel on Climate Change
MCWAP	Mokolo Crocodile (West) Water Augmentation Project
MMEWR	Ministry of Minerals, Energy and Water Resources
MoU	Memorandum of Understanding
MW	Megawatt
NO_x	Nitrous oxides
NSC	North south carrier (Botswana)
NWA	National Water Act (South Africa)
PM_{10}	Particulate matter in the size range < 10 microns
PWV	Pretoria Witwatersrand Vereeniging
RDP	Reconstruction and development programme
RESA	Regional Environmental and Social Assessment
RSA	Republic of South Africa
SADC	Southern African Development Community
SAPP	Southern African Power Pool
SO_2	Sulphur dioxide
STDs	Sexually transmitted diseases
TA	Technical assistance
ToR	Terms of Reference
UK	United Kingdom
UNFCCC	United Nations Framework
US	United States

WHO	World Health Organisation
WMA	Water Management Agency

1. INTRODUCTION

1.1 Regional Investments in Coal-based Energy Projects

The deepening energy crisis across the Southern Africa sub-region is a serious impediment to economic growth plans, and requires a major concerted effort at the national and regional levels to address this crisis. The sub-region (including South Africa, Botswana, and its neighbouring countries) has been experiencing severe shortages of power since the end of 2007, due to high growth and lagging investments in new capacity. Botswana's energy demand is supplied partially by the energy generated from its Morupule A Power Station and mostly by the imported energy from South Africa (through Eskom), which is cut back. South Africa has been load shedding intermittently since December 2007, and this condition may worsen through the medium term until sufficient new generation capacities are commissioned. The Southern Africa Power Pool (SAPP) generation expansion plan, which includes twelve countries of the region, indicates a need to add nearly 39,000 MW through 2025, of which about 32,000 MW is intended to meet South Africa's demand alone.

The Government of Botswana desires that energy sector development – especially coal-fired power plant generation – be developed with the least environmental and social impacts possible. The Government of Botswana and the Botswana Power Corporation (BPC) have called on the World Bank to partner in the country's energy sector development and requested an International Bank for Reconstruction and Development (IBRD) loan for the Morupule B Project investments (Morupule B power station, transmission lines, and substations) and Technical Assistance (TA). The TA component includes support for the Regional Environmental and Social Assessment (RESA) to examine the cumulative environment and socio-economic impacts of all the planned and existing energy sector investments on both sides of the border between Botswana and South Africa.

In addition to the Morupule B Project, two other energy projects are being considered in Botswana, the Mmamabula Energy Project and the Mmamantswe Energy Project, for whichCIC Energy and Aviva Corporation are undertaking feasibility studies respectively. Two major new coal-fired facilities are planned on the South African side of the border. These projects are all further discussed in Section 3. Combined with the existing Morupule A power plant in Botswana and the Matimba power plant in South Africa, it is possible that within a decade or so there may be more than 17,000 MW of coal-fired power generation capacity within approximately one hundred and fifty kilometres of the Botswana – South Africa border. Beyond the power generation sector, there is also a proposal from Sasol to develop a coal to liquids (CtL) production facilityin the same area on the South African side of the border. Taken together, these facilities raise the possibility of cumulative environmental and socio-economic impacts, with potential trans-boundary consequences, that may not be adequately addressed through their individual Environmental Impact Assessments (EIAs).

1.2 Objectives

The objective of this study is to conduct an initial analysis of the scope of the cumulative environmental and socio-economic regional impacts that are likely to occur as a result of investments in coal-fired power and associated mines on either side of the Botswana – South Africa border over the next twenty years. The principal outputs of the study are:

(i) this report which presents an initial analysis of cumulative impacts; and,
(ii) draft Terms of Reference (ToR) for a more detailed RESA that will include public consultation to be undertaken as an element of World Bank support for the development of the energy sector in Botswana and South Africa.

2. THE APPROACH

2.1 Overview

In general terms cumulative and potential cross border effects are typically not comprehensively assessed in EIAs. Without detracting from the quality of the individual environmental and social assessments (ESA) for these coal-based industry projects, the cumulative and cross-border impacts were not generally considered, except for a few limited cases (e.g. the ESA for the Morupule B Power Project assessed the cumulative impacts of discharges from both the existing Morupule A and B Power Plants). Given the scale and potential rapidity of development of energy projects in the Botswana-South Africa border, cumulative and cross-border impacts are highly likely and, as such, it is essential to properly characterize the nature and scale of these impacts.In order to present the potential significance of these cumulative impacts the approach proposed here is to assess the impacts within a broadly defined sustainability model.

2.2 The sustainability model

2.2.1 Constraints and opportunities

The sustainability model is based most fundamentally on the identification of characteristics of the receiving environment that serve to *constrain* or *provide opportunities* for sustainable development. The assessment is then based on how the combined environmental and social aspects of the various energy projects meet or exceed the defined constraints and opportunities. A sustainable development path would then be underpinned by the energy projects capitalising on opportunities and not exacerbating or exceeding the defined constraints. An unsustainable development path would be where constraints to sustainable development are ignored or exacerbated by the various energy projects.

2.2.2 Strategic impacts

A key element of the sustainability model is focussing on 'strategic impacts'. In any environmental assessment a distinction can be made between impacts that are important for decision-making and those that must be assessed and ultimately managed, but are unlikely to be material to decision-making. Strategic impacts are then by definition those impacts that would influence decision-making on the acceptability or otherwise of any proposed activity. By definition, cross-border impacts should be considered important for decision-making and thus must be deemed strategic impacts especially in light of possible cross border agreements. At the same time large-scale cumulative impacts have to be seen as potentially significant so they too must be viewed as strategic impacts. On that basis, the following are considered to be strategic impacts for the assessment at hand:

a. Air Quality Impacts on human health and/or biodiversity ;
b. Surface Water Resource Impacts;
c. Groundwater Resource Impacts;
d. Social Impacts;
e. Economic Impacts;
f. Climate Change Impacts;
g. Biodiversity Impacts; and
h. Cultural/Archaeological/Heritage Impacts

2.2.3 The assessment method

The assessment method is illustrated schematically in Figure 1. In essence the method is one of firstly characterising the receiving environment in terms of constraints and opportunities and secondly quantifying the environmental and social aspects[1] of the various coal-related activities. Cumulative impacts are then assessed by considering the combined (or cumulative) aspects and how these may interact with the receiving environment, specifically in terms of the constraints or opportunities that prevail in that environment.

2.2.4 Coordination and implementation

The coordination of the implementation of the RESA will be in accordance with the provisions of the Memorandum of Understanding (MoU) signed between the two countries. The World Bank project team will be involved in all aspects of conducting the RESA Study and strive to ensure smooth conduct, deliberations and completion of the study. The following broad principles will therefore, apply:

a. The Participants will establish a Joint Advisory Committee comprising officials from the following institutions to implement the MOU;
    i. For Botswana - the Permanent Secretary of the Ministry of Environment, Wildlife and Tourism and senior officials, one each, from the Ministry of Minerals, Energy and Water Resources headquarters, the Department of Environmental Affairs, the Department of Waste Management and Pollution Control, the Department of Public Health and the Department of Town and Regional Planning.
    ii. For South Africa – the Director General of the Department of Environmental Affairs and senior officials, one each, from the Department of Water Affairs,

[1]*Aspects are defined in the ISO14001 Environmental Management Systems standard as 'elements of an* organisation's activities, goods or services that can *interact* with the environment.

the Department of Mineral Resources, the Department of Energy, the Department of Human Settlements and then Department of Health.

b. The Joint Advisory Committee will provide guidance to the Joint Technical Committee, which will comprise twelve (12) officials each from the two (2) countries to coordinate the implementation of the project.

c. The Permanent Secretary of the Ministry of Environment, Wildlife and Tourism in Botswana and the Director General of the Department of Environmental Affairs in South Africa will be the co-chairs of the Joint Advisory Committee.

d. The Coordination Secretariat will be established in both Botswana and South Africa to provide the secretariat support to the Joint Technical Committee and ensure timely and proper coordination of the implementation of the project. Grant funds mobilized for the RESA Study will cover incremental costs such as costs for travel and subsistence for the Joint Advisory Committee and Joint Technical Committee members during the RESA study, the cost of consultants supporting the logistics and associated costs, but will not cover any remuneration for officials of either or both Participants.

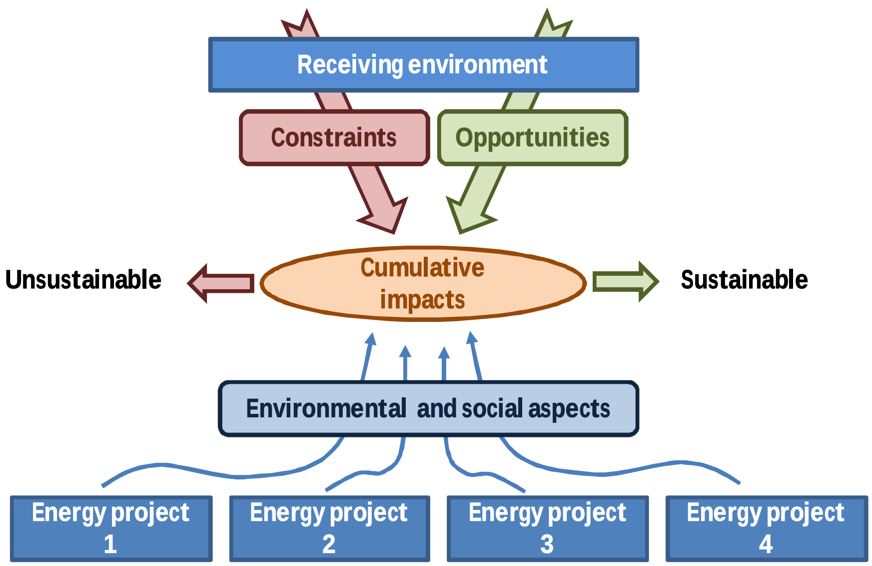

Figure 1: Conceptual presentation of the method used for the assessment of cumulative impacts as a result of energy projects on the Botswana-South African border.

3. THE ENERGY PROJECTS

The energy projects (both proposed and existing) in the Botswana – South Africa border area are summarised below. It should be noted that information on these projects and whether or not they will ever be implemented is hard to come by. As such at the time of the RESA it will be necessary to update this information.

3.1 South Africa

3.1.1 Matimba power station

The Matimba Power Station is an existing power station with an output of some 3990MW. The power station is situated approximately 13km west of Lephalale. Coal is sourced from the Grootegeluk Coal Mine, just to the west of the power station.

3.1.2 Medupi power station

The MedupiPower Station (4800 MW) (previously known as Matimba B Power Station) is currently under construction. This project will require (with the associated plant [terrace area]) an area of approximately 700 ha, and an additional 500 - 1000 ha for ancillary services, including ashing facilities. It is anticipated that 7 million tonnes of coal per year will be required in order to supply the power station. The proposed positioning of the power station is approximately 20 km west of Lephalale.

3.1.3 Coal 3 and Coal 4

These two proposed 5400 MW power stations will require an area of at least 5000 ha (including ancillary services), although sites of up to 8000 ha have been considered as part of the project. The proposed sites are as close as 10km to the Botswana border, and approximately 40km west of Lephalale.

3.1.4 Mafutha

Project Mafutha is a proposed new 80 000 bpdCoal to Liquid Plant (CtL), as well as a new mine of approximately 40 million tpa run of mine capacity (adjacent to the site of the CtL facility) and town for an estimated 60 000 inhabitants, and a services corridor linking the various project units. Mafutha will be located about 30km west of the existing Matimba power station, and just north of the proposed sites for Coal 3 and Coal 4.

3.2 Botswana

3.2.1 Morupule A power station

The existing Morupule A power station (132MW) consists of four turbo-generators, each with a rating of 33 MW output. The power station utilizes between 480 000- 600 000 tons of coal per annum, depending on the availability of the plant. The power station is located about 300 km north of Gaborone. The coal is transported by a 2km conveyor belt from a nearby underground mine.

3.2.2 Morupule B power station

The Morupule B Power Station is to be situated adjacent to the existing MorupuleAPower Station. Palapye is the nearest village, situated approximately 5 km to the east of the power station site. The power station is planned for 2 phases, with phase 1 involving 4 x 150 MW units (600MW), and phase 2 planning on doubling this capacity to a total of 1200 MW. The area required for the plant is approximately 476ha.Indicative coal requirements are between 2.2 and 2.7 million tonnes per annum.

3.2.3 Mmamabula energy project

This initially proposed 2700 MW power plant is about 80 km west of the existing Matimba Power Plant in South Africa. The proposed area that has been assessed for this project (including ancillary services) is approximately 3000ha. Coal will potentially be mined from the Mookane and Dovedale sites (with the current focus on Mookane Site). It is likely that anew residential village will be required for this project, and currently it is proposed to establish this near toMmaphashalala. Indicative coal requirements for Phase 1 of the 2700MW are between 7.5 - 9.0 million tonnes per annum.

3.2.4 Mmamantswe

The actual size of the Mmamantswe Power Station is yet to be finalised, but current scenarios are for 2 x 500MW units, with a capacity to expand to another two units at a later stage (for a total of 2000MW). The proposed site is approximately 130km north-east of Gaborone and about 15km from the South African border near Olifants Drift. Current scenarios suggest that coal will be mined (using an open cut method) from the adjacent Mmamantswe coal deposit, containing approximately 1.3 billion tonnes of black coal. It is predicted that the coal consumption for the Mmamantswe Energy Project (for the 2 x 500 MW) units will be around 4 million tons per annum.

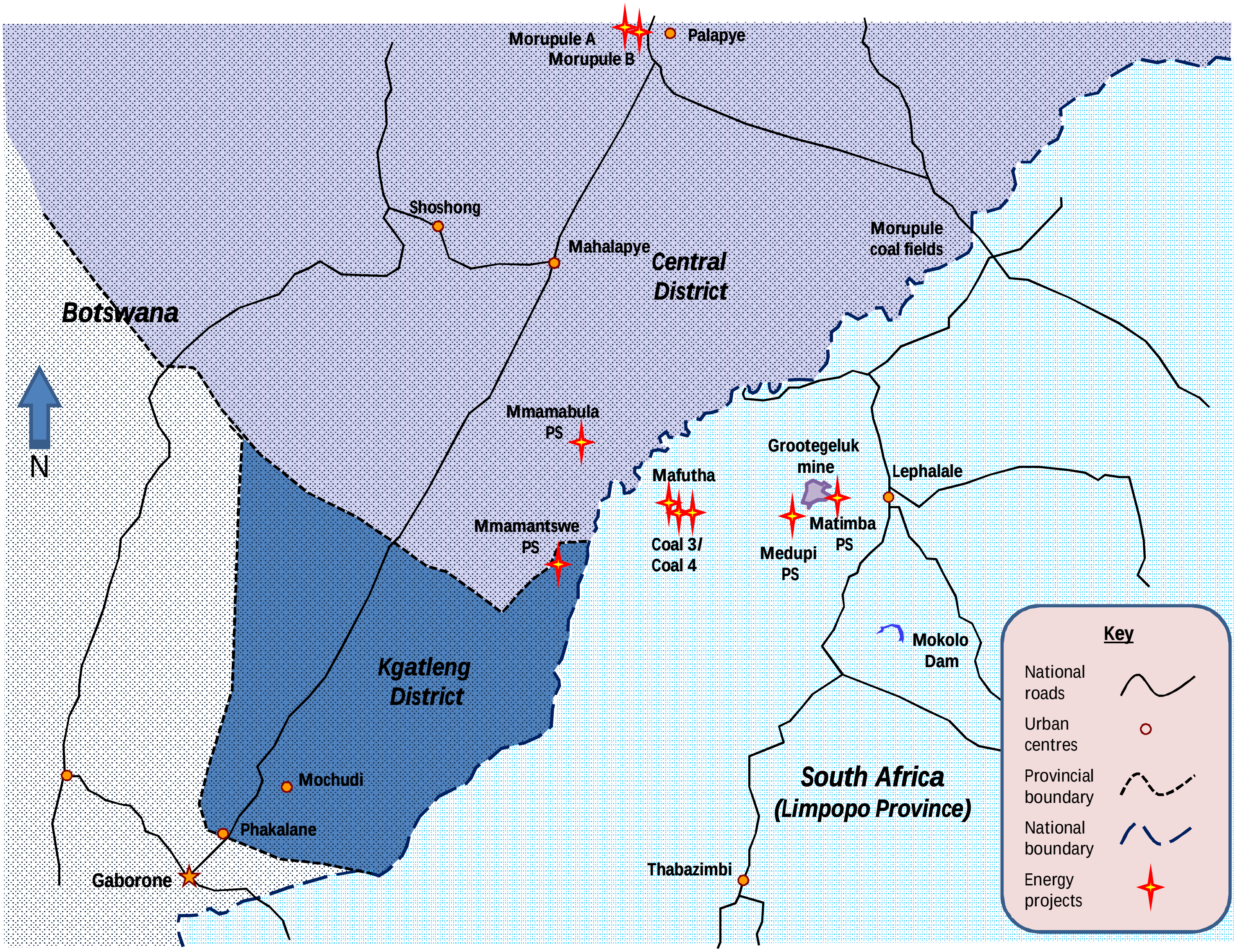

Figure 2: Schematic presentation of the Botswana- South Africa border area showing the relative positions of the energy projects, national and provincial boundaries, national roads and urban centers.

4. INITIAL CHARACTERIZATION OF CUMULATIVE IMPACTS

4.1 Air quality impacts on human health and/or biodiversity

4.1.1 Emissions characterisation

Estimates of the emissions from the various energy projects in the Botswana - South Africanborder area are summarised in Table 1. The values presented in the table have been derived from various sources of information on direct emissions and extrapolated, where such information has not been directly available. Extrapolated emissions have been conservatively presented as maximum plausible values in order to ensure that the assessment is robust but could well prove in reality to be less per individual source than presented here.

Table 1: Emissions estimates of criteria pollutants from the various energy projects in the Botswana-South African border area(figures in shaded blockshave been estimated in the absence of directly available information).

Projects	Output	SO_2	SO_2 (with sulphur removal)	PM_{10}	NO_2
	MW	Tonnes per annum			
South Africa					
Matimba	3 990	263 259	263 259	6 175	96 461
Medupi[2]	4 800	363 895	191 045	7 429	116 043
Mafutha[3]		120 801	12 080	7 600	71 601
Coal 3[4]	5 400	363 895	36 390	8 357	130 549
Coal 4[5]	5 400	363 895	36 390	8 357	130 549
South Africa Total	**19 590**	**1 475 745**	**539 164**	**37 918**	**545 203**
Botswana					
Morupule A	118	8 946	895	183	2 853
Morupule B[6]	1 200	90 974	9 097	1 857	29 011
Mmamabula[7]	2 700	107 198	107 198[8]	4 081	54 049

[2]*Environmental Impact Report for the proposed establishment of a New Coal-Fired Power Station in the Lephalale Area, Limpopo Province; The Medupi Coal Fired Power Station – Independent Review of the Compliance with the Equator Principles.*

[3]*Environmental Impact Assessment for the Sasol Natural Gas Expansion (NGE), Proposed 15% Expansion in Gas Loads, Final Impact Report, July 2000. Please note that this estimate is only for the CtL plant and excludes the associated town and mine;*

[4] *Final Scoping Report: Environmental Impact Assessment Process: Proposed coal-fired power stations and associated infrastructure in the Waterberg, Limpopo.*

[5] *Final Scoping Report: Environmental Impact Assessment Process: Proposed coal-fired power stations and associated infrastructure in the Waterberg, Limpopo.*

[6]*Morupule B Power Station Project, EIS.*

[7] *Environmental Impact Statement, Mmamabula Energy Project, CIC Energy Corp, Oct 2007, Final Report for submission to stakeholders and authorities, Executive Summary.*

Projects	Output	SO_2	SO_2 (with sulphur removal)	PM_{10}	NO_2
	MW	Tonnes per annum			
Mmamantswe[8]	2 000	151 623	15 162	3 095	48 351
Botswana Total	**6018**	**358 741**	**132 352**	**9 216**	**134 264**
TOTAL	**25 608**	**1 834 486**	**671 516**	**47 134**	**679 467**

It can be seen from the table that emissions that derive from energy projects in Botswana are significantly less than those from the energy projects on the South African side of the border. In general emissions of criteria pollutants from energy projects in Botswana are less than 20% of the combined totals.

To contextualise the scale of these emissions it is helpful to compare the combined emissions for energy projects on the Botswana-South Africaborder to those of the Highveld Priority Area (HPA) (Figure 3). The Highveld area in South Africa is known to have poor air quality due to the concentration of industrial and non-industrial sources. The Minister of Environmental Affairs and Tourism therefore declared the Highveld Priority Area (HPA) on 23 November 2007.Combined emissions estimates for the HPA are presented in Table 2.

Table 2: Summary of the combined emissions of energy projects in the Highveld Priority Area (HPA) [9]

Pollutant	PM_{10}	NO_x	SO_2
Emissions (tpa)	279 630	978 781	1 622 233

The reason for the comparison is that the HPA is aSouthern African area that has similar power generating, mining and other coal-based industrial activities to those proposed for the Botswana-South Africaborder area. In addition the HPA has been relatively comprehensively studied in terms of air quality including acid aerosol transport and deposition. A recently released study of the HPA identifies at least 9 'hot spots' where predicted ambient concentrations of criteria pollutants are seen to exceed the air quality standards. It seems highly probable that similar 'hot spots' could occur in the Botswana-South Africa border area and indeed in both Botswana and South Africa as a result of emissions from the various energy projects.

While the emissions are generally less than those generated in the HPA the emissions derive from a slightly more concentrated set of sources in the Botswana-South Africaborder area than they do in the HPA. In addition due to the control of particulate emissions at power stations in the HPA, the PM_{10} emissions noted for the HPA are principally derived from other sources such as mine dust, other industries, biomass fires, domestic fuel use and others none

[8] *Email communication with Mark Chatfield, General Manager Energy, Aviva Corporation Ltd*
8 Although FGD is described in the EIS it is not clear whether the SO2 emissions will be less as a result of FGD than what was presented in the EIS.
[9]*DEA, 2010: Draft Air Quality Baseline Assessment for the Highveld Priority Area (HPA)*

of which have been accounted for in respect of the Botswana-South Africaborder area but which are likely to manifest albeit to a lesser extent. Elevated PM_{10} concentrations are widespread in the HPA and probably one of the most significant air quality issues for that area. The proliferation of coal mines required to fuel the various energy projects, other industries, residential emissions and biomass burning will all contribute significantly to the combined ambient PM_{10} concentrations that are likely to manifest in the Botswana-South Africaborder area.

Figure 3: Highveld Priority Area (source: www.saaqis.org.za).

4.1.2 Prevailing wind direction

Wind roses have been sourced from Lephalale to illustrate the prevailing wind direction in the area (Figure 4). It can be seen from the wind roses that the wind direction is predominantly northeasterly. This is consistent with meso-circulation patterns and the presence of a continental anti-cyclone that occurs above the Southern African Highveld (the primary driver of the generally drier climate on the western side of the country). In the region of Morupule A and B, the dominant winds also occur from a north easterly direction with an average wind speed of 3 m/s. What is important about these circulation patterns is the longer range transport potential of the pollutants emitted by energy projects in the Botswana - South Africa border area.

4.1.3 Long range transport

In respect of long range transport it must be noted that Gaborone (the capital of Botswana) lies approximately 130 km southwest of the nearest proposed Power Station (Mmamantswe Energy Project) (see Figure 2). Long-range transport of concentrated pollutants (SO_2,

$PM_{10}$and NO_xamongst others) is a well-recognised phenomena in Southern Africa especially under the highly stable conditions that are known to prevail over the plateau. As such it is conceivable that long range transport could result in elevated concentrations of SO_2, PM_{10} and NO_x in the Gaborone area, as a result of emissions from energy related activities in the Botswana border area. It is also conceivable that this long range transport could circulate in towards the highly urbanised and industrialised PWV (Pretoria-Witwatersrand-Vereeniging) area of South Africa. There is a high seasonal variation of transport of air into the region. It has been noted that 41% of all the air that is transported from the Highveld Priority Area effects countries that border on South Africa, through direct or re-circulated transport. It has been found that transport of air to Botswana occurs more than 30% of the time (Freiman and Piketh, 2003[10]). As such, the large scale-meteorological effects, deposition and transformation rates, will play an important role for the long range transport of the pollutants into and out of the study area.

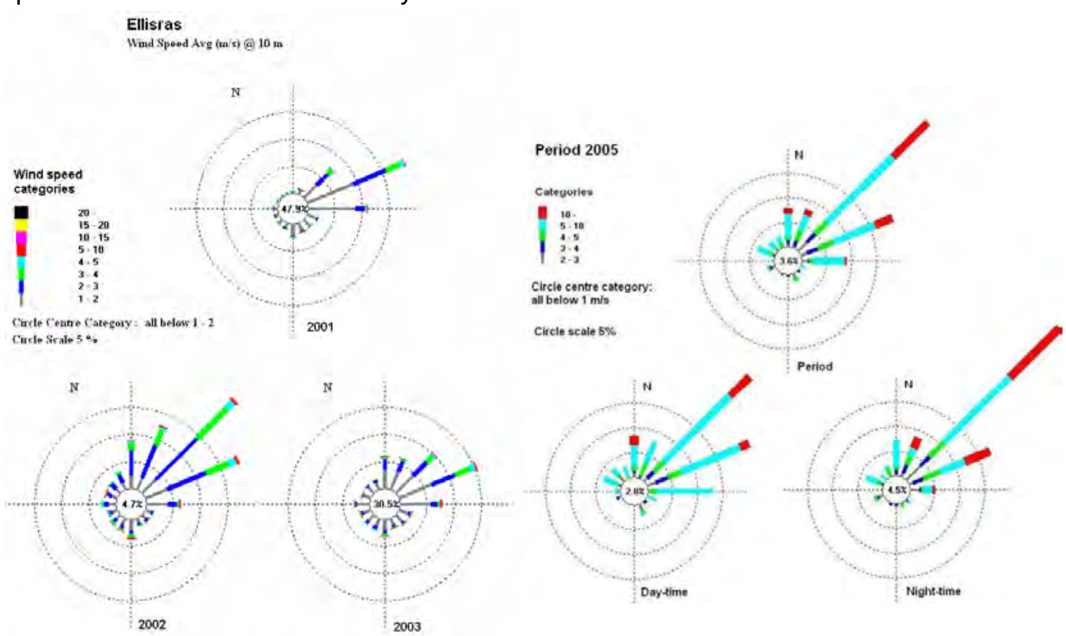

Figure 4: Annual average wind roses for the Lephalale (previously Ellisras) Weather Service Station for the years 2001 to 2003 (left) and for the Mmamabula site for 2005 (right). The strong predominance of northeasterly sector winds at both sites is to be noted.

4.1.4 Potential human health effects

It is also evident that in none of the EIAs have the combined emissions from all potential sources of emissions been considered in modelling resultant ambient air quality concentrations (although the MedupiEIAdid include an assessment of the combined effects of both Matimba and Medupi). In addition, although infrequent, there are easterly and westerly winds that blow along the axis of development of most of the major

[10]FriemanM.T. and Piketh, S.J. (2003): Air transport into and out of the industrial Highveld region of South Africa, Journal of Applied Meteorology, 42, 994-1002.

developmentsthat would serve to combine emissions from all facilities in a manner not currently dealt with in the individual EIAs. It is also clear from the EIAs that some of the larger scale activities (such as power stations and coal mines) have resulted in predicted ambient concentrations exceeding WHO guidelines for at least SO_2 and PM_{10} over the shorter averaging periods (1 hour and 24 hours).

In order to better understand this circumstance of WHO guidelines exceedances, it is necessary to review measured ambient air quality measurements that have been derived from Eskom both up and downwind of the existing Matimba power station. These are shown as frequency distributions (for daily SO_2 averages) in Figure 5. There are several important considerations that derive from the measured values. The first of these is that the WHO guideline of 20 µg/m^3 is exceeded for some 18% of the time (about 65 days in a year) on the downwind side of Matimba and 8% on the upwind side of Matimba (more than 29 days a year). While both stations are in close proximity to the power station, the number of exceedances of WHO guidelines for SO_2 emissions is greater at downwind locations of Matimba than at upwind locations. The high frequency of exceedances suggests a high SO_2 loading. The frequency distributions are typical of air pollution on the plateau with frequent low concentrations and very high concentrations occurring very infrequently.

It should be noted that the WHO guideline values was used here for assessment purposes only and should not be interpreted as a defining standard. The WHO offers interim target values as well. South Africa, for example, has adopted the value of 125µg/m^3 which is a WHO interim target value.

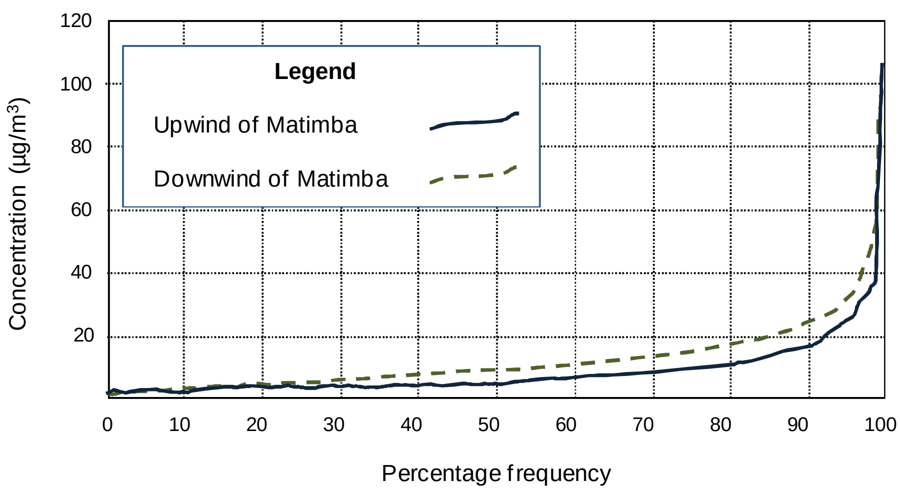

Figure 5: Frequency distribution of measured ambient daily SO_2 concentrations up- and downwind of the Matimba Power Station. The stations are approximately 2 km upwind and 1.8 kms downwind of the power station.

These very high concentrations appear to derive principally from highly stable atmospheric conditions. They occur as a result of the use of domestic fuels (coal) for cooking and space heating where emissions occur at ground level. Residential emissions are the most likely source of elevated SO_2 concentrations on the upwind side of Matimba evident in Figure 5, although emissions from Matimba itself cannot be discounted entirely. Emissions from domestic fuel use are then ‘trapped’ at ground level due to stable inversion conditions which inhibit dispersion. As residential cooking emissions occur close to ground level, these emissions are not likely to be transported long distances, and the impacts of these emissions are likely to be local. Emissions from industrial sources, coal-fired power generation in particular, occur several hundred meters above ground level. Under highly stable night-time conditions these plumes do not come to ground, but are brought to ground during the day as solar warming generates turbulence and mixing. Industrial emissions are the most likely source of the elevated SO_2 concentrations evident on the downwind side of Matimba in Figure 5.

The most important social health issues that were identified in the Mmamabula Energy Project study were sexually transmitted diseases (STDs), HIV/AIDS, nutritional status and the emotional or psychological state of mind of the villagers. Air quality impacts on human health were not identified as issues of major concern. However, assessments of atmospheric emissions from Morupule A and the proposed Morupule B indicated that the highest predicted ground level concentrations exceeded all the relevant guidelines and standards for hourly, daily and annual averaging periods, with the zone of exceedance for highest hourly predictions (EC standard) covering a area with a radius of approximately 10 km around the Morupule B power plant site. However, it was found that it was not predicted to exceed the Botswana and WBG guideline for highest daily average and annual average at Palapye and Serowe. The highest daily averaged SO_2 concentrations were shown to exceed the critical level for agricultural crops, forest trees and natural vegetation both on the Morupule B site and at Palapye as well as other surrounding areas.PM_{10} concentrations around Morupule B exceed the daily and annual guidelines (Botswana, WBG and WHO) for maximum ground level concentrations.

4.1.5 Hot spots

What this means for the proliferation of coal-fired activities in the Botswana - South Africa border area is that there will be areas in which very high ambient pollution concentrations (exceeding WHO guidelines)could occur. Such effects are highlighted in the various EIAs where modelling of emissions from individual activities have indicated localised areas where defined air quality standards, and the WHO guidelines in particular, are likely to be exceeded. Both Morupule B and Medupi are so characterised in the respective EIAs.Predicted ambient PM_{10} concentrations for Morupule B exceeded the WHO daily and annual guidelines for the maximum ground level concentrations; an exceedance of the annual averagePM_{10} concentrations of WHO guidelines extends up to 1km from the source; the highest predicted ground level SO_2 concentrations exceeds the WHO guidelines for hourly, daily and annual averaging periods.

The issue is of course where such areas occur, the concentrations that are likely to manifest, and the frequency of the exceedances of the WHO guidelines. In order to properly characterise these effects it will be necessary to conduct high resolution dispersion modelling which includes all the coal-fired power generating activities, and all other emissions especially those from low income residential areas that depend on domestic fuel use for energy. These various sources will need to be properly characterised in terms of their emissions and modelled in combination with one another to provide a comprehensive assessment of potential ambient air pollution concentrations, the risks posed by these concentrations to human health and biodiversity and the degree to which the impacts are manifest as cross-border impacts.

4.1.6 Exposure

It is also important to recognise that the Botswana - South Africa border area is sparsely inhabited suggesting limited exposure of people to air pollution. Much of the area is agricultural on both sides of the border, however, there are areas on the Botswana side of the border where agriculture is significantly more concentrated than on the South African side of the border. The largest urban settlements are Lephalale and Onverwacht (South Africa) and Palapye (close to Morupule A and B Power Plants), Mahalapye (Mahalapye is further away from these power plants), Mochudi and Gaborone (Botswana) (both further away from emission sources).

As will be discussed in Section 4.4, it is likely that other urban centres will be developed (for example the town associated with Sasol's Mafutha project) as well as informal residential areas as work seekers move into the area. To properly characterise and assess the full potential impacts of atmospheric emissions from the various coal-fired projects, it will be necessary to determine where such residential areas are likely to be, what they will contribute as emitters in their own right and the likely ambient air pollution concentrations to which residents will be exposed. Potential pollutant concentrations in existing urban areas as a result of the combined emissions from the various coal-fired sources must also be considered

4.1.7 Acid transport and deposition

In respect of acid transport and deposition it is instructive to note that after several campaigns and extended acid deposition monitoring, the combined sources of acid aerosols on the HPA were not seen to result in significant acid deposition. In fact acid deposition monitoring and programmes have been discontinued on the HPA due to the fact that there was so little evidence of acid deposition. With the generally dryer climate of the Botswana - South Africa border area and the relatively smaller emissions of acid gases and aerosols in that area, it seems unlikely that acid deposition would manifest as a significant impact as a result of combined emissions from energy projects.

4.1.8 Metals

Emissions of metals associated with ash have been assessed in some detail in at least the MedupiEIA. Probable emissions of a range of metals were calculated and modelled to determine ambient concentrations and to characterise the associated risk of adverse health effects. The assessment concluded that cancer risks were very low with total incremental cancer risk across all carcinogens calculated at between 1:10.6 million and 1:24.8 million. In terms of non-carcinogenic risks, no inhalation related thresholds for metals were predicted to be exceeded. More recently, however, the South African DEA has indicated renewed interest in metals from coal combustion, especially mercury, and is currently assessing the likely heavy metal contamination risks that would derive from coal use. It will be necessary to stay close to further developments in this regard.

4.2 Climate change impacts

4.2.1 Coal dependence

South Africa contributes disproportionately to global carbon emissions due to the dependence of the economy on coal. Official carbon dioxide equivalent emissions from South Africa are outdated and are available only for 1990 and 1994 during which time a 9% increase is evident (Table 3). It stands to reason that these emissions will increase significantly with the large scale development of coal-based energy projects. Combined CO_2 emissions from the various energy projects on the Botswana South Africa border are estimated at some 177 000 Gg (Table 4) the bulk of which can be seen to derive from activities in South Africa.

Table 3: Aggregated emissions of carbon dioxide, methane, and nitrous oxide in South Africa in 1990 and 1994 (Source: DEAT 2003).

Source	CO_2 equivalent (Gg)							
	CO_2		CH_4		N_2O		Aggregated	
	1990	1994	1990	1994	1990	1994	1990	1994
Energy	252 019	287 851	7 286	7 890	1 581	1 823	260 886	297 564
Industrial processes	28 913	28 106	69	26	1 810	2 254	30 792	30 386
Agriculture			14 456	15 605	738	825	15 194	16 430
TOTAL							**347 346**	**379 842**

Table 4: Estimates of CO_2 emissions from the various energy projects that are being developed on the Botswana-South Africa border.

Projects	Output	CO_2
	MW	Tpa
South Africa		
Matimba	3 990	21 782 734
Medupi	4 800	25 821 338
Mafutha[1]		26 000 000[2]
Coal 3	5 400	29 480 392
Coal 4	5 400	29 480 392
Botswana		

Projects	Output	CO_2
	MW	Tpa
Morupule A	118	644 201
Morupule B	1 200	6 551 198
Mmamabula	2 700	14 740 196
Mmamantswe	2 000	10 918 664
TOTAL	**25 608**	**177 032 978**

[1] *Only for CtL Plant (excludes Town and Mine)*

[2] *Sasol Sustainability Report 2009 ("To achieve a 20% reduction in absolute emissions for new CtLplants commissioned before 2020, and a 30% reduction for plants commissioned before 2030*

This is an enormous additional load to add to a country which is already recognised along with India, China and Brazil as a significant developing country source. Given the twenty year timeline for the RESA, the implications of this additional greenhouse load (bearing in mind that methane and CO_2 emissions from coal mines are not yet included here) must be assessed in detail within the context of the further efforts of the global community to properly address and reduce the risks of climate change.

4.2.2 International commitments

Internationally, commitments to reduce emissions of greenhouse gases were agreed in Kyoto in December 1997. The Kyoto Protocol, which entered into force on 16 February 2005, stipulates that Annex 1 Parties (mainly industrialised countries) shall individually or jointly reduce their aggregate emissions of a "basket" of six greenhouse gases to 5% below 1990 levels by the period 2008-2012. The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) was adopted in December 1997 but only entered into force in February 2005, following a lengthy process of ratification by various countries.

The Kyoto Protocol is now a legally binding treaty to which all parties are bound, including South Africa which acceded to the Kyoto Protocol in mid-2002. In acceding to the protocol South Africa was categorised as a Non-Annex 1 (or developing) country under the terms of the Protocol. As such, South Africa does not have a commitment to reduce carbon emissions or to place any cap (or upper limit) on its carbon emissions. However, the Inter-governmental Panel on Climate Change (IPCC) has called for an immediate 50-70% reduction in global CO_2 emissions in order to stabilise global CO_2 concentrations at the 1990 level by 2100 (IPCC).Although difficult to quantify, these various initiatives will place considerable pressure on the various coal-based energy projects to at least minimise CO2 emissions, if not to prevent the projects from going ahead.

4.3 Cumulative impacts on water availability and quality

4.3.1 General rainfall

South Africa has a relatively low annual rainfall mean of less than 500 mm per annum and Botswana even less.The annual average rainfall recorded at the Mmamabula site is 445mm, with an average of 371mm at the Morupule B site, and an average annual rainfall of 435mm in the Matimba area (South Africa). A rainfall gradient extends across the sub-continent from the higher rainfall areas in the east to the semi-arid and arid regions in the west. Unsurprisingly, surface water is scarce and the area is prone to drought.

4.3.2 Water availability

Water resources in South Africa are managed under the auspices of the National Water Act (NWA). The NWA in turn is based on the principle of managing catchments or as defined in the act, Water Management Areas (WMA). The act also identifies three broad categories of water use, namely, and in order of importance, basic human needs, maintenance of the ecological function of the water system and water for other users. The maintenance of the ecological function is defined in terms of a so-called 'ecological reserve' which is the amount (and quality) of water that must be maintained in the system to ensure the sustained functioning of the aquatic eco-system in the given WMA.

The energy projects within South Africa that are the subject of this assessment are situated in the Limpopo WMA the characteristics of which are summarised in Figure 6. While the Limpopo WMA is focussed on South Africa and is not recognized as such within Botswana, the Limpopo River Basin is shared by Botswana, Zimbabwe, South Africa and Mozambique. The utilisation of water in the Limpopo Basin is governed by the SADC Protocol on Shared Watercourses, which provides guidelines on the utilization of water across international boundaries[11]. It can be seen from the figure that the total amount of water available is already exceeded by existing utilisation, even with the inward transfer of water from other water management areas.

The effect is a negative balance which is projected to worsen over time. It can also be seen from the graph that there is almost no provision for the ecological reserve (shown on the right hand side of the graph) given the existing state of water use. This means that there will need to be significant further water augmentation to the Limpopo WMA from other WMAs to provide for any additional water use in the province. The Makolo-Crocodile West Augmentation Scheme (MCWAP) is planned to provide the additional water required by various power projects in the area but will not make any contribution to the recovery and future sustainability of the reserve.

The supply of water for the Mmamabula Energy project is under investigation. Groundwater will be the main water source for the MEP. Surface water will be supplied from the North

[11] http://www.dwaf.gov.za/Documents/Other/WMA/1/optimised/LIMPOPO%20REPORT%20PART%20B%20AND%20APPENDICES.pdf

South Carrier (NSC) as an alternative for use if and when required. Morupule B Power Plant will use the NSC as its primary source of water.

4.3.3 Groundwater

More recently groundwater has been advocated as a supplementary source of industrial water in the area and preliminary information on Coal 3 and Coal 4 suggests that ground water may be used to meet the water demand of the stations. Available information indicates that all the power projects in Botswana will source the water requirements from groundwater, except for Morupule B which will source water from the North Source Carrier (NSC) as its primary water source. There is very limited information in the EIAs on groundwater as a resource. No information is directly available on the volume and quality of the groundwater as a water resource and in particular the relationship between the groundwater resource in South Africa, the Limpopo River and the groundwater resource in Botswana.

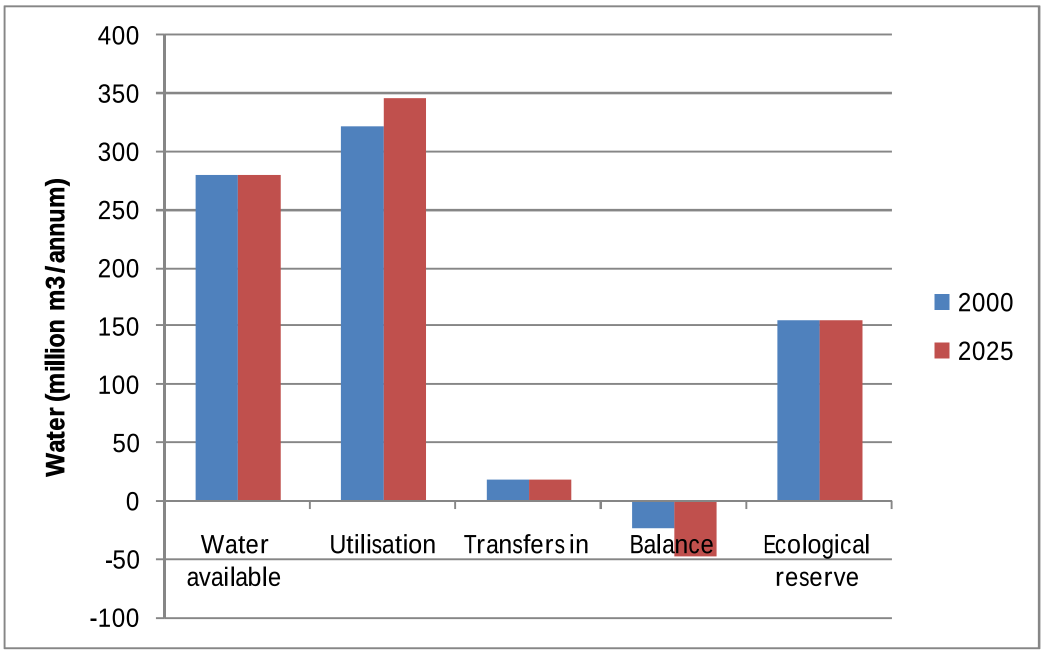

Figure 6: Histogram showing water availability and use in the Limpopo Water Management Area (WMA) (Limpopo Water Strategy and 5-year Workplan, 2006). Note the existing and future projected negative balances.

On the eastern side of the Waterberg district is a dispersed settlement of between 3 and 4 million people. These communities are totally dependent on access to groundwater which is what has allowed the community to settle in the way that it has. Any risk to the groundwater either through contamination or use of the resource would have the effect of this supply. Due to the dispersed nature of the settlement it would be virtually impossible to provide reticulated water (and indeed other services) to such areas. It is most improbable that developments on the western side of the district would have an impact on these communities, but the risk of affecting similar communities on the Botswana side of the border must be considered. Although the settlements are less dense in Botswana there are score of small agricultural plots that are obviously dependent on access to groundwater.

4.3.4 Flue gas desulphurisation (FGD)

Water scarcity in the Limpopo province of South Africa (and indeed across the country as a whole) has seen the stipulation that all future coal-fired power stations will be dry-cooled rather than wet. This has the effect of slightly reducing the efficiency of the power station but results in a dramatic reduction in the water required for cooling purposes. The requirement to control SO_2 emissions through flue gas desulphurisation (FGD) has the effect, however, of increasing again, the water requirements of the power stations. It seems that a decision has been made to install FGD on 3 units at Medupi but all new power stations in South Africa will require FGD on all 6 units. Power stations in Botswana will also have FGD(except for Morupule B, which instead removes sulphur during combustion with limestone addition) although it is suggested that the lower sulphur in the coal to be used for Mmamantswe may forgo the need for FGD. The issue here is assessing the utility of the water for FGD and determining whether or not that is the best possible for the water, given the multiple competing demands for water in the area, over and above the protection of the ecological reserve.

4.3.5 Water requirements

The combined water requirements of the various energy projects that are currently defined total some 66 Mm^3/a (Table 4). Although that requirement includes water needs for Botswana projects, the bulk of it will be required in South Africa where current sources total some 2.6 Mm^3/a[12]. As previously described water augmentation will be required to provide for this 'industrial' demand. It is not clear, however, how the requirement of meeting the ecological reserve will be addressed if at all, in order to ensure the sustainability of the river systems in the area. Even the Department of Water Affairs (DWA) acknowledges that 'generally, the environmental (ecological) reserve cannot be adequately provided for – which creates a serious sustainability issue' but provides no further indication on how the problem will be addressed. The large scale water requirement must also be seen within the context of projections on the availability of water indicate that South Africa will experience a national water deficit by 2025[13].

4.4 Economic impacts

4.4.1 Economic development

The various sectors contributing to the GDP of Botswana are presented in Figure 7 together with those for the Limpopo Province. It can be seen that mining contributes significantly in

[12] *The Medupi Coal Fired Power Station – Independent Review of the Compliance with the Equator Principles.*
[13] *South Africa Environment Outlook (2006)*

Table 5: Estimates of water requirements of the various energy projects that are being developed in the Botswana-South Africa border area.

Projects	Output	Water use - no FGD	Water use with FGD on 3 units	Water use with FGD on 6 units
	MW	Mm^3/a		
South Africa				
Matimba	3 990	3.64		
Medupi	4 800	4.38	3.85	7.70
Mafutha[14]		32	32	32.00
Coal 3	5 400	4.38	3.85	7.70
Coal 4	5 400	4.38	3.85	7.70
South Africa Sub Total	**19 590**	**48.78**	**43.55**	**55.1**
Botswana				
Morupule A	118	2.00	2.00	2.00
Morupule B	1 200			
Mmamabula	2 700	NA	NA	5.30
Mmamantswe	2 000			3.93
Botswana Sub Total	**6 718**	**2.00**	**2.00**	**11.23**
TOTAL	**26308**	**50.78**	**45.55**	**66.33**

both instances. Information is not directly available on the contributions to GDP per district in Botswana but it is assumed that the districts in which the energy projects are being developed do not contribute significantly to GDP. It is also assumed that the mining contribution from the district is low with the higher value addition of copper and diamonds elsewhere in the country. An average growth rate of 5.5% was attained in the Waterberg District (the area in which the various South African energy projects will unfold) between 2000 and 2005 and the District contributed 25% to the GDP of Limpopo Province in 2005[15]. Botswana had an average growth rate of 8.8%, in the period 2000 – 2005, mainly due to diamond mining and other mineral projects. Botswana has income per capita of US$8,700.

4.4.2 Botswana's electricity dependence

Botswana supplies less than 20% of its own electricity demand. The ratio of supply is shown in Figure 8 where it can be seen that nearly 60% of the demand is met by electricity generated in South Africa. The remainder is made up by supply from Namibia, Zambia and Zimbabwe. These ratios highlight Botswana's vulnerability to supply crises in neighbouring countries and the obvious need to grow its own generating capacity.

14 Only for CtL Plant (excludes Town and Mine)

15 Waterberg District Municipality LED

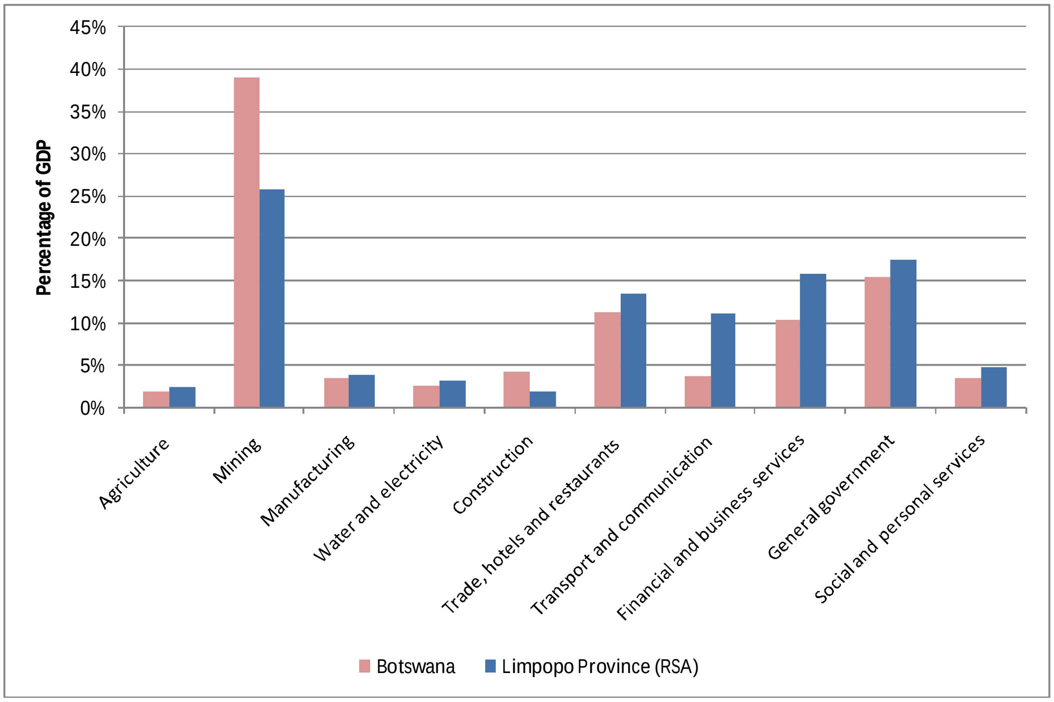

Figure 7: Percentage contribution by sector to the GDPs of Botswana and Limpopo Province (RSA).

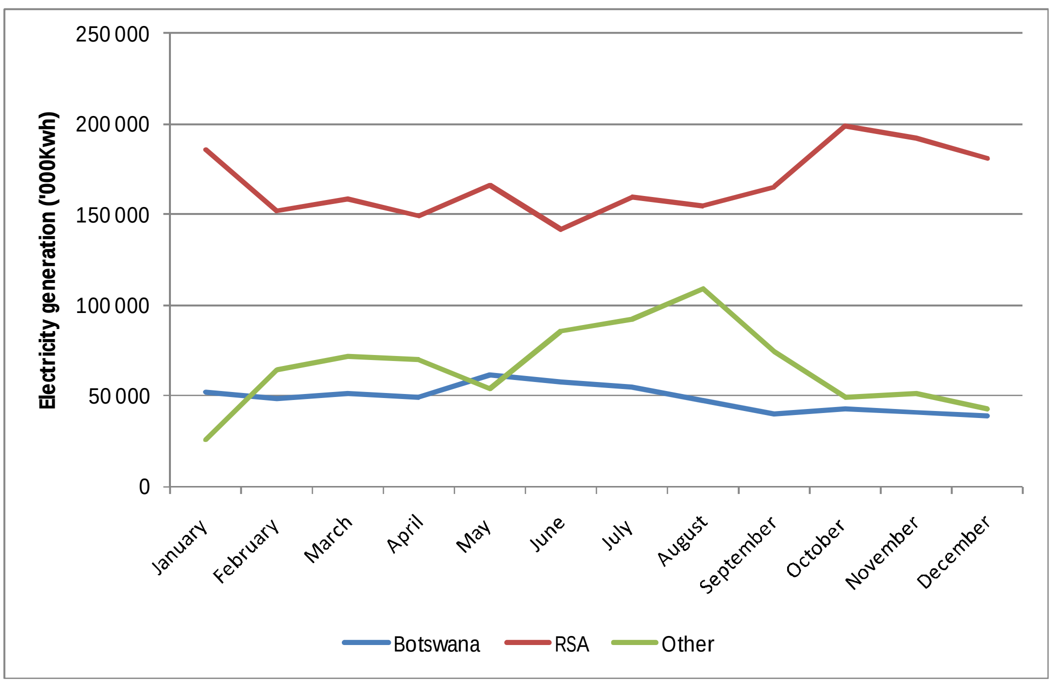

Figure 8: Electricity supply in Botswana per source for 2008.

4.4.3 Tourism

While the tourism potential of the Waterberg district is significant in terms of the biosphere reserve and other natural features, the tourism potential of the area affected by the energy projects on the South African side of the border is limited to game lodges and hunting. The same is largely true of the districts affected by the energy projects in Botswana, highlighting of course the safari tourism of the Tuli Block. Tourism accounted for 12% of Botswana's GDP in the 2003 – 2004 period. This indicates the importance of tourism to the Botswana economy, however, exact details are not known of tourism levels within the project areas on the eastern side of the country.

4.4.4 Growth and development

The coal mining and petrochemical industries in the Lephalale area have been identified as one of the growth clusters in Limpopo Province. Factors identified to contribute to the success of local economic development strategies are:

a. Improving education and skills;
b. Providing essential infrastructure;
c. Building capacity in technology;
d. Opening access to capital markets; and,
e. Improving institutional efficiency.

4.4.5 Policy and regulatory issues

In South Africa, economic development is underpinned by broad framework policy frameworks including the Reconstruction and Development Programme (RDP), the growth, employment and redistribution (GEAR) strategy, and the Accelerated and Shared Growth Initiative for South Africa (AsgiSA).

The RDP is an integrated, socio-economic policy framework that seeks to mobilise people and the country's resources toward the final eradication of the results of apartheid and the building of a democratic, non-racial and non-sexist future. Amongst the key issues within the RDP framework is that integrated process of transformation must ensure that South Africa becomes a prosperous society, having embarked on an (environmentally) sustainable growth and development path. Amongst the key programmes of the RDP are meeting human needs, developing and growing the economy, and skills development.

The main thrusts of the GEAR are pro-poor wealth distribution through sustainable job creation, and economic growth and stabilization through, amongst others, industrial development. The AsgiSA is premised on the need to achieve broad social and economic objectives. Amongst these is halving the unemployment between 2007 and 2014, and achieving GDP growth rate of 6% by 2010, and sustaining that into the future. AsgiSA has the following broad objectives:

a. Reduce the unemployment rate from 30% to 15% by 2014;
b. Reduce poverty from one-third to one-sixth of the population by 2014; and,
c. Increase the annual GDP growth rate from the then average of 3% to 4,5% per year for the period 2005 to 2009 and to 6% for the period 2010 to 2014. This target should create a sustainable annual growth rate of 6%.

In order to meet the above overarching objectives, AsgiSA identified the following areas as requiring interventions, namely:

a. Macro-economic issues;
b. Infrastructure;
c. Education and skills;
d. Sector development strategies;
e. Second Economy, and small, medium and micro enterprise (SMME) development; and,
f. Governance and public administration.

The various energy projects cover the first five areas of interventions, and general falls within the priority areas requiring intervention. Skills development will be critical in designing, developing and maintaining the various projects which will not only meet the skills imperatives of the AsgiSA, but also address the Joint Initiative on Priority Skills Acquisition (JIPSA), which identifies skills shortages in engineering and energy sectors as requiring immediate interventions. JIPSA advocates and representatives consist of business, government and organized labour. The chemicals sector is one of the priority development areas for AsgiSA, which further provides social and economic impetus for the development of additional downstream industries in the area.

4.4.6 Assessment

In recent years, South Africa has seen significant levels of growth in electricity consumption and the level of peak demand (for example some 4.31% more energy was consumed in 2007 than in 2006). In 2008 Eskom was forced to implement load-shedding due to the inability to meet electricity demand which had a major negative on the economy. Neighbouring countries like Botswana, Namibia, Mozambique and Lesotho rely heavily on South African energy exports, were thus also negatively impacted by the power shortage. If South Africa is to meet the AsgiSA growth target of 6% then new electricity generating capacity will have to grow at 4% per annum. That translates into more than 40 000 Megawatts (MW) of new electricity generating capacity over the next 20 years if the economy is to grow at the levels required to address the wealth divide and other socio-economic problems in the country.

The spending required for the various energy projects which will be hundreds of billion Rand will result in a significant contribution to local, regional and national economic development. Although strongly mining and energy based, the projects would also be likely to contribute to the diversification of economic activities in the province, most notably the proposed Mafutha project especially if the promotion of downstream chemical products is promoted. All the projects would likely have a knock on effect of further promoting other economic activities even if these are only to provide services to the various energy projects.

The Mafutha Project provides an additional economic benefit in the ability to produce liquid fuels locally without the need to import crude oil. This would likely play an important role in minimising the negative effects on the balance of payments and could play an inflation buffering role too. The specifics of these effects simply cannot be quantified here but suffice it to say that they would in all probability manifest as significant economic benefits at local, regional and national level. However, in further assessing these effects it would be necessary to assess also the capital outflows and the potentially negative effects that these would have in terms of the procuring of the technology and components of the plant that would need to be manufactured in other parts of the world.

The key issue in terms of cumulative economic impacts is who benefits from these various economic gains and how. It is especially important to understand the degree to which poor people in the area will benefit from the economic activities and the sustainability of that benefit. If for example, the economic activities promote rather than reduce the wealth divide then the benefits will translate into social ills rather than gains. It is essential to understand how the spending will translate into improving the financial resources available to the poor so that their general levels of welfare are improved.

4.5 Social impacts

4.5.1 Population

The populations of Botswana and Limpopo Province (RSA) are shown by age group in Figures 9 and 10 respectively. Both populations have a high percentage of younger people with both having some 68% of the population younger than 30 years. These younger populations imply both higher dependencies and a lower employability (lack of work experience). The populations in each of the districts that will be affected by energy projects in Botswana are shown in Figure 11 together with the population densities in Figure 12. Collectively the populations in these districts make up some 34% of the population of Botswana.

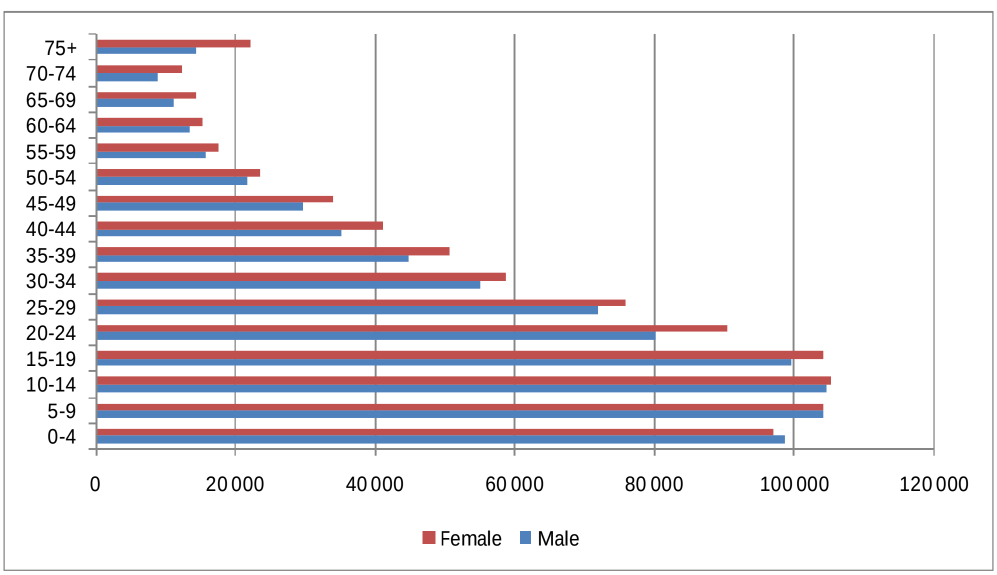

Figure 9: Population by age group in Botswana. The population of the country is some 1 675 210 (2008 figures).

The population densities indicate more urbanised communities in Kgatleng with more dispersed communities in the Central District. The lower density settlements imply small (subsistence) agricultural holdings which are vulnerable to drought and for which the provision of services (water, power and sewage) is difficult if not impossible. Although the populations densities are low it is important to note that there is some 200 000 people in Botswana (and possibly) more that could be affected by the combined impacts of the various energy project in terms of degraded air quality, and water resource impacts.

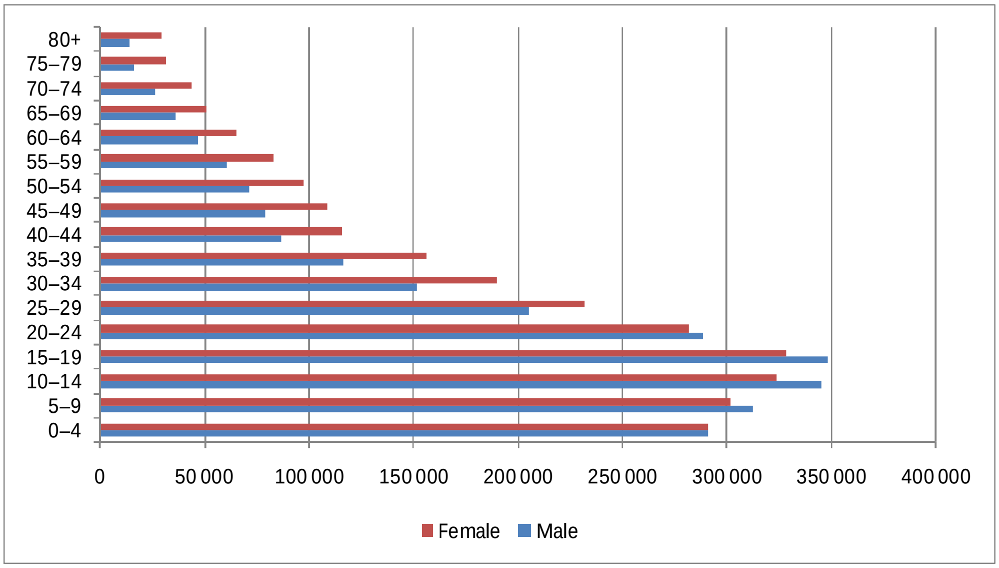

Figure 10: Population by age group in Limpopo Province. The population of the province is some 5 227 200 (2008 figures).

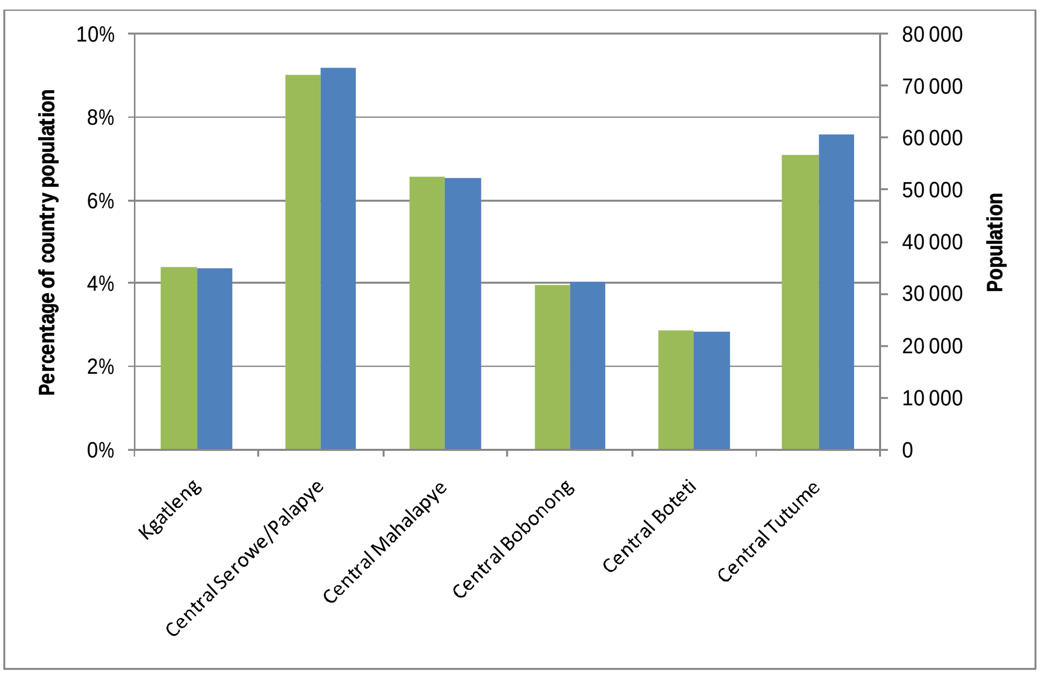

Figure 11: Botswana population and percentage of the national population by districts and gender (green blocks are male and blue are female.

Although not directly supported by information on population densities it is known that the area due west of Lephalale on the South African side of the border is very sparsely inhabited with large scale farms and small pocket settlements (farm houses and labour dwellings).
Although not directly supported by information on population densities it is known that the area due west of Lephalale on the South African side of the border is very sparsely inhabited with large scale farms and small pocket settlements (farm houses and labour dwellings).

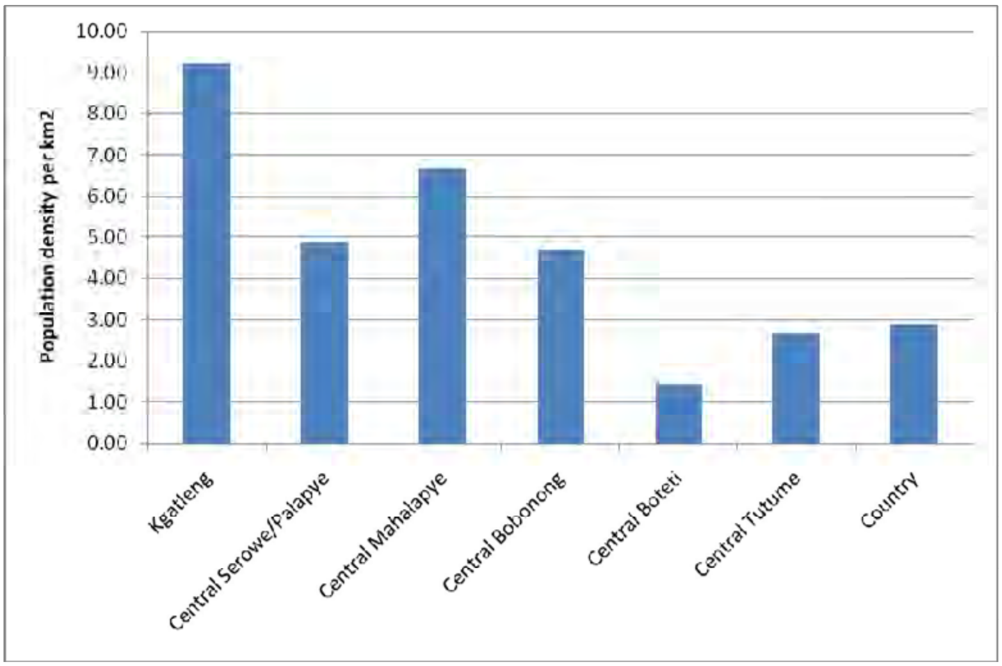

Figure 12: Population density in Botswana by district.

4.5.2 Employment

The Limpopo Province remains one of South Africa's poorest provinces with low incomes and approximately 32% unemployment in 2007[16]. The human development index of the province is 0.49, while the average for South Africa is 0.59[17]. The national unemployment rate for Botswana is 15.3% (males) and 19.7% (females) while the national Gini coefficient is 0.63 and for urban villages and rural areas 0.55 and 0.62 respectively[18].

Employment is shown by sector in Figures 13 (Botswana) and 14 (Limpopo province). There are several important issues that are evident in the graphs. The first of these is the relatively high employment in the agricultural sector in Limpopo and the Waterberg versus that of Botswana. It is assumed that this is a function of the generally lower level of formalised agriculture in Botswana although it should be noted that the relative contributions of agriculture to GDP and GGP is broadly similar for both Botswana and Limpopo. Mining offers

[16] *http://www.statssa.gov.za*
[17] *Limpopo Growth and Development Strategy 2004 – 2014.*
[18] *Botswana statistical year book 2008*

relatively little employment in comparison to the contribution to GDP for both areas and the water and electricity sectors both offer the least numbers of direct, formal employment. The construction sector employs significantly more people relative to the contribution to GDP of the sector in both areas.

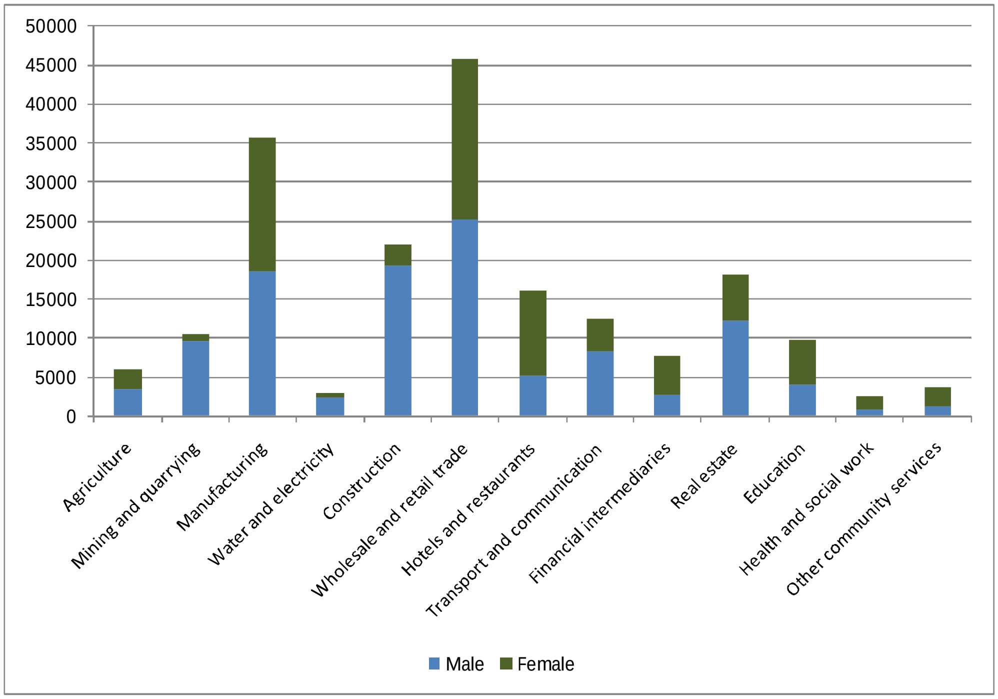

Figure 13: Employment by sector in Botswana.

The employment profile for the Limpopo Province, Waterberg District and South Africa is presented in Figure 15. The percentage of non-economically active persons is significantly higher in the Waterberg District at 57.1%, compared to 42.2% and 55.7% in South Africa and Limpopo Province respectively. This is consistent with the population statistics in Section 4.5.1. whichhighlighted the predominance of young people in the populations of both Limpopo and Botswana. It is therefore assumed that Botswana has a relatively high percentage of non-economically active persons as well although it is recognised that the unemployment rate in Botswana is significantly lower than in Limpopo province.

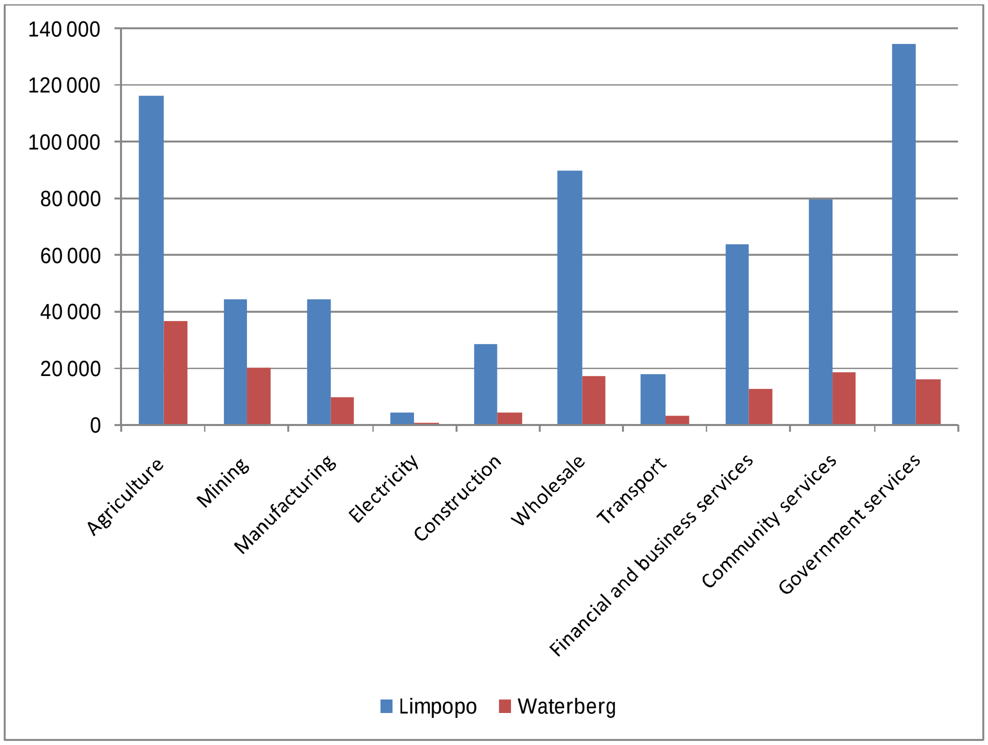

Figure 14: Employment by different sectors in the Limpopo Province and Waterberg District.

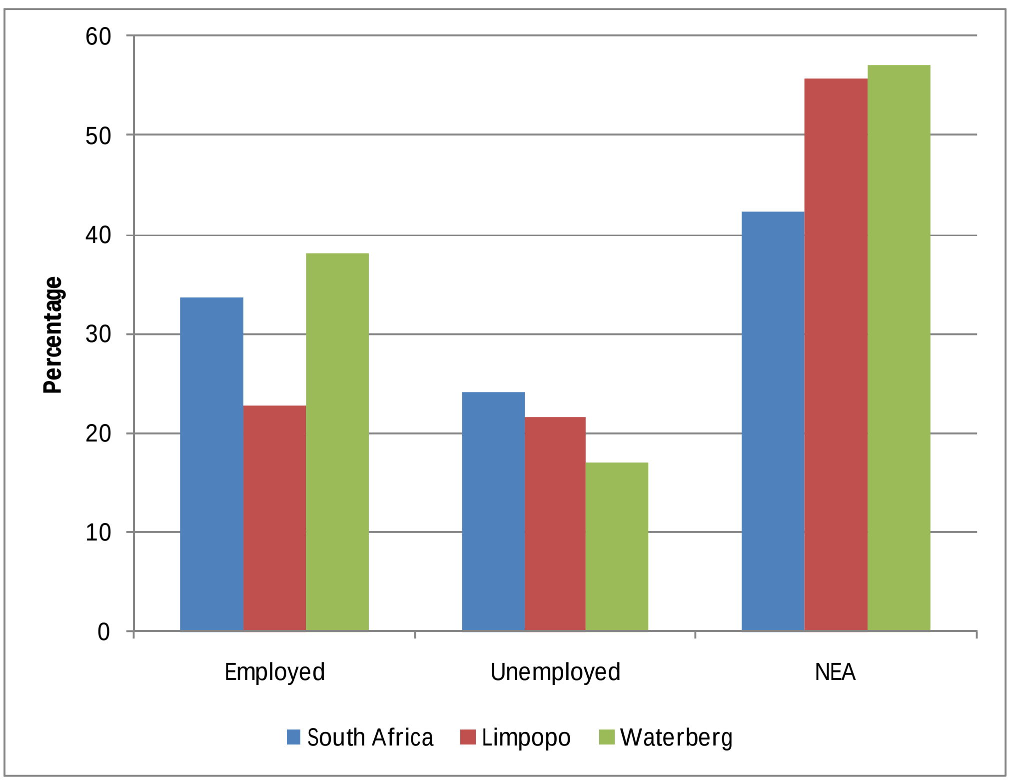

Figure 15: Employment profile of South Africa, Limpopo Province and Waterberg District in 2001.

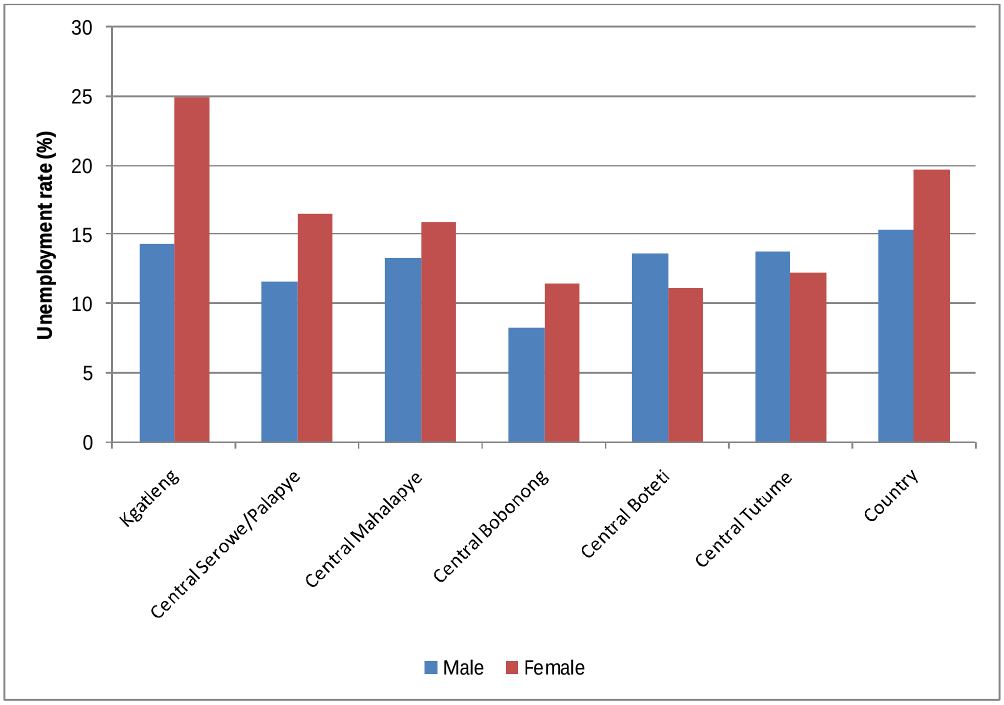

Figure 16: Unemployment in the Kgatleng and Central Districts of Botswana.

4.5.3 Education and skills levels

Educational levels of people in the Limpopo Province and Waterberg District are indicated in Figure 17. Approximately 25% of the people in the Waterberg District have had no schooling, compared to 33% in Limpopo Province.

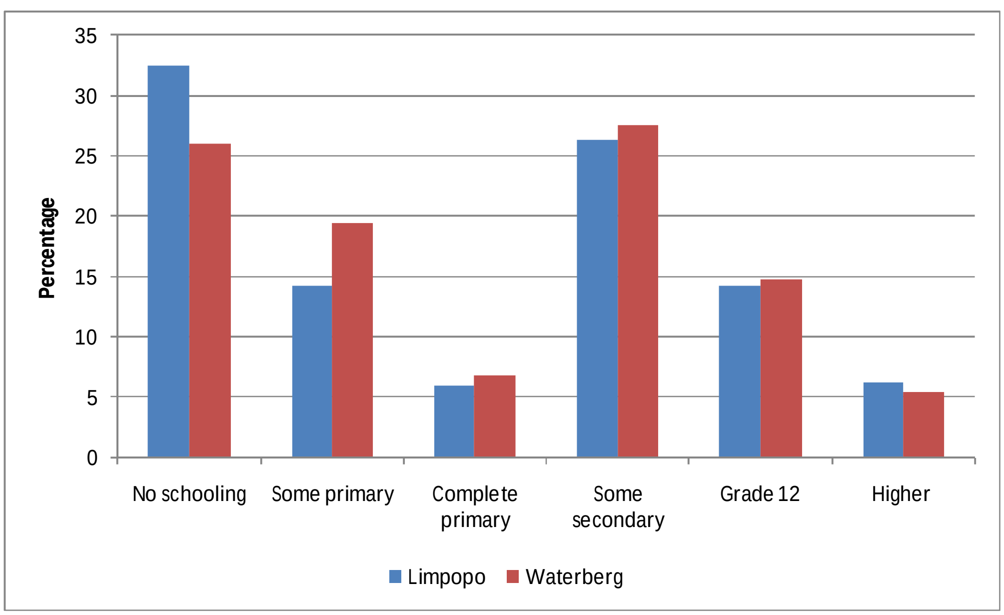

Figure 17:Educational levels in the Limpopo Province and Waterberg District in 2001.

Enrolments at different educational levels in Botswana in 2006 are shown in Table 6 as an indicator of educational level in Botswana. It can be seen from the table that a significant percentage of the population is likely to be unskilled or semi-skilled at best.

Table 6: Number of enrolments at different educational levels in Botswana (2006 figures).

Sector	No of enrolments
Primary schools	330 417
Secondary schools	164 201
Teacher training	1 379
Vocational and technical training	12 701
University	15 513

4.5.4 Income levels

Personal income levels are shown in Figure 18 for the Limpopo and Waterberg areas and per economic sector for Botswana in Figure 19. It can be seen that average wages are low and for example that more than 50% of the working population in the Waterberg District earned less than R800 per month in 2001 (48% in the case of the province as a whole). Wages per economic sector show that in Botswana, wholesale and retail trade offer the highest salaries together with construction and manufacturing (at least for men). The water and electricity offers the lowest wages.

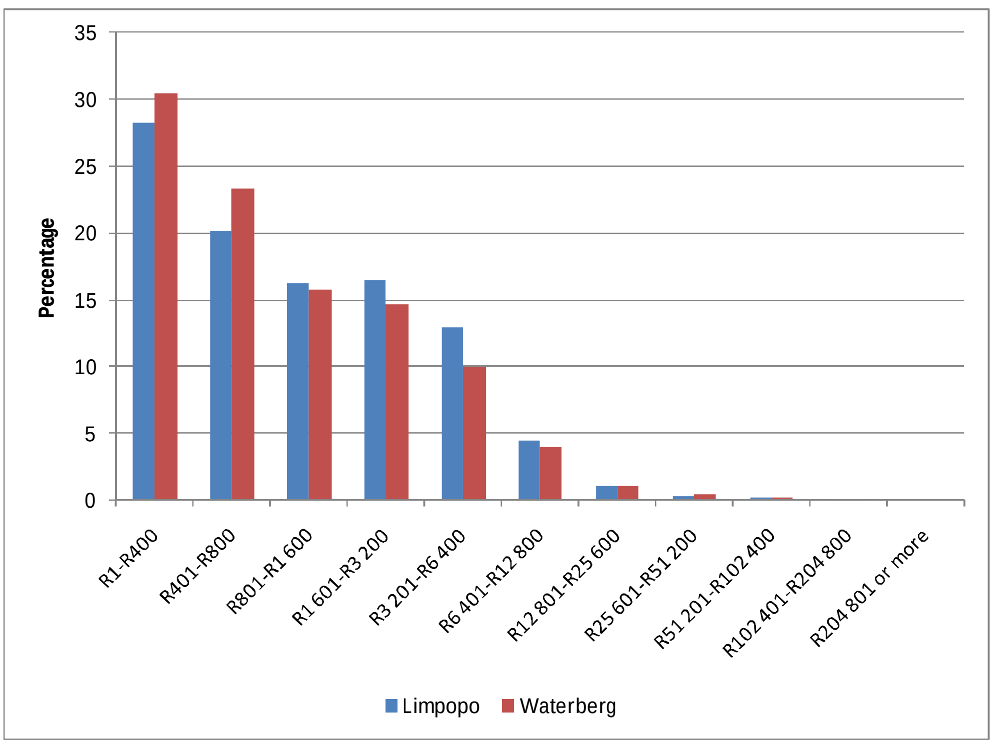

Figure 18: Income distribution in Limpopo and Waterberg (note 2001 figures).

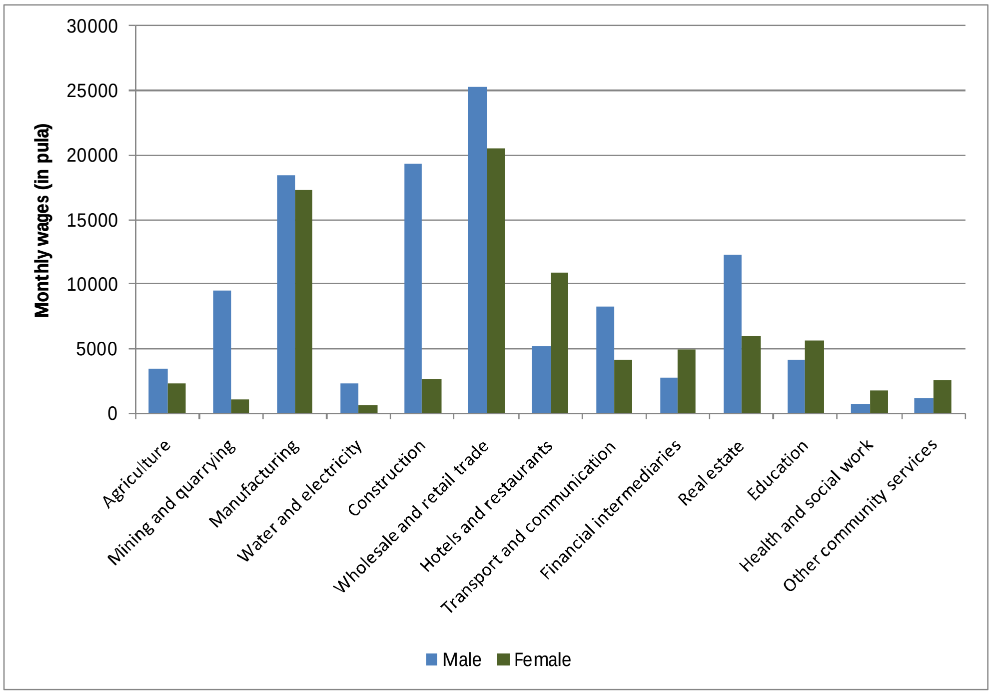

Figure 19: Wages earned per economic sector in Botswana.

4.5.5 Assessment

The populations on both sides of the border are characterised by generally young populations with high numbers of dependents, high unemployment and low educational and skills levels. The economic sectors of wholesale and retail trade, manufacturing and construction offer the most employment opportunities and better wages although these are heavily skewed in favour of men. The employment opportunities of the various energy projects are presented as estimates in Table 6. It can be seen from the table that the direct permanent job opportunities are limited to some 8 945 in total. The likely local uptake of workers is also likely to be insignificant as many of these jobs will need to be filled by skilled workers. That notwithstanding the permanent jobs would have a downstream knock-on impact through improved economic growth and the employment opportunities subsequently generated.

The construction jobs present a more significant potential impact on unemployment with some 41 500 temporary construction jobs being contemplated. Such construction jobs are a potential mixed blessing though. Although the job opportunities are welcomed, the demobilisation of a large construction force at the end of the project poses the threat of potentially serious social problems. It is also incumbent on these various projects to ensure that local uptake of labour is maximised to the greatest extent possible and that influx of labour (and work seekers) is minimised.

Table 7: Estimates of the numbers of jobs that will be created by the various energy projects on the Botswana South Africa border during construction and operations.

PROJECTS	EMPLOYMENT	
	Construction	Operations
South Africa		
Matimba	NA	670
Medupi	5000	500
Mafutha (CTL)	25 000 [2]	3500 [3]
Mafutha (Mine)		2500
Coal 3	5000	500
Coal 4	5000	500
South Africa Sub Total	**40 000**	**8170**
Botswana		
Morupule A	NA	375
Morupule B	1 500	400
Mmamabula	?	?
Mmamantswe	?	?
Botswana Sub Total	**1 500**	**775**
TOTAL	**41 500**	**8945**

[1] *Only for CtL Plant (excludes Town and Mine)*

[2] *Sasol Limited Annual Report for 1980*

[3] *Sasol Limited Annual Report for 2009*

The episodic nature of the maintenance work at the various plants, while creating employment opportunities, can also create social problems. These social problems are a function of workers who may only be employed for limited periods who then purchase goods on credit and are then unable to service the debt during periods where there is no work. In addition, the influx of work seekers to the area presents another potential source of negative social impacts, including increases in crime, burden on infrastructure and services, communicable diseases and potentially others. These potentially negative effects cannot simply be traded off against the benefits of employment that will be created by the various projects.

The key cumulative social impact is how the welfare of people living in these areas is improved or not by the various energy projects. That welfare derives principally, but not exclusively, from the work opportunities that will be created and the sustainability of those work opportunities. How well the work opportunities translate into sustainable employment for people in the affected areas is a function of the degree to which skills, competence and experience are grown in the local population. That will require both programmes to build and sustain the skills but also programmes to ensure that uncontrolled influx is prevented from diluting the skills profile in the local community. The phasing of the projects and the phasing of shutdowns and maintenance periods will be essential in ensuring that construction and maintenance workers are sustainably employed.

In addition the negative social consequences of the projects also need careful review. These negative impacts would include additional disease risks and burdens that derive from the spread of communicable diseases but also from additional pollution loading in the area. This pollution loading must be considered at a large scale with a clear understanding of where health thresholds may be exceeded without only considering urban areas. The less densely populated areas in the Kgatleng and Central Districtsof Botswana must be seen as areas where a large number of people could be negatively affected under certain meteorological circumstances. The same holds true for water resources and how these might be affected by the combined projects on both sides of the border.

5. REFERENCES

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3) Environmental Impact Report for the proposed establishment of a New Coal-Fired Power Station in the Lephalale Area, Limpopo Province; Eskom Holdings Limited;
4) Environmental Impact Statement, Mmamabula Energy Project, CIC Energy Corp, Oct 2007, Final Report for submission to stakeholders and authorities, Executive Summary;
5) Final Scoping Report: Environmental Impact Assessment Process: Proposed coal-fired power stations and associated infrastructure in the Waterberg, Limpopo, Eskom Holdings Limited;
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11) The Medupi Coal Fired Power Station – Independent Review of the Compliance with the Equator Principles, SE Solutions (Pty) Ltd. Pretoria;
12) Waterberg District Municipality, http://led.co.za/municipality/waterberg-district-municipality.

ANNEXURE A:

REGIONAL ENVIRONMENTAL AND SOCIAL ASSESSMENT OF COAL-BASED ENERGY PROJECTS ALONG THE BOTSWANA – SOUTH AFRICA BORDER:TERMS OF REFERENCE FOR A DETAILED STUDY

1. TERMS OF REFERENCE (TOR) FOR THE RESASTUDY

1.1 Background

a. The sub-region (including South Africa, Botswana, and its neighbouring countries) has been experiencing severe shortages of power since the end of 2007, due to high growth and lagging investments in new capacity. Botswana's energy demand is supplied partially by the energy generated from its Morupule A Power Station and mostly by the imported energy from South Africa (through Eskom). South Africa has been load shedding intermittently since December 2007. The Southern Africa Power Pool (SAPP) generation expansion plan, which includes twelve countries of the region, indicates a need to add nearly 39,000 MW through 2025, of which about 32,000 MW is intended to meet South Africa's demand alone.

b. The RESA, which will be jointly conducted by Botswana and South Africa will be used to aid planning and decision-making in the region, to identify specific interventions that may be required, and to provide a common view for both Botswana and South Africa on the nature and magnitude of potential cross border impacts. The RESA will need to build on and expand the preliminary assessment that has been offered here. That process will be one of updating the information presented in the assessment, properly characterising and assessing the impacts that have been qualitatively presented and affirming or modifying the assessment findings. The focus of the RESA is likely cumulative and cross-border impacts that may derive from existing and proposed energy projects in the Botswana-South African border area. These energy projects are listed below and supplemented by a map (Figure 20) which indicates the location of the projects:

1.2 South Africa

a. **Matimba power station**

The Matimba Power Station is an existing power station with an output of some 3990MW. The power station is situated approximately 13km west of Lephalale. Coal is sourced from the Grootegeluk Coal Mine, just to the west of the power station.

b. **Medupi power station**

The MedupiPower Station (4800 MW) (previously known as Matimba B Power Station) is currently under construction. This project will require (with the associated plant [terrace area]) an area of approximately 700 ha, and an additional 500 - 1000 ha for ancillary services, including ashing facilities. It is anticipated that 7 million tonnes of coal per year will be required in order to supply the power station. The proposed positioning of the power station is approximately 20 km west of Lephalale.

c. **Coal 3 and Coal 4**

These two proposed 5400 MW power stations will require an area of at least 5000 ha (including ancillary services), although sites of up to 8000 ha have been considered as part of the project. The proposed sites are as close as 10km to the Botswana border, and approximately 40km west of Lephalale.

d. **Mafutha**

Project Mafutha is a proposed new 80 000 bpdCoal to Liquid Plant, as well as a new mine of approximately 40 million tpa run of mine capacity (adjacent to the site of the CtL facility) and town for an estimated 60 000 inhabitants, and a services corridor linking the various project units. Mafutha will be located about 30km west of the existing Matimba power station, and just north of the proposed sites for Coal 3 and Coal 4.

1.3 Botswana

a. **Morupule A power station**

The existing Morupule A power station (132 MW) consists of four turbo-generators, each with a rating of 33 MW output. The power station utilizes between 480 000 - 600 000 tons of coal per annum, depending on the availability of the plant. The power station is located about 300 km north of Gaborone. The coal is transported by a 2km conveyor belt from a nearby underground mine.

b. **Morupule B power station**

The Morupule B Power Station is to be situated adjacent to the existing Morupule A Power Station. Palapye is the nearest village, situated approximately 5 km to the east of the power station site. The power station is planned for 2 phases, with phase 1 involving 4 x 150 MW units (600MW), and phase 2 planning on doubling this capacity to a total of 1200 MW. The area required for the plant is approximately 476ha.Indicative coal requirements are between 2.2 and 2.7 million tonnes per annum.

c. **Mmamabula energy project**

This proposed 2700 MW power plant is about 80 km west of Matimba Power Plant in South Africa. The proposed area that has been assessed for this project (including ancillary services) is approximately 3000ha. Coal will potentially be mined from the Mookane and Dovedale sites (with the current focus on Mookane Site). It is likely that a new residential village will be required for this project, and currently it is proposed to establish this near to Mmaphashalala. Indicative coal requirements for Phase 1 of the 2700MW are between7.5 -9.0 million tonnes per annum.

d. **Mmamantswe**

The actual size of the Mmamantswe Power Station is yet to be finalised, but current scenarios are for 2 x 500MW units, with a capacity to expand to another two units at a later stage (for a total of 2000MW). The proposed site is approximately 80km north of Gaborone and about 15km from the South African border near Olifants Drift. Current scenarios suggest that coal will be mined (using an open cut method) from the adjacent Mmamantswe coal deposit, containing approximately 1.3 billion tonnes of black coal. It is predicted that the coal consumption for the Mmamantswe Energy Project (for the 2 x 500 MW) units will be around 4 million tons per annum.

1.4 Objectives of the study

The objective of the study is to assess the regional environmental and social impactsofthe existing and proposed coal-based energy projects along the Botswana-South Africa border. The assessment is to determine the cumulative environmental and social impacts of these projects over the next twenty (20) years and to propose policy recommendations and, identifyspecific mitigation measures for curtailing the negative impacts and enhancing the benefits.

1.4.1 General Approach

The RESA must focus on those impacts that would (or should) have an influence on decision making in the "area of influence" of coal-based (existing) investments and (proposed) projects in the Botswana-South Africa border area. By definition, cross-border impacts will be considered important for decision-making and thus will be considered as strategic impacts. At the same time, large-scale cumulative impacts will be seen as potentially significant and these too will be viewed as strategic impacts. On that basis, the following are considered to be strategic impacts for the RESA:

a. Air quality impacts on human health and/or biodiversity;
b. Surface water resource impacts;
c. Groundwater resource impactswith special attention to acid mine drainage impacts(there should be a strong link between the groundwater and surface water studies);
d. Social Impacts;
e. Economic Impacts;
f. Climate Change Impacts
g. Biodiversity Impacts; and,
h. Cultural/Archaeological/Heritage Impacts

1.5 Scope of Work

The Scope of Work consists of the following eleven(11) tasks as detailed under Sections 5.3.1 to 5.3.6:

Task 1: Review of existing strategic planning, land use planning, and natural resource management planningdocumentsincluding but not limited to the Waterberg EMF, the Waterberg Priority Area and the WRC's investigations into AMD potential in the shallow Waterberg coal reservesand any other relevant documentsin the proposed study area;

Task 2: Air Quality Impacts on Human Health and/or Biodiversity;

Task 3: Surface Water Resource Impacts;

Task 4: Groundwater Resource Impacts;

Task 5: Social Impacts;

Task 6: Economic Impacts;

Task 7: Climate Change Impacts;

Task 8: Biodiversity impacts;

Task 9: Cultural/ Archaeological/Heritage Impacts;

Task 10: Formulation of strategies for mitigation (reduction) of adverse impacts and enhancing the benefits; and

Task 11: Stakeholder Consultation.

1.5.1 Existing information

Wherever possible the Consultant must make use of existing (reliable) information rather than gathering new data. The principle is to make the study as cost-effective as possible minimising resource expenditure on gathering data.

1.5.2 Area of influence

For each of the impact categories, the Consultant will identify and characterize the 'area of influence' for each of the individual coal-based energy projects. Within the combined areas of influence the Consultant will then assess the potential cumulative impacts of the coal-based industries located in the Botswana-South Africa border area.

1.5.3 State of the receiving environment

Within each impact domain the Consultant will, maximising the use of existing information, characterise the state of the receiving environment by:

a. Specifying the size of the area (impact domain) that needs to be assessed as a function of the anticipated area where an impact may manifest?
b. Listing all the variables that are needed to characterise the baseline e.g. ambient air quality (SO_2, PM, NO_x, CO), water quality (biological, chemical, physical), population, hospitals, housing and so forth).
c. Defining an existing state (or baseline) for each of these variables quantitatively wherever this is possible and qualitatively where it is not;
d. Defining a maximum acceptable level of impact for each of the variables identified (i.e. standards, limits, thresholds); and,
e. Highlighting information that is not available, and defining the importance of that missing information in respect of representativeness and what has been done (viz. assumptions made or proxies used) to address that missing information.
f. Data should be collected and deposited in a geographical information system accessible in both countries i.e. www.environment.gov.za and www.eis.gov.bw

1.5.4 Assessment

Within each impact domain the Consultant will, maximising the use of existing information, assess the potential cumulative impacts of the various energy projects by:

a. Identifying and quantifying the environmental and/or social aspects of the various energy projects (note that the aspects listed in this preliminary assessment need to be verified and updated where required);
b. Assessing the degree to which the previously identified aspects will affect the existing state of the environment from one or more of the individual energy projects;
c. Wherever possible linking the aspects to the individual variables defined in terms of the baseline e.g. emissions of SO_2 will increase the ambient concentrations of SO_2 resulting in an increased risk of upper respiratory tract disease; and,
d. Characterise the significance of the impacts.

1.5.5 Management Measures

The JTC will propose institutional arrangements and the Consultant will propose management interventions to the JTC, to implementthe recommendations for mitigating the adverse impacts and enhancing the benefits.

1.5.6 Description of Tasks

Task 1: Air quality impacts on human health and/or biodiversity

The Consultant will, maximising the use of existing and available information:

a. Describe each energy project in the Botswana-South Africa border area, emphasizing the factors affecting air emissions. The description can include the plant capacity and design (in terms of boiler type, air pollution control system/equipment (sulphur removal during combustion, or post-combustion with ESP or baghouse filter), and stack characteristics; coal type (washed/run-of mine), characteristics, and feed rate; and pollutant emissions in the flue gases;
b. Specify the boundaries of the area of influence (the study boundary) for atmospheric emission impacts on a map.
c. Within the area of influence, describe the surface cover/land use patterns; list and describe locations of flora and fauna of concern; and list and characterize the main population centres and other human settlements and population density together with cultural heritage resources;
d. Characterise the climate and the dispersion meteorology (in particular, those parameters that are used for input in dispersion modelling) including the meso-scale circulation patterns that drive air flow in the vicinity of the Botswana-South African border, with emphasis on the possible long-range pollutant transport in the direction of Gaborone and PWV Megalopolis[19]

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[19] *PWV: Pretoria-Witwatersrand-Vereeniging industrial and commercial heartland of South Africa.*

e. Describe and assess the legal/regulatory framework regarding air pollution management policies, laws and regulations in Botswana and South Africa.
f. Describe and assess the institutional framework regarding air pollution management policies, laws and regulations in Botswana and South Africa.
g. List all the pollutant parameters that need to be characterized (e.g. for ambient air quality impacts: SO_2, PM-10, NO_x, ozone, and selected based on PM analysis for heavy metals).
h. Within the area of influence, compile ambient quality parameters for selected pollutant parameters
i. Within the area of influence, obtain meteorological data site–specific and representative to air dispersion modelling.
j. Within the area of influence, develop an emissions inventory for such emission sources as industries, mines, residences, biomass burning, motor vehicles, and others. The types of pollutants will include PM, SO2, and NO_x (and, if data is available, heavy metals).
k. Identify a suitable air pollution dispersion model to estimate the air quality impacts in the project's area of influence (including Gaborone and PWV), and calibrate the model using existing ambient air quality data. A long-range transport of atmospheric emissions from the energy projects in the Botswana-South Africa border area would be needed to estimate the potential ambient pollutant concentrations in Gaborone and PWV.
l. Calibrate the model or at least present comparative measurements to assess the accuracy of the model;
m. Run the dispersion model with the existing sources of emissions and compare the data against the monitored ambient air quality data;
n. Update the air dispersion model using appropriate calibration factors;
o. Run the updated dispersion model with the existing and proposed energy projects;
p. Use the WHO ambient air quality guidelines to assess human health impacts and the EU (or UK) standards to assess impacts on crops. In addition, air quality data for heavy metals can be obtained from international standards (e.g. U.S. mercury standards); where national standards are more stringent these should be used ;
q. Identify hot spots – all points with predicted concentrations that exceed the WHO or EU (or UK) standards based on receptor type; and
r. Assess options for mitigation measures to ensure compliance with the WHO guidelines and EU (or UK) standards, and recommend the most appropriate compliance measure(s).

Task 2: Surface Water Resource Impacts

The Consultant will, maximising the use of existing and available information:

a. Describe each energy project in the Botswana-South Africa border area, emphasizing the factors affecting surface water quality and water use. The description can include the plant capacity and design (in terms of boiler type, pollution control system/equipment, coal type (washed/run-of mine), and waste water discharges;
b. Specify the boundaries of the area of influence (the study boundary) for surface water quality impacts on a map.
c. Within the area of influence, describe the surface cover/land use patterns; list and

describe locations of flora and fauna of concern; list and characterize main population centres and habitation patterns (especially subsistence farmers);

d. Describe and assess the legal/regulatory framework regarding surface water pollution management policies, laws and regulations in Botswana and South Africa assessing in particular any inter-governmental agreements between the two countries as these may pertain to water resource protection;
e. List all the water quality parameters that need to be characterized;
f. Within the area of influence, compile existing surface water quality parameters for selected water quality parameters;
g. Within the area of influence, develop an inventory of other sources within the catchment or along water sources that impact on surface water within the region.
h. Using a scientifically defendable method characterise the likely resultant water quality that may result as a result of the combined operations of the various energy projects;
i. Characterise the likely resultant water quality water for existing and proposed energy projects;
j. Identify hot spots – all points with higher concentrations above the defined standards.
k. Assess options for mitigation measures to ensure compliance with the defined standards, and recommend the most appropriate compliance measure(s). Propose policy(ies) and institutional arrangements to ensure implementation of the recommended measure(s) for mitigating the adverse impacts;
l. Characterize and define the ecological reserve requirements of the Olifants Water Management Area (WMA), with a particular focus on the Limpopo River;
m. Determine if the ecological reserve will be provided for, and how it will be provided for, as a function of the proposed water augmentation project, as well as all water allocation processes from sources within the WMA;
n. Characterise the groundwater dependence of communities living in the Botswana - South Africa border area;
o. Determine the sustainability of the supply from either the surface water resource on the South African side, or the ground water resource from the South African and Botswana side and assess within the context of the water use requirements of energy project within the South African-Botswana border area;
p. Determine how livelihoods may be affected as a result of water resource or contamination of the resource by the energy-projects;
q. Assess the likely quality of the water that will be supplied from MCWAP (Mokolo Crocodile-West Augmentation Project) and on the basis of this assessment characterize the treatment requirements, and volume and quantity, of waste water that will need to be discharged, as well as quantity and quality (i.e. hazardous or non-hazardous) brines and sludges that will need to be treated and disposed of; and,
r. Asses the implications of waste water discharges on the existing ground and surface water in the area and describe how this may impact on water availability and use.

Task 3: Groundwater Quality Impacts

The Consultant will, maximising the use of existing and available information:

a. Describe each energy project in the Botswana-South Africa border area, emphasizing the factors affecting ground water quality. This would include using groundwater as a resource as well as activities that may generate leachate or other forms of potential groundwater impactwith special attention to acid mine drainage impacts;
b. Specify the boundaries of the area of influence (the study boundary) for ground water quality impacts on a map;
c. Describe and assess the legal/regulatory framework regarding ground water pollution management policies, laws and regulations in Botswana and South Africa;
d. Describe and assess the institutional framework regarding ground water pollution management policies, laws and regulations in Botswana and South Africa;
e. List all the pollutant parameters that need to be characterized;
f. Within the area of influence, compile existing ground water quality parameters for selected pollutant parameters;
g. Within the area of influence, develop an inventory of other sources within the catchment or along water sources that impact on ground water within the region;
h. Characterize the ground water resource in the South African-Botswana border area, focusing particularly on linkages between aquifers in the two countries and including the Limpopo River;
i. Ascertain the sustainable yield from these ground water resources;
j. Determine the sustainability of the supply from either the surface water resource on the South African side, or the ground water resource from the South African and Botswana side and assess within the context of the water use requirements of energy project within the South African-Botswana border area;
k. Assess the likely quality of the water that will be supplied from MCWAP and on the basis of this assessment characterize the treatment requirements, and volume and quantity, of waste water that will need to be disposed of and how this may affect the groundwater resource;
l. Using a scientifically defendable method characterise the likely resultant ground water quality that may result as a result of the combined operations of the various energy projects; and,
m. Characterise the likely resultant ground water quality water for existing and proposed energy projects;

Task 4: Social Impacts

The proposed energy projects (investments) would lead to population growth, with additional needs for health care, and general services including education and skills development and, possibly, associated investments.

The Consultant will, maximising the use of existing and available information:

a. Describe each energy project in the Botswana-South Africa border area, emphasizing the factors affecting the social environment;
b. Specify the boundaries of the area of influence (the study boundary) on a map.

c. Within the area of influence, describe social environment focussing in particular on the populations that may be affected including education and skills status (employability), vulnerabilities such as health risks, and livelihoods;
d. Describe and assess the legal/regulatory framework regarding social impact management policies, laws and regulations in Botswana and South Africa;
e. Characterize in detail the skills and capabilities of people living in the area, focusing particularly on their livelihoods and how these livelihoods are maintained;
f. Characterize the labour requirements in the energy based industry in the South African-Botswana border area, detailing in particular the phasing and requirements for construction labour, operations labour, and labour in support of shut-downs and maintenance;
g. Determine the degree to which local labour can be used for addressing these labour requirements;
h. Define the training and skills development programs that could plausibly be implemented to maximize local labour uptake to these various labour requirements;
i. Ascertain on the basis of project phasing the likely demobilisation periods where construction or other part time labour will be demobilized;
j. Determine the impact of society on these labour demobilisation processes;
k. Ascertain and detail mechanisms that can be used to reduce the impacts of these demobilisation episodes; and,
l. Characterize the likely inflows of job seekers in terms of likely origin and skills base.

Task 5: Economic Impacts

The Consultant will, maximising the use of existing and available information:

a. Describe each investment in the Botswana-South Africa border area, emphasizing the factors affecting the economic environment;
b. Describe and assess the legal/regulatory framework regarding economic impact management policies, laws and regulations in Botswana and South Africa;
c. Describe and assess the institutional framework regarding economic impact management policies, laws and regulations in Botswana and South Africa;
d. Determine the total capital costs of the various energy projects in the South African-Botswana border area;
e. Characterize the monetary flow in terms of these capital costs in terms of money that will go offshore and money that will be spent nationally and locally;
f. Develop an economic model that determines who will receive money as a result of spending through the provision of services or wages;
g. Derive a suitable 'multiplier' for the area and supplement the previous analysis with the multiplier and associated knock-on benefits; and,
h. Predict the growth in GDP in Botswana and GDP for South Africa and also the possible growth scenarios at a local level in both countries.
i. Liaise with parties executing or evaluation projects in the area to determine if past studies on the economic impact of the projects has been conducted (relevant in terms of projects that may have a macro-economic impact on the country and not just on the

immediate area in which the project occurs)

Task 6: Climate Change Impacts

The Consultant will, maximising the use of existing and available information, most especially the planned reductions in Greenhouse Gas (GHG) emissions in each country:

a. Accurately quantify all (GHG) emissions from the various energy projects in the South African-Botswana border area;
b. Determine how the total load compares to country volumes in aggregate terms and total volumes for the South African-Botswana border area;
c. Assess the latest developments in terms of the IPCC and characterize the likely limitations in terms of GHG emissions that may manifest over the next twenty years; and.
d. Assess the implications of these requirements on activities within the South African-Botswana border area and for both Botswana and South Africa individually.
e. Consider the efficiency of coal usage, possibly by assessing the tons of coal used per product produced (the product is a unit of energy kWh); and
f. Recommend mitigation measures which will augment interventions/options the countries are considering in reaching emission step down targets.

Task 7: Biodiversity Impacts

The Consultant will, maximising the use of existing and available information:

a. Specify the boundaries of the area of influence (study boundary) on a map;
b. Describe the existing biological diversity in the study boundary through faunal and floristic survey, wetland survey, etc;
c. Describe the attributes to be considered in determining the ecologically sensitive areas within the study boundary (e.g. habitat uniqueness and quality (local and regional), gazetted wildlife management / conservation areas, heritage sites and archaeologically sensitive areas, presence of Red Data species, medicinally and culturally significant species etc);
d. Specify the areas of ecological sensitivity on a map and provide for comparison, overlays indicating the biodiversity impacts;
e. Describe and assess the effects of the combined operations of the projects on the biodiversity gene pool in the study boundary and the potential reduction, loss or variance of biodiversity resulting from the alteration of the ecosystems within the area of influence;
f. Assess the value of biodiversity in the area of influence in relation to the goods and services provided by the ecosystems and determine how livelihoods may be affected as a result of biodiversity reduction, loss or variance;
g. Determine the effects on soil fertility, breeding populations of fish and game or wild animals, natural regeneration of woodland, wetland resource degradation or wise use of wetlands with an aim of ensuring sustainable use of biodiversity by the local communities;
h. Assess options for mitigation measures to ensure conservation of biodiversity, and

recommend the most appropriate compliance measure(s). Propose policy(ies) and institutional arrangements to ensure implementation of the recommended measure(s) for mitigating the adverse impacts;

i. Describe and assess the legal / regulatory framework regarding the ecological /environmental management policies, laws and regulations in Botswana and South Africa as well as regional and bilateral agreements between the two countries as these may pertain to environmental protection and conservation; and,
j. Develop a programme to monitor changes in biodiversity within the area of influence over time.

Task 8: Impacts on the Cultural, Archaeological and Heritage resources

The Consultant will, maximising the use of existing and available information:

a. Undertake a survey to establish the heritage status of the area of influence (study area)
b. Carry out a mapping exercise of all heritage resources within the study area
c. Develop coordinates of all heritage resources to guide future developments
d. Report on the existence and importance of heritage resources to livelihoods and the developments of tourism
e. Recommend measures for the maintenance of the integrity and authenticity of the area for possible listing as a world heritage site
f. Describe and assess the legal/regulatory framework regarding the conservation and / or management of heritage resources, laws and regulations in Botswana and South Africa.

Task 9: Formulation ofmanagementmeasures for mitigation of adverse impacts

The Consultant will, maximising the use of existing and available information:

a. List and describe various interventions that could be used to reduce or mitigate the cumulative impacts associated with the various energy projects;
b. Describe mechanisms for the implementation of these interventions such as individual company responsibility, national policy, regulations and so forth.
c. Highlight key areas of uncertainty that will require special monitoring as the various projects unfold to ensure that impacts have been properly understood and characterised/assessed;
d. Define a combined monitoring regime for the area that will serve to provide an ongoing measure of general environmental quality in the area;
e. Define suitable performance measures and targets that can be used to assess ongoing performance assessments;
f. Consider options for integration and /cooperation with settlements in Botswana; and,
g. Consider the impact of opportunities related to coal bed methane (CBM) from Botswana on the longevity of assets for power generation and liquid fuel production.

Task 10: Stakeholder consultations

It is important that the regional assessment of the environmental and social development impacts of energy projects in the Botswana-South Africa border area be conducted in consultation with key stakeholders (e.g. relevant government agencies, business community, civil society organizations, donor agencies) in both countries. Such consultations will be aimed at providing study-related information (e.g. ToRs, findings on impact assessments, policy recommendations) to the stakeholders and also receiving stakeholders' views for incorporation into the design of this study. This process should also allow early engagement of the stakeholders into the planning process for mitigating the potential adverse impacts of these energy projects. The areas of potential impacts are envisaged to be: (i) air quality impacts; (ii) surface water resource impacts; (iii) groundwater resource impacts; (iv) economic impacts; (v) social impacts; and (vi) climate change impacts (vii) biodiversity impacts (viii) impacts on cultural and heritage resources. Stakeholder consultations will be conducted on a continuum basis during the course implementation of these consulting services.

The consultant will:

a. Prepare a consultation plan inclusive of a communication strategy identifying the key stakeholders in each impact area on both sides of the border, and describing how and when the consultations will be conducted. The key stakeholders will include, but not limited to, Ministry of Minerals, Energy and Water Resources (MMEWR), BPC, DEA and Department of Waste Management and Pollution Control (DWMPC) in Botswanaand Sasol, Eskom, Department of Environmental Affairs, Department of Energy, Department of Mineral Resources, Department of Water Affairs and Department of Health in South Africa. The consultation plan will require recording of, among other things, who was consulted and what were the issues raised during the consultation meetings, and how the study intended to address the issues/concerns raised; and,
b. Implement the consultations according to the consultation plan.

1.6 Ownership of the final product

The RESA will be the property of the South Africa and Botswana governments and all information gathered by the consultants during the course of the study is to be made available to the respective authorities on completion of the RESA.

1.7 Capacity building and transfer of skills

The consultant will ensure that every opportunity is examined for capacity building and skills transfer. Mechanisms that will be used to achieve this important requirement are to be detailed in the proposal.

1.8 Work Coordination

The coordination of the implementation of the study will be in accordance with the provisions of the Memorandum of Understanding (MoU) signed between Botswana and South Africa. The World Bank project team will be involved in all aspects of the conduct of the RESA Study and strive to ensure smooth conduct, deliberations and completion of the Study.

The following institutional framework will be put in place to coordinate the RESA Study:

a. The Joint Advisory Committee (JAC) which shall comprise ofsenior officials from both countries. The JAC shall be responsible for :
   1) Overseeing the implementation of the RESA Project;
   2) Consideration and making decisions on proposals presented by the Joint Technical Committee (JTC) regarding the Project;
   3) Provision of guidance to the JTC;
   4) Reporting and soliciting approvals from the respective Governments;
   5) Approving budgets and soliciting financing of the various components of the Project;
   6) To present high level issues to the respective Ministers/Governments for decision; and
   7) To ensure successful delivery of the expected outputs of the RESA.

b. The Joint Technical Committee (JTC) which will comprise twelve (12) officials each from the two countries to steer and lead the implementation of the Project. The specific responsibilities of the will be toundertake the following:
   1) Supervise the Consultant in the implementation of the Project activities;
   2) Recommend the implementation of new activities for the Project to the JAC where necessary;
   3) Identify any policy, legislative or regulatory issues that may impact the implementation of the Project and recommend remedial actions to the JAC;
   4) Provide technical guidance to the Consultant during the implementation of the Project;
   5) Identify and determine the Terms of Reference for the recruitment of the Consultant necessary for the delivery of the Project;
   6) Provide input into the consideration of the proposals by World Bank from bidders, following competitive tendering and evaluation processes;
   7) Review and discuss all reports, findings and recommendations from the Consultant and ensure that adequate stakeholder consultation of the same is undertaken;
   8) Focal points act as spokesperson for the Project;
   9) Implement instructions of the JAC;
   10) Facilitate project implementation through the Project Secretariat/Office;
   11) Advise and provide support to the Project Office to ensure that relevant meetings are arranged and deliverables by the Consultant are as per the approved work plan;
   12) Regularly, review progress of the activities of the Project and evaluate performances, including that of the Consultant;
   13) Approve Project Secretariat/Office requests and reports;
   14) Where necessary, establish relevant Task Forces, including determining their objectives and time frames;
   15) Ensure that all Project budget proposals meet the project guidelines;
   16) Determine areas of overlap with other national environmental assessment projects and propose appropriate methods for coordination or linkages in these areas;
   17) Plan, co-ordinate and monitor implementation of the Project;
   18) Provide project information, deliverables and documents to JAC for discussion and consideration;
   19) Prepare pertinent reports and information as required by the JAC;

20) Present progress of the Project at JAC meetings;
21) Manage project budget and recommend disbursement to the World Bank for work done by the Consultant;
22) Make recommendations for Project performance improvements to the JAC;
23) Prepare any relevant new project ideas for consideration by the JAC;
24) Agree on issues for presentations to the JAC;
25) Manage Project Consultant and convey issues raised by them to the JAC;
26) Review progress of the Project and evaluate performances presented to the JTC;
27) Approve project development proposals;
28) Oversee development of proposals for new activities relating to the Project as found appropriate; and
29) Perform any other activities considered pertinent for the implementation of the project.

c. The Coordination Secretariat will be established in both Botswana and South Africa to provide administrative/logistical support directly to the JTC, JAC and the World Bank and ensure timely and proper coordination of the implementation of the project.. The Secretariat shall report directly to the JTC Focal Point in each countryand shall be responsible for the following:

1) Provide logistical support to the JAC and the JTC during implementation of the Project such as arrangement of relevant meetings, taking minutes of meetings, make travel arrangements; etc;
2) Facilitate communication between the Consultant , JTC, JAC and the World Bank on all issues related to the Project;
3) Facilitate reporting by the Consultant to the JTC and the World Bank;
4) Ensure that all project budget proposals meet the project guidelines;
5) Prepare requests and periodic administrative and financial reports for the consideration by the JTC and World Bank;
6) Facilitate disbursements to the Consultant for work done upon approval by the JTC;
7) Facilitate integration and coordination of the project between Botswana and South Africa;
8) Present progress of the Project at JTC meetings;
9) Prepare pertinent reports and information as required for consideration by the JTC;
10) Make recommendations for Project performance improvement to the JTC;
11) Prepare any relevant new project ideas for consideration by the JTC;
12) Manage Project Consultant and convey issues raised by them to the JTC;
13) Provide advice and support to the JTC;
14) Provide advise on methodologies and systems for the effective and timely delivery of the project;and
15) Perform any other activities considered pertinent for the implementation of the project.

1.9 Deliverable and Schedule

The Consultant will develop a programme for the execution of the RESA including a detailed schedule, work breakdown structure and milestones and deliverables. An overall schedule of 12 months is envisaged, but the consultant can motivate for additional time if that is considered necessary. The table below serves to provide a framework within which the detailed schedule is to be developed and also lists the deliverables that are to be provided.

ITEM	Number of Copies*	Due Date (months from start)
(A) **Inception report**, to then be the basis of public consultation as a draft scoping report after presentation to and discussion with the Joint Technical Committee. Inception report should provide a review of existing documents and information, the approach/methodology to be used, the consultation plan, work plan with clearly defined milestones.	25	1
(B) Prepare a **consultation plan** and present to the Joint Technical Committee to review.	25	1
(C) First round of consultation - all issues to be captured and documented in **issues-response report**	25	2
(D) Revisit ToRs to ensure that relevant public issues have been suitably addressed. Note the principle here is to only address those comments that are germane to the RESA objectives. Consultation must manage expectations and ensure that the RESA does not attempt to become everything to everybody.		2
(E) Conduct **specialist assessments** in response to ToRs.	25	5
(F) Submit each specialist assessment report to the Joint Technical Committee for internal review.		6
(G) Update specialist assessments in response to comments from the Joint Technical Committee		7
(H) Write up **integrated RESA report**, drawing from each of the specialist assessment as appropriate		8
(I) Draft RESA for presentation to and discussion with the Joint Technical Committee		9
(J) Update RESA and write up **non-technical summary**	25	9
(K) Public disclosure and consultations on the Draft RESA		10
(L) Review of public comments with Joint Technical Committee - agree on modifications that need to be made to the final report		11
(M) **Final RESA**	25	12

Consultants are expected to provide the following outputs, as per the schedule suggested. Consultants are expected to allocate resources, such as for surveys, keeping this output schedule in mind. The Inception Report and Draft RESA should be submitted as Word documents for review and comments. An electronic version (pdf format) on a CD is required for the submission of each deliverable.

1.10 <u>Reporting</u>

The Consultant shall submit deliverables to at least the Joint Technical Committee but may be expandedonce the coordination structure has been finalised.

1.11 <u>Requirements for the Consultant</u>

The project team should include an Air Pollution Specialist, a Hydrologist, a Hydro-geologist, a Social Scientist, an Economist, an Ecologist, an Archaeologist / Heritage Specialist (Botswana requires a locally accredited archaeologist), a Communication Specialist, a Geographical Information Systems (GIS) Specialist each with a professional experience of a minimum of 10 years in similar projects involving energy. The team should be headed up by a Project Manager with a minimum of 20 years of professional experience, 10 years of which in multi-disciplinary team (of similar composition) management and 10 additional years in at least one of the specialty areas relevant to this assignment. Excellent written and verbal communication skills in English are required.