

# AFRICAN DEVELOPMENT BANK

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**PROJECT: Morupule B Power Project**  
**COUNTRY: Botswana**

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## PROJECT APPRAISAL REPORT

*Date: 15 September 2009*

|                |                   |                     |                          |        |      |
|----------------|-------------------|---------------------|--------------------------|--------|------|
| Appraisal Team | Team Leader       | Mr. B. RAM          | Chief Power Engineer     | OINF.3 | 2266 |
|                | Team Members      | Mr. Y. VYAS         | Lead Environmentalist    | OIVP   | 2178 |
|                |                   | Mr. M. DIMMER       | Senior Financial Analyst | OINF.3 | 2377 |
|                | Sector Manager    | Mr. A.T. DIALLO     |                          | OINF.3 | 2125 |
|                | Sector Director   | Mr. G. MBESHERUBUSA |                          | OINF   | 2034 |
|                | Regional Director | Mr. A. BEILEH       |                          | ORSA   | 2039 |

|                |   |  |  |        |      |
|----------------|---|--|--|--------|------|
| Peer Reviewers | H.R. HEERO (Senior Infrastructure Specialist) |  |  | GFO    | 6134 |
|                | E. NZABANITA (Principal Power Engineer)       |  |  | OINF.3 | 3081 |
|                | A. OUMARU (Chief Transport Engineer)          |  |  | OINF.2 | 3075 |
|                | G. HONDE (Senior Country Economist)           |  |  | ORSA   | 3542 |
|                | L. MOOLA (Senior Disbursement Officer)        |  |  | FFCO.3 | 2603 |
|                | C. AHOSSI (Chief Procurement Officer)         |  |  | ORPF.1 | 2718 |

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**Currency Equivalents***As of June 2009*

|             |   |                         |
|-------------|---|-------------------------|
| 1 UA        | = | 1.55223 US Dollar       |
| 1 UA        | = | 10.4951 (Botswana) Pula |
| 1 US Dollar | = | 7.04722 Pula            |
| 1 Pula      | = | 100 thebe               |

**Fiscal Year**

1 April – 31 March

**Weights and Measures**

|                       |   |                           |
|-----------------------|---|---------------------------|
| 1 metre (m)           | = | 3.28 feet (ft)            |
| 1 kilometre (km)      | = | 0.62 mile                 |
| 1 hectare (ha)        | = | 2.471 acres               |
| 1 Kilovolt (kV)       | = | 1000 volts                |
| 1 Megawatt (MW)       | = | 1000 kW                   |
| 1 Gigawatt (GW)       | = | 1000 MW                   |
| 1 Gigawatt hour (GWh) | = | 10 <sup>6</sup> watt hour |

**ABBREVIATIONS**

|             |   |
|-------------|---|
| AAAC        | All Alloy Aluminum Conductor  |
| AC          | Advance Contracting   |
| ACSR        | Aluminium Conductor Steel Reinforced                                    |
| ADB or Bank | African Development Bank Group  |
| ASP         | Average Selling Price   |
| BPC         | Botswana Power Corporation  |
| BWP         | Botswanan Pula  |
| CFL         | Compact Fluorescent Lamp  |
| CFBC        | Circulating Fluidized-Bed Coal  |
| CNEEC-SBW   | China National Electric Equipment Corporation and Shenyang Blower Works |
| CSP         | Concentrating Solar Power   |
| DEA         | Department of Environmental Affairs                                     |
| DFI         | Development Financial Institutions                                      |
| FIRR        | Financial Internal Rate of Return                                       |
| EIRR        | Economic Internal Rate of Return  |
| ESIA        | Environmental and Social Impact Assessment                              |
| ENPV        | Economic Net Present Value  |
| EOCK        | Economic Opportunity Cost of Capital                                    |
| EPC         | Engineering, Procurement and Construction                               |
| ESMP        | Environmental and Social Management Plan                                |
| FC          | Foreign Cost  |
| FE          | Foreign Exchange  |
| GENBO       | Governance and Energy Network of Botswana                               |

|         |  |
|---------|--|
| FGD     | Flue Gas Desulphurization  |
| FIRR    | Financial Internal Rate of Return                                |
| FNPV    | Financial Net Present Value                                      |
| GDP     | Gross Domestic Product   |
| GEF     | Global Environment Facility                                      |
| GoB     | Government of Botswana   |
| HFO     | Heavy Fuel Oil   |
| IBRD    | International Bank for Reconstruction and Development            |
| ICB     | International Competitive Bidding                                |
| ICBC-SB | Industrial and Commercial Bank of China/Standard Bank consortium |
| ICT     | Information and Communication Technology                         |
| IDC     | Interest During Construction                                     |
| IPP     | Independent Power Producer                                       |
| LC      | Local Cost   |
| MCL     | Morupule Colliery Limited  |
| MDBS    | Multilateral Development Banks                                   |
| MIC     | Middle Income Country Trust Fund                                 |
| MoFDP   | Ministry of Finance and Development Planning                     |
| MoMEWR  | Ministry of Minerals, Energy and Water Resources                 |
| NPV     | Net Present Value  |
| O&M     | Operation and Maintenance  |
| OGWC    | Optical Ground Wire Cable  |
| p.a.    | Per Annum  |
| PAP     | Project Affected Person  |
| PC      | Pulverised Coal  |
| PIT     | Project Implementation Team                                      |
| QPR     | Quarterly Progress Report  |
| RAP     | Resettlement Action Plan   |
| SAPP    | Southern African Power Pool                                      |
| SPU     | Strategic Project Unit   |
| SWAP    | Sector Wide Approach   |
| TBU     | Transmission Business Unit                                       |
| UA      | Units of Account   |
| WACC    | Weighted Average Cost of Capital                                 |
| WB      | World Bank   |

## Loan Information

### Client's information

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**BORROWER** : The Government of Botswana (GoB)

**EXECUTING AGENCY** : Botswana Power Corporation (BPC)

### Financing plan (excl. Interest During Construction, other financing fees, custom taxes and duties)

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| Source                | Amount<br>(UA million) | Instrument |
|-----------------------|------------------------|------------|
| ADB                   | 139.30                 | Loan       |
| MIC Grant (ADB)       | 0.60                   | Grant      |
| WB                    | 98.2                   | Loan       |
| ICBC-Standard<br>Bank | 535.7                  | Loan       |
| GoB                   | 131.6                  |            |
| <b>TOTAL COST</b>     | <b>905.4</b>           |            |

### ADB's key financing information

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|                        |                             |
|------------------------|-----------------------------|
| Loan currency          | Euro                        |
| Interest type          | Fixed or Floating           |
| Interest rate spread   | Bank's cost of funding+40bp |
| Commitment fee         | Nil                         |
| Service Charge         | Nil                         |
| Tenor                  | 20 years                    |
| Grace period           | 5 years                     |
| FIRR, FNPV (Base case) | 6.7%, USD 328 million       |
| EIRR, ENPV (Base case) | 24.9%, USD 1.7 billion      |

### Timeframe - Main Milestones (expected)

---

|                       |                  |
|-----------------------|------------------|
| Concept Note approval | 27 May 2009      |
| Project approval      | October 2009     |
| Effectiveness         | April 2010       |
| Last Disbursement     | 31 December 2013 |
| Completion            | 31 December 2012 |
| Last repayment        | January 2030     |

## **Project Summary**

### **1. PROJECT OVERVIEW**

The project consists in the construction of a 600 MW (4 x 150 MW) coal fired power plant and associated transmission infrastructure. The Morupule B plant will be located adjacent to the existing Morupule A plant, at a mine-mouth. The plant will be connected to the national grid by two new transmission lines. Measures will be put in place to ensure that the combined emissions of Morupule A and B remain within the World Bank guidelines. The works for the project have started in June 2009 and the four generation units are scheduled to come online sequentially between January and October 2012. The power transmission system will be commissioned by December 2011.

### **2. NEED ASSESSMENT**

Botswana has until now principally relied on imports to meet its growing demand for power (peak demand of 500 MW in 2008 and around 600 MW projected for 2012). In 2008, 80% of the electricity supplied in Botswana consisted of imports from neighbouring countries, principally from South Africa. The remaining 20% was generated by the country's only generation plant, Morupule A, a 25 year old plant that is becoming increasingly unreliable. As a result of the acute energy crisis in the region, neighbouring countries are rapidly reducing exports to Botswana and the country has been forced to resort to load shedding since 2008. Imports will be further reduced in coming years and are expected to be fully discontinued by 2013. The objective of the Morupule B project is to achieve energy generation self-sufficiency in order to substitute for rapidly declining electricity imports and thereby enhance the economic competitiveness of Botswana, fuel economic growth and diversification, and contribute to the poverty reduction objectives of the government.

Moreover, the project will support the government's strategy of increasing household access rates from 47% to 80% by 2016. Finally, the project will be beneficial to the region as a whole as it is expected that Botswana will become a net energy exporter by 2014.

### **3. BANK'S ADDED VALUE**

The Bank has provided advice to BPC on the implementation arrangements and the environmental and social management plan for the project, as well as provided feedback to the Ministry of Energy, Minerals and Water Resources with regards to the envisaged institutional and pricing reforms for the sector. Together with the World Bank and the ICBC-Standard Bank consortium, the Bank is ensuring that the project is fully funded with newly raised capital and implemented according to schedule.

### **4. KNOWLEDGE MANAGEMENT**

The project comprises a number of technical assistance activities related to the (i) Morupule B project; (ii) capacity building at BPC; and (iii) the establishment of an independent regulator and the diversification of Botswana's energy sources, which are being funded by the World Bank. Through a MIC Grant, ADB will be financing the Feasibility Study for a 200 MW Concentrating Solar Power (CSP) plant.

The contracts with the EPC contractor and the Consultant for the power plant have significant requirements in terms of staff training and capacity building. Besides, the plant will be operated under an Operation and Maintenance contract in early years of operation and training will be provided to over 300 local employees so that it can be fully operated by newly recruited BPC staff thereafter.

## Result-based Logical Framework

| Hierarchy of Objectives   | Expected results and schedule  | Scope (Target population)  | Performance indicators  | Indicative targets & schedule (Existence of basic data?)  | Assumptions/Risks   |
|---|--|--|---|---|---|
| <p><b>SECTOR GOAL</b><br/>Achieve energy security, foster economic growth, support diversification and contribute to enhancing the competitiveness of the economy</p>   | <p><b>IMPACTS (long-term results)</b></p> <ol style="list-style-type: none"> <li>Sustained growth of economic activity</li> <li>Social institutions and households to benefit from adequate and reliable power supply</li> </ol>   | <ol style="list-style-type: none"> <li>Economic actors operating in Botswana</li> <li>Population of Botswana</li> </ol>  | <ol style="list-style-type: none"> <li>Increase in domestic generating capacity serving the national grid</li> <li>Rate of access of the population to electricity</li> <li>Self-sufficiency in meeting the electricity demand</li> </ol> <p><b>Source</b><br/>- BPC statistics<br/>- MoMEWR statistics</p>   | <ol style="list-style-type: none"> <li>Domestic generating capacity connected to the national grid to increase from 132 MW in 2009 to 1370 MW by 2016</li> <li>Household access to electricity to increase from 47% in 2008 to 80% by 2016</li> <li>Increase the share of supply from domestic sources from 20% (2008) to 100% (2013)</li> </ol>  | <ol style="list-style-type: none"> <li>Availability of funds from commercial and development financing institutions to finance BPC's investment program</li> <li>Continued financial support to BPC from GoB, MDBs and bilateral donors</li> <li>Electricity tariffs allow sufficient cashflow generation for BPC to mobilize internal and external resources to fund investment program</li> </ol>   |
| <p><b>PROJECT PURPOSE</b><br/>The objective of the project is to achieve energy generation self-sufficiency in order to substitute for rapidly declining electricity imports to support economic growth and reduce poverty.</p>   | <p><b>IMPACTS (medium-term results)</b></p> <ol style="list-style-type: none"> <li>Fully serve national electricity demand from domestic generation capacity</li> <li>Export of excess electricity to neighboring countries</li> </ol>   | <ol style="list-style-type: none"> <li>Economic actors operating in Botswana.</li> <li>Domestic users nationally</li> <li>Countries in Southern Africa Power Pool (SAPP)</li> <li>BPC</li> </ol> | <ol style="list-style-type: none"> <li>Increase in domestic generating capacity serving the national grid</li> <li>Export of excess electricity to SAPP</li> </ol> <p><b>Source</b><br/>- BPC statistics<br/>- MoMEWR statistics</p>  | <ol style="list-style-type: none"> <li>Domestic generating capacity connected to the national grid to be increased by 600 MW by Dec-12 from 132 MW in 2009</li> <li>BPC to have an exportable surplus in the range of 500 GWh by 2014</li> </ol>  | <ol style="list-style-type: none"> <li>Government support</li> <li>Efficient coordination between ministries and BPC to ensure timely completion of the project</li> <li>Reforms put in place to support the financial sustainability of BPC</li> </ol>   |
| <p><b>ACTIVITIES</b></p> <p><b>Funded by ADB</b><br/>(i) Supply and installation of equipment and materials for the construction of the Southern transmission line and substations (ii) Supply of 'start-up' fuel (coal, oil and limestone) to be used during the commissioning of the 4 generation units of Morupule B<br/>(iii) Feasibility study for 200 MW solar power plant</p> <p><b>Funded by ICBC-Standard Bank</b><br/>(iv) Construction of a 600 MW (4 x 150 MW) coal fired Morupule 'B' power adjacent to existing Morupule 'A' plant</p> <p><b>Funded by IBRD</b><br/>(v) Supply and installation of equipment and materials for the construction of the Northern transmission line and inter-tie with existing Morupule A power plant<br/>(vi) Technical Assistance</p> <p><b>Financial resources</b><br/>ADB : UA 139.3 million<br/>MIC Grant: UA 0.6 million<br/>WB: UA 98.2 million<br/>ICBC-SB: UA 535.7 million<br/>GoB UA 131.6 million<br/>Total : UA 905.4 million</p> | <p><b>OUTPUTS (Short-term results)</b></p> <p><b>ADB component</b></p> <ol style="list-style-type: none"> <li>Power transmission system and substations to evacuate power from Morupule B to the national grid (Isang Substation)</li> <li>Start-up fuel available to BPC during the commissioning of the 4 generation units for Morupule B</li> </ol> | <ol style="list-style-type: none"> <li>BPC</li> <li>Local workers and regional contractors during construction phase</li> </ol>  | <ol style="list-style-type: none"> <li>Length of transmission lines constructed</li> <li>Isang substations constructed.</li> <li>Compensation equipment installed</li> <li>Fuel supplied during commissioning period</li> <li>Recommendations of ESIA and RAP adhered to</li> </ol> <p><b>Source</b><br/>- BPC implementation team<br/>- Monthly reports from the Consultant<br/>- MoMEWR<br/>- DEA</p> | <ol style="list-style-type: none"> <li>1x 400 kV, 215 km transmission line from Morupule B to Isang substation</li> <li>400/220 kV substation at Isang</li> <li>Reactive Power Compensation equipment at Isang, Morupule and Phokoje 400 kV substations</li> <li>Fuel supplied for each of the four units during the commissioning period. Current estimate per unit: 87,000 t of coal; 3,7 t of fuel oil; and 3,200 t of limestone</li> <li>28 households compensated per RAP</li> </ol> | <ol style="list-style-type: none"> <li>Efficient supervision and execution of the project by BPC, consultants and contractors</li> <li>Institutional capacity of each of and collaboration between BPC, DEA, MoMEWR and MoFPD</li> <li>Execution of coal supply contract with Morupule Collieries Ltd</li> <li>Availability of adequate coal and water resources</li> <li>Components financed by other co-financiers are implemented on-schedule</li> <li>O&amp;M contract with EPC contractor is effected</li> </ol> |



**REPORT AND RECOMMENDATION OF THE MANAGEMENT OF THE ADB GROUP TO THE  
BOARD OF DIRECTORS ON A PROPOSED LOAN TO BOTSWANA FOR THE MORUPULE B  
POWER PROJECT**

Management submits the following Report and Recommendation on a proposed ADB loan of UA 139.3 million and a MIC Grant of UA 0.6 million to finance specific components of the Morupule B power station and associated transmission infrastructure.

**1. STRATEGIC THRUST & RATIONALE**

**1.1 Project linkages with country strategy and objectives**

1.1.1 Botswana is an upper-middle-income country heavily reliant on the mining sector (39% of GDP) as well as other sectors (financial and business services (10% of GDP), manufacturing and construction (8% of GDP), and other services (25% of GDP)) that are dependent on the availability of reliable electricity supply. To date, Botswana has principally relied on imports to meet its growing demand for electricity (peak demand of 500 MW in 2008 and around 600 MW projected for 2012). In 2008, 80% of the electricity supplied in Botswana consisted of imports from South Africa's Eskom and other neighbouring countries, while 20% was generated by the country's only generation plant, Morupule "A", a 25 year old plant that has become increasingly unreliable<sup>1</sup>.

1.1.2 Because of inadequate supply and load shedding in the Southern Africa region, neighbouring countries have significantly reduced their power sale commitments for the 2008-2012 period and imports are expected to be totally discontinued by 2013. As a result, load shedding has been occurring in Botswana since 2008. In the absence of sizeable new domestic generation capacity to substitute for rapidly declining imports, BPC will be unable to meet the bulk of domestic electricity demand as of 2013.

1.1.3 As a result, the National Development Plan 10 (2009-2016) underscores the need to achieve national "energy security" in light of the region-wide power deficit. In addition, "self-reliance" is one of the four National Principles outlined in Vision 2016, the country's development roadmap<sup>2</sup>. Therefore, securing adequate and reliable electricity supply through implementing Morupule B project would contribute to meeting GoB's stated objective of achieving national "energy security". The Morupule B project (600 MW) was identified as the least-cost option to achieve electricity supply self-sufficiency.

1.1.4 BPC is implementing an emergency diesel plant on rental basis (70 MW) and is looking to secure 90 MW from a diesel plant implemented by an Independent Power Producer (IPP), which would constitute Phase I of a 270 MW Coal Bed Methane project under exploration. BPC is also implementing Demand Side Management measures including (i) installation of Compact Fluorescent Lamps (CFL) (ii) water heating control and (iii) tariff restructuring study. All these measures are aimed at ensuring that adequate power supply is guaranteed until Morupule B comes on-line in 2012, by which time Botswana will achieve energy security in support of NPD 10.

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<sup>1</sup> The plant annual availability currently is less than 50%

<sup>2</sup> Vision 2016 is a document prepared by a Presidential Task Group in 1997 with a view to present a long-term development roadmap to 2016, the year when Botswana will celebrate its 50th year of independence

1.1.5 The two pillars identified in the Bank's CSP for Botswana (2009-2013) are (1) support actions to expand private sector investment; and (2) remove infrastructure bottlenecks to enhance competitiveness and growth. The Morupule B project has been included in the CSP for implementation in order to remove the infrastructure bottlenecks as one of the Final Outcomes in support of Pillar 2.

## **1.2. Rationale for Bank's involvement**

1.2.1 As noted above, the Southern African region as a whole is experiencing power generation deficits as a result of higher demand growth than projected over the past decade. With the objective of reducing dependence on imported power, assisted by PB Power, BPC has prepared a generation expansion feasibility study in 2004, which was updated in 2006. The study recommended the development of a coal fired power plant with a capacity of 600 MW close to the existing Morupule power station. Separately, GoB is also supporting the development of the Mmamabula power plant (1200 MW – 300 MW for BPC and 900 MW for Eskom) by an IPP. However, the timing for the implementation of Mmamabula is not yet clear, in part due to the plant size having been revised and the mobilisation of financing having been delayed. Separately, BPC had also initiated the feasibility study for Morupule B Phase II (consisting in an additional 600 MW of capacity).

1.2.2 A 10 Year Transmission Development study was conducted in 2006/7 to guide on transmission investments for the period 2007 – 2016 which covered the integration of new power plants: Morupule B Phases 1 & 2 (600 MW each) and Mmamabula (1200 MW). The transmission system development study recommended the construction of two new lines: (i) a 400 kV transmission line from Morupule B to the existing 400/220 kV substation at Phokeje; and (ii) from Morupule B to Isang substation just north of Gaborone. An inter-tie between Morupule B and Morupule A was also recommended. Furthermore, BPC has conducted a detailed study on the requirement of the reactive power to ensure voltage stability for reliability of the electricity supply in the country<sup>3</sup>. The design of these transmission lines, substations and inter-tie has now been completed.

1.2.3 The proposed project has been conceived on the basis of the above-mentioned studies. Furthermore, the viability of the conceptualized project has been confirmed by considering the regional studies conducted under the aegis of the Southern Africa Power Pool (SAPP<sup>4</sup>), of which Botswana Power Corporation is a member. These studies are : (i) the Southern Africa Regional Generation and Transmission Expansion Plan (November 2007); and (ii) the World Bank's study on the Development Strategy for Transformative Generation and Transmission projects in Sub-Saharan Africa (June 2008). These studies confirmed Morupule B as a 'priority project' from a regional perspective.

1.2.4 The Bank's participation in the financing of the project has been secured on the basis of a competitive selection process through which proposals from a wide range of DFIs and commercial banks were considered. The Government of Botswana (GoB) has successfully mobilized the required external financial resources for this project from the Industrial and Commercial Bank of China and Standard Bank Consortium (ICBC-SB) and the IBRD. ICBC-SB signed a 20 year loan agreement for US\$ 825 million on the 15<sup>th</sup> June 2009<sup>5</sup> and

<sup>3</sup> Reactive Power Compensation Report, dated May 2009

<sup>4</sup> Operating members: Botswana, Mozambique, South Africa, Lesotho, Namibia, DRC, Swaziland, Zambia and Zimbabwe. Non-operating members: Malawi, Angola and Tanzania.

<sup>5</sup> Supported by guarantees from (i) GoB; as well as (ii) Sinasure (to be provided in the form of an insurance policy) and IBRD for years 1-15 and 16-20 respectively

IBRD's Board is expected to consider the Partial Credit Guarantee and the loan for the project in October 2009. ADB funding is required to close the financing gap of the project. Given the size of the investment and the strategic importance of Morupule B to the country, the Government's request to the Bank to fund this project deserves the support of the Bank.

### **1.3 Donors coordination**

1.3.1 Botswana has for the past decade enjoyed sustained economic stability and high levels of foreign reserves<sup>6</sup>, principally as a result of high export revenues from the diamond mining sector. As an upper-middle income country, most of Botswana's traditional donors have reduced the level of their assistance to the country<sup>7</sup>. It is only recently, in order to finance the growing fiscal deficit stemming from a contraction in economic activity, that GoB has started re-engaging with DFIs for loan products. It is in this context that ADB approved a UA 1 billion Economic Diversification Support Loan in June 2009. The Loan Agreement has been signed.

1.3.2 The Ministry of Finance and Development Planning coordinates the donor activities. A Development Partners Coordination Forum was established in 2007 to coordinate ODA and meets twice a year. In the power sector, the number of donor-funded projects has been very limited and focussed on technical assistance and renewable energy projects (a list of donor-funded projects is included in Annex 3). During the Preparation and Appraisal Missions, meetings were held with GoB, BPC and the World Bank with a view to (i) devise a harmonized approach in the implementation of the Morupule B project; and (ii) discuss developments in the power sector, particularly with regards to sector reforms and the diversification of energy sources. With regards to the latter, it has been decided that ADB will fund the Feasibility Study of a 200 MW Concentrating Solar Power (CSP) Plant. On its side, the WB will fund a number of Technical Assistance projects for BPC and the Ministry of Minerals, Energy and Water Resources (MoMEWR), which are detailed in Section 4.6.

## **2. PROJECT DESCRIPTION**

### **Project Objective**

The objective of the project is to achieve energy generation self-sufficiency in order to substitute for rapidly declining electricity imports to support economic growth and reduce poverty.

### **2.1 Project components**

The project will comprise the components summarized in table 2.1 hereafter:

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<sup>6</sup> Foreign reserves represented 23 months of import in 2008

<sup>7</sup> Development grants have in recent years only accounted for a small part of total revenue representing about 0.7% of the GDP while external loans only represent 4% of GDP

Table 2.1: project components

|   | <b>Component name</b>                              | <b>Est. cost (UA million)</b> | <b>Component description</b>   |
|---|--|-------------------------------|--|
| A | Power Plant (including the fuel for commissioning) | 688.1                         | <ul style="list-style-type: none"> <li>• Supply and installation of a 600 MW pulverised coal fired power plant comprising 4 units of 150 MW each</li> <li>• Fuel used during the commissioning of each of the 4 generating units prior to full commercial operation</li> </ul>   |
| B | Water Supply System Development                    | 50.7                          | <ul style="list-style-type: none"> <li>• Includes an interconnection to the existing North-South Carrier and, as a backup, new water supply developments including wells and pipelines</li> </ul>  |
| C | Power Transmission System and Substations          | 150.8                         | <ul style="list-style-type: none"> <li>• One 400kV, 105 km transmission line from Morupule “B” to an existing 400/220 kV substation near Selebi Phikwe (Phokoje substation). Line to include optical ground wire cable (OPGW) for optic fibre telecommunication facilities</li> <li>• A new 400/220 kV substation to be developed about 60 km from Gaborone (Isang substation) ,</li> <li>• One 400 kV, 215 km transmission line from Morupule “B” to Isang 400/220 kV substation, a new substation referred to above. Line to include optical ground wire cable (OPGW) for optic fibre telecommunication facilities.</li> <li>• Reactive Power Compensation equipment to be installed for secure transfer of up to 530 MW to either Phokoje or Isang after loss of any one of the 400 kV transmission lines connecting the power plant to the grid</li> <li>• Inter-tie line 400/220 kV power transformer to link the existing Morupule “A” to the proposed Morupule B power plant</li> <li>• Automatic Generation Control Equipment</li> </ul> |
| D | Technical Assistance                               | 2.8                           | <ul style="list-style-type: none"> <li>• Control Area Establishment</li> <li>• Training of Power Plant Operators</li> <li>• Harmonic Studies</li> <li>• Feasibility Study of 200 MW Concentrating Solar Power</li> <li>• Carbon Capture Readiness</li> </ul>   |
| E | Project Supervision & Management                   | 13.0                          | <ul style="list-style-type: none"> <li>• Consultancy Services for Project Supervision and Management</li> <li>• Environmental and Social Management Plan (ESMP), including Resettlement Action (RAP)</li> </ul>  |
|   | <b>Total</b>                                       | <b>905.4</b>                  |  |

## 2.2 Technical solution retained and other alternatives explored

2.2.1 Until now, Botswana has been able to import the bulk of electricity supplies from South Africa’s Eskom. However, due to the regional energy crisis, Eskom will significantly reduce power exports to Botswana over coming years and has declined to supply firm power as of 2013. If no domestic generation capacity is built to substitute for these declining imports, the consequences would be disastrous for the country.

2.2.2 GoB has considered several electricity supply options to substitute for the imported power. Coal currently is the sole indigenous resource that can be used for the development of electricity generation capacity in a scaleable and timely manner. A Coal Bed Methane project is currently under exploration but resources have not been proven to date. Similarly, Botswana has prepared a pre-feasibility study and is actively looking to develop solar power

plants in the future, but such schemes could not be used to meet the huge requirements stemming from declining imports over coming years. Finally, oil-powered generation plants for base load generation would be considerably more expensive than coal-fired units as a result of the availability of cheap domestic coal resources, compared to higher and more volatile oil prices and considerable transport costs from the nearest port.

2.2.3 Finally, the development of a new coal-fired plant ( Morupule B-4X150 MW) adjacent to the existing Morupule ‘A’ plant was adopted as the least cost solution to guarantee electricity supply self sufficiency as a result of the following factors: (i) adequate availability of coal resources of suitable quality; (ii) mine already developed on-site for Morupule A (mine expansion will be required); (iii) availability of adequate water supply and of existing water supply infrastructure; (iv) scope for synergy with transmission infrastructure for Morupule A and Mmamabula; (v) availability of land, environmental suitability and availability of transport infrastructure.

2.2.4 A coal-fired power plant requires prudence in selecting boiler technology. The main factors considered are the type of coal, power system reliability and the electricity grid. Two options were considered for the Morupule B Power Plant, namely (i) Circulating Fluidized-Bed Combustion (CFBC) and (ii) Pulverised Coal (PC) boilers. The CFBC boiler technology was preferred over PC because it is better suited to the type of coal found in Botswana. CFBC boilers process solid fuel where the fuel is suspended in a mixture of superheated air and sand, collectively called “fluidized bed”. Reagents like limestone are added and temperatures are controlled to directly capture the sulphur and reduce the formation of Nitrogen Oxides.

2.2.5 For CFBC, two technologies were considered, namely (i) sub-critical steam conditions and (ii) super-critical steam conditions. The latter was considered in order to achieve higher efficiency level but it was found that there is limited experience with this technology. Indeed, the first supercritical CFBC boiler of 460 MW rating is under construction at Lagisza in Poland. Besides, the single unit size is more than the BPC grid can sustain if there is an unplanned outage of the unit. For the above reasons, the application of CFBC super-critical boiler technology was rejected.

2.2.6 Furthermore, the Pulverised Coal super-critical technology was considered. Traditionally, the plants which adopted the super-critical technology were of large capacity, more than 500 MW (e.g. Matimba and Medupi of Eskom). Given the nature of the BPC’s power system and the electricity grid limitation, the application of the PC super-critical boiler technology was also rejected.

2.2.7 The Morupule B power plant will deploy CFBC boiler technology. The plant will be supplied coal from the existing mine currently supplying coal to the Morupule A power plant. The coal supply agreement is expected to be signed before October 2009. The coal will be transported by overland conveyors that are covered to a coal processing plant where the coal will be separated, the coarse coal washed, and transported to the power plant B via another set of conveyors. This method of transporting coal is more cost effective than transportation by trucks. However, the conveyors belts when they break down will cause the spilling of coal and disruption of supply to boilers. The maintenance of the conveyor belts is part of the emergency preparedness plan to minimise the accidental spillage and the disruption of supply to boilers.

2.2.8 The use of dry-cooling through the use of air cooled condensers as opposed to a wet cooling tower system will reduce water consumption (by as much as 70 to 90%), as will the installation of electrostatic precipitators to minimise the particulate emissions from the power plant. The use of air cooled condensers is the key technology used in the power plant to conserve water.

2.2.9 To evacuate power from the Morupule ‘B’ Power Station, a 400 kV transmission system with OPGW shield wire will be constructed to transmit power to a 400/220 kV Step-down Substation at Isang, north of Rasesa. The alternative to build 220 kV and 765 kV transmission lines were considered but rejected based on technical requirements and financial considerations. The Isang substation and Phokoje will be connected to the new Morupule “B” Power Station, via one 400 kV line.

2.2.10 The existing 220 kV lines from Morupule A to Segoditshane and Thamaga will be turned into the Isang substation. Two 315 MVA autotransformers will be provided to couple the 400 kV and 220 kV bus bars. The Statistic VAR compensators will be installed on the 400 kV bus bars at appropriate locations.

*Table 2.2: project alternatives considered and reasons for rejection*

| <b>Alternative</b>  | <b>Brief description</b>  | <b>Reasons for rejection</b>   |
|---|---|--|
| <b>Generation</b>   |   |  |
| a) No new generation capacity built / Reliance on power imports | a) Botswana currently needs to import >80% of power consumed nationally | a) Due to the regional power crisis, neighbouring countries will considerably reduce exports to Botswana over coming years and totally discontinue firm exports by 2013. Imports will therefore no longer be available over coming years and the economic cost of not meeting the demand for electricity would be enormous |
| b) Other power sources  | b) (i) Coal Bed Methane; (ii) Solar (iii) Oil                           | b) (i) Reserves not proven yet; (ii) Not possible to develop in scaleable and timely manner to meet supply deficits over medium-term; (iii) Considerably more expensive and volatile (fuel would need to be imported). Would not provide the same level of energy self-reliance  |
| c) Plant size   | c) Plant size of 600 MW with 4x 150 MW units was selected               | c) While a smaller plant size (400 MW) was originally considered, it was rejected to ensure that Botswana becomes self-sufficient. Implementing 4x150 MW units was identified as the least-cost configuration by taking into account the condition of the electricity grid   |
| d) Boiler technology  | d) Super-critical versus sub-critical boiler                            | d) Sub-critical CFBC boiler technology chosen over PC and CFBC supercritical due to the fact that CFBC is more suited to the type of coal and grid limitations in Botswana.  |
| <b>Transmission</b>   |   |  |
| e) Voltage of transmission line                                 | e) 220 kV or 765 kV instead of 400 kV lines                             | e) the 400 kV option was deemed to be optimal for Botswana’s transmission system based on the 10 Year Transmission Development study conducted in 2006/7   |

## 2.3 Project type

2.3.1 The proposed project is a standalone project which will be connected to the country’s existing transmission and distribution infrastructure through two new transmission lines so as to ensure power evacuation in the event of a failure on one of the lines.

## 2.4 Project cost and financing arrangements

2.4.1 The project costs, excluding custom taxes and duties, financing fees and Interest During Construction (IDC) on the ICBC-SB loan, are estimated at US\$ 1,394.3 million (UA 905.4 million) based on cost estimates as at June 2009. These cost estimates include physical contingencies of 10% on all components except for EPC contract, which has already been awarded. The price contingencies of 5% have been applied on all components. The breakdown by component and financier for the project as a whole is presented below.

Table 2.1: Project costs by Component and source of financing (in million UA)

| Components  | Financier  | Million UA   |              |              | Million UA   |             |              |              |
|---|------------|--------------|--------------|--------------|--------------|-------------|--------------|--------------|
|   |            | Local        | Foreign      | Total        | AfDB         | WB          | ICBC         | GoB          |
| <b>A: Power Plant</b>                                       |            |              |              |              |              |             |              |              |
| Power plant   | ICBC / GoB | 94.6         | 535.7        | 630.3        | -            | -           | 535.7        | 94.6         |
| Start up fuel for commissioning                             | AfDB       | -            | 22.7         | 22.7         | 22.7         | -           | -            | -            |
|   |            |              |              |              | -            | -           | -            | -            |
| <b>B: Water supply systems</b>                              |            |              |              |              |              |             |              |              |
| Water supply systems  | WB / GoB   | 2.3          | 41.6         | 43.9         | -            | 41.6        | -            | 2.3          |
| <b>C: Power transmission system and substations</b>         |            |              |              |              |              |             |              |              |
| Morupule B-Phokoje 400 kV line and associated works         | WB         | 0.5          | 23.3         | 23.7         | -            | 23.7        | -            | -            |
| Morupule B-Isang 400 kV line and associated works           | AfDB       | 0.8          | 37.1         | 37.9         | 37.9         | -           | -            | -            |
| Supply of 3 Transformers (2 for Isang and 1 for Morupule B) | WB         | 1.6          | 15.6         | 17.2         | -            | 17.2        | -            | -            |
| Isang 400/220 kV Substations                                | AfDB       | 3.9          | 35.4         | 39.3         | 39.3         | -           | -            | -            |
| Reactive Power Compensation Equipment                       | AfDB       | 1.2          | 10.5         | 11.7         | 11.7         | -           | -            | -            |
| Purchase of AGC Hardware and Software                       | WB         | -            | 0.8          | 0.8          | -            | 0.8         | -            | -            |
|   |            |              |              |              | -            | -           | -            | -            |
| <b>D: Technical assistance</b>                              |            |              |              |              |              |             |              |              |
| Consultancy Services for Power System Harmonic Studies      | WB         | -            | 0.6          | 0.6          | -            | 0.6         | -            | -            |
| Consultancy Services for Control Area Establishment         | WB         | -            | 0.5          | 0.5          | -            | 0.5         | -            | -            |
| Training for Power System Operators                         | WB         | -            | 0.5          | 0.5          | -            | 0.5         | -            | -            |
| Feasibility Study of Concentrating Solar Power              | AfDB       | -            | 0.7          | 0.7          | 0.7          | -           | -            | -            |
|   |            |              |              |              | -            | -           | -            | -            |
| <b>E: Project management</b>                                |            |              |              |              |              |             |              |              |
| Consultancy services for project supervision and mgmt       | AfDB / GoB | 1.6          | 9.0          | 10.5         | 9.0          | -           | -            | 1.6          |
| RAP / ESMP  | GoB        | 0.7          | -            | 0.7          | -            | -           | -            | 0.7          |
| <b>Base cost</b>  |            | <b>107.1</b> | <b>734.1</b> | <b>841.2</b> | <b>121.3</b> | <b>85.0</b> | <b>535.7</b> | <b>99.1</b>  |
| Physical Contingencies(@10%) - all items except EPC         |            | 1.2          | 19.8         | 21.1         | 12.1         | 8.5         | -            | 0.5          |
| <b>Subtotal</b>   |            | <b>108.3</b> | <b>753.9</b> | <b>862.2</b> | <b>133.4</b> | <b>93.5</b> | <b>535.7</b> | <b>99.6</b>  |
| Price Contingencies (@5%) - all items except EPC            |            | 0.7          | 10.9         | 11.6         | 6.7          | 4.7         | -            | 0.3          |
| EPC contingency (@ 5%)                                      |            | 4.7          | 26.8         | 31.5         | -            | -           | -            | 31.5         |
| <b>Total Cost</b>   |            | <b>113.7</b> | <b>791.6</b> | <b>905.4</b> | <b>140.1</b> | <b>98.2</b> | <b>535.7</b> | <b>131.4</b> |

Table 2.2: Project costs by source of financing (in million UA)

| Financiers   | In Million UA | %           |
|--------------|---------------|-------------|
| ADB loan     | 139.3         | 15%         |
| MIC grant    | 0.6           | 0.1%        |
| WB           | 98.2          | 11%         |
| ICBC         | 535.7         | 59%         |
| GoB          | 131.6         | 15%         |
| <b>Total</b> | <b>905.4</b>  | <b>100%</b> |

2.4.2 The project costs relevant for ADB funded components and categories of expenditure are given below:

*Table 2.3 The costs of the ADB funded components (in million UA)*

| <b>Components</b>     | <b>Local Cost</b> | <b>Foreign Cost</b> | <b>Total</b>  |
|-----------------------|-------------------|---------------------|---------------|
| Start up Fuel         | -                 | 22.70               | 22.70         |
| Morupule B-Isang Line | 0.8               | 37.10               | 37.90         |
| Isang Substation      | 3.9               | 35.40               | 39.30         |
| Reactive Comp.        | 1.2               | 10.50               | 11.70         |
| Technical Assistance  | -                 | 0.70                | 0.70          |
| Project Management    | -                 | 9.00                | 9.00          |
| <b>Sub-Total</b>      | <b>5.90</b>       | <b>115.40</b>       | <b>121.30</b> |
| Contingencies         | 0.89              | 17.91               | 18.80         |
| <b>Total</b>          | <b>6.79</b>       | <b>133.31</b>       | <b>140.10</b> |

*Table 2.4 ADB funded components by Category of Expenditure (in million UA)*

| <b>Exp. Categories</b> | <b>Local Cost-LC</b> | <b>Foreign Cost-FC</b> | <b>Total</b>  |
|------------------------|----------------------|------------------------|---------------|
| Goods                  | 5.90                 | 105.70                 | 111.60        |
| Services               | 0.00                 | 9.00                   | 9.00          |
| Sub-Total              | 5.90                 | 114.70                 | 120.60        |
| Contingencies          | 0.89                 | 17.81                  | 18.70         |
| <b>Total</b>           | <b>6.79</b>          | <b>132.51</b>          | <b>139.30</b> |

## **2.5 Project's target area and population**

2.5.1 The proposed Morupule B project is situated adjacent to the existing Morupule Power Station, which lies approximately 280 km north of Gaborone. Palapye is the nearest village, situated approximately 5 km to the east of the power station. Morupule B project is of great strategic importance for Botswana as it will contribute to national energy security and improving the competitiveness of the national economy. It also will benefit the whole population, estimated at 1.8 million in 2008. The direct project beneficiaries will be the households, mines and manufacturers and economic actors at large.

2.5.2 The availability of reliable electricity supply will allow the country to continue its rural electricity access enhancement program, with a view to increase national household access rates from 47% to 80% by 2016. The enhanced electricity access rate will contribute to reducing rural poverty.

## **2.6 Participatory process for project identification, design and implementation**

2.6.1 Public consultations were conducted for the project as part of the various environmental and social assessments. The process has been incorporated into a Public Consultation and Disclosure Plan (PCDP), which includes the findings of the authorities and public participatory meetings held at the national and district levels as well as meetings in the villages along the proposed transmission line routes. The stakeholder engagement process for the ESIA of the power plant was commenced in August 2007 with the publication of an advertisement in English and Setswana announcing the project. An invitation to attend the scheduled public meeting regarding the project was included in the advertisements, and at these meetings a background information document was presented in both Setswana and English.

2.6.2 A public meeting was held at Palapye main Kgotla on September 4, 2007, and was conducted in Setswana as all the participants could speak and understand the language. The

meeting was attended by 31 people including the consultations team and representatives from BPC. A meeting with key local and central government officers was also convened in Palapye in September 2007, and the stakeholder engagement team undertook consultations with focus groups comprised of local farmers in the following lands areas within 10 km of the proposed power station site: Morupule; Mantshadidi; Mmalenakana; Dikabeana; and Molapowadipitse.

2.6.3 A Grievance Resolution Procedure has been developed, which describes the process whereby stakeholders can report their concerns and grievances related to activities, and identifies processes for addressing these concerns. It also allows for stakeholder involvement at various points in the resolution process. The Grievance Resolution Procedure makes possible the lodging of a grievance in any appropriate format (written, verbal, telephonic, email, post etc). The process is designed to be easily accessible and friendly.

2.6.4 While the above explained consultation process was initiated during the ESIA phase of the project, it will continue through construction and operation of the power plant.

## **2.7 Bank Group experience, lessons reflected in project design**

2.7.1 The Bank's experience with power sector projects (fossil fuel fired generation, transmission, technical assistance) has been suitably incorporated in the project. As such, the following project features have been ascertained: (i) the executing agency has the adequate capacity to implement the project of this nature; (ii) there is a champion of the project; (iii) there is a strong country ownership of the project; (iv) experienced and qualified consultants are employed; (v) there has been adequate consultation with communities and stakeholders on issues related to the project design and safeguards; (vi) there is adequate human resource capacity to implement safeguards; (vii) there are adequate financial resources to implement the measures to minimise the negative environmental and social impacts of the project; (viii) risks have been identified and can be mitigated; (ix) the financial management systems of the beneficiary are acceptable; (x) the government is committed to undertake reforms for improving sector governance, structure and the efficiency of service delivery; and (xi) the project includes adequate Technical Assistance components as discussed in section 4.6.

2.7.2 For a project of this kind, the past experience recommends that Bank supervision is adequately staffed with appropriate skill mix. At a minimum, the project will be supervised twice a year and a mid-term review will also be conducted.

2.7.3 The Bank, through a MIC grant will also finance a Technical Assistance component to prepare a Feasibility Study for a 200 MW Concentrating Solar Power (CSP) plant. This will pave the way for diversification away from coal for electricity generation in order to address climate change issues. CSP is a strategic option for Botswana to utilise solar energy which is a very important energy resource for the country (21 MJ/m<sup>2</sup>/annum) but remains unexploited. The exploitation of solar energy to produce power is also a strategic option for the Bank which is involved in neighbouring South Africa, where it is preparing the Investment Plan to fund a CSP project (100 MW) under the Clean Technology Fund. In partnership with other donors, the Bank will progressively mobilise financial resources for scaling up the funding of solar power plants in the Southern Africa region.

## 2.8 Key performance indicators

2.8.1 The Morupule B Power Project will result into the implementation of a power plant and power evacuation systems to ensure national self sufficiency in the supply of electricity as of 2013. Specifically, the main deliverables of the project are : (i) a 600 MW coal fired power plant (ii) 317 km 400 kV transmission line (iii) a new 400/220 kV substation at Isang.

2.8.2 Moreover, the increased electricity produced by the project will help the government increase the household electricity access rate from 47% (2008) to 80% (2016), for which the GoB is implementing (i) 100 village electrification with financial assistance from Norway and (ii) renewable energy based electrification funded by GEF.

2.8.3 Finally, the MIC grant will be used to finance a Technical Assistance component to prepare a Feasibility Study for a 200 MW Concentrating Solar Power (CSP) plant to diversify energy supply and address climate change issues. The TOR for the Feasibility Study are presented in Annex 9. Moreover, the World Bank funded technical assistance activities will result into 300 trained power plant operators, a load dispatch system, carbon capture readiness and improved quality of electricity supply without harmonics.

2.8.4 Besides, the studies on pricing and sector reforms to establish a sector regulator will be prepared to guide GoB with sector reforms in order to improve BPC's financial standing and attract private investors in the sector.

2.8.5 The power plant for ADB is an associated facility as the 600 MW coal-fired power plant is being funded by ICBC-SB with guarantees provided by GoB and IBRD and insurance to be provided by Sinosure. Monitoring of environmental impacts will be done through compliance with the ESMP as discussed in detail in B8/Annex 8. Specific attention will be paid on the following (i) Stack emissions; (ii) Air quality; (iii) Water resources; and (iv) Waste monitoring. The automatic monitoring system used will indicate when emission limits for each pollutant are being approached.

## 3. PROJECT FEASIBILITY

### 3.1 Economic and Financial Performance

3.1.1 As shown in the table below, the results of the financial and economic analyses support the implementation of the project. The Base Case FIRR is estimated at 6.7%, which is greater than BPC's estimated Weighted Average Cost of Capital (WACC) of 5.0% and the Base Case EIRR is estimated at 24.9%, which is greater than the assumed Economic Opportunity Cost of Capital (EOCK) in Botswana of 12.0% (all rates are expressed in real terms). Moreover, key sensitivities support the resilience of the project's financial returns and economic benefits. The level of the returns computed in the financial and economic analyses are impacted by the prevailing low tariff levels and the very high cost of alternative technologies respectively. A detailed discussion of the assumptions and results of these analyses is included in B.7/Annex8.

*Table 3.1: Base Case financial and economic returns*

| <b>Item</b>                          | <b>Base case returns</b>                    |
|--------------------------------------|---|
| FIRR / FNPV @ 5.0% real (Base case)  | 6.7% / Pula 2.3 billion (USD 328 million)   |
| EIRR / ENPV @ 12.0% real (Base case) | 24.9% / Pula 11.9 billion (USD 1.7 billion) |

## Tariff Analysis

3.1.2 The Government, through the Ministry of Minerals, Energy and Water Resources, is responsible for setting electricity tariffs. The Average Selling Price (ASP) in Botswana is Thebe 36 / KWh (\$ 5.1 cents). BPC has historically been able to keep tariffs at a low level as it sources the bulk of its supply from Eskom. However, going forward BPC's cost structure will radically change, with the Corporation sourcing the bulk of its power from its own plants and most likely IPPs. Separately, the current tariff structure in Botswana does not include any cross-subsidisation.

3.1.3 Going forward, GoB is committed to establishing an independent regulator in order to set tariffs at a level that will (i) ensure that the Corporation meets the requirements of the BPC Act by operating as a commercially viable entity; and (ii) attract private investors in the sector in a sustainable manner. Moreover, the tariff segmentation and structure will be reviewed to make electricity more affordable to poorer customers, increase connection rates (particularly in rural areas) and sustain economic growth.

3.1.4 As such, the Ministry of Minerals, Energy and Water Resources (MoMEWR) is in the process of engaging two consultants funded by the World Bank (i) to develop an appropriate pricing policy together with a pricing model; and (ii) to assist in establishing an independent regulatory authority, staffing it and building capacity. It is intended that the regulator will be established by 2011. In the interim period, tariffs will continue to be determined by GoB. MoMEWR has already publicly announced that there will be a hike in prices to cover for BPC's operating costs and to reach a level that will allow the recovery of the corporation's capital investments (including costs associated with the expansion of the distribution network in support of the government's target for 80% of households to be connected to the grid by 2016). It is noted that electricity tariffs are also expected to be increased substantially in neighbouring countries (South Africa for instance) in order to finance capital expenditure programs. As part of the supervision of the project, the Bank will review the progress of these reforms, consult and advise MoMEWR and BPC as necessary.

## 3.2 Environmental and Social impacts

### Environment

3.2.1 The Project has been assigned **Category 1**. The Executive Summaries of the ESIA studies were posted on the Bank's website and distributed to the Board on 14 July 2009 (Ref: ADF/BD/IF/2008/164). Full documents are available on BPC's website ([www.bpc.bw](http://www.bpc.bw)). In addition to meeting the requirement of the Botswana's Department of Environmental Affairs (DEA), all the ESIA's also conform to the Bank's Environmental & Social Assessment Procedures (ESAP, 2001). Other applicable Bank's safeguard policies include Involuntary Resettlement, Consultations with CSOs/NGOs, Gender, Poverty Alleviation, and Information Disclosure. The project also complies with the World Bank OP 4.01 on Environmental Assessment, the Operational Policy on Involuntary Resettlement (OP 4.12), and the OP 4.37 on the Safety of Dams given the need to ensure sound management of the ash impoundment dam. More detailed information is provided in B.8/Annex8.

3.2.2 A number of environmental and social studies related to the development of coal-fired power generation and transmission at Morupule have been completed. These include: the ESIA studies for the Morupule B Power Station, the two transmission corridors, the Isang Substation the MCL mine expansion and the well field proposed as a water source for

Morupule B were approved by DEA. Each ESIA contains an Environmental Management Plan for ongoing monitoring and management. The Resettlement Action Plan (RAP) for the transmission line route between the Morupule B and Isang substation has also been completed.

3.2.3 Transmission Line: No significant adverse impacts are expected for the transmission lines as they follow the existing right-of-way. A sum of 7.8 million Pula (US\$ 1.1 million) has been estimated to compensate for the affected population along the transmission route for minimum farmlands. Confirmation from a Financial Institution acceptable to ADF of the deposit into an escrow account of the amounts for the resettlement and compensation, as set out in the Resettlement Action Plan (RAP) with respect to components to be financed by the Bank is a condition prior to first disbursement.

#### **Power Plant :Air Quality**

3.2.4 As indicated in 2.2.5, the use of CFBC boilers would produce lower emission of SO<sub>2</sub> and NO<sub>x</sub> compared to typical coal fired power plant. Notwithstanding, the baseline ambient air quality of the local air shed was simulated through dispersion modelling because there is insufficient on-site data available for the criteria pollutants of concern. The main sources contributing to the ambient air quality within the vicinity of the proposed Morupule B Power Station are the current Morupule Power Station and the Morupule Coal Mine. The other main sources, i.e. Matimba and Medupi Power Stations across the border in South Africa are considered to be too far away to have a significant influence on the background concentrations at the Morupule Power Plant. The predicted baseline SO<sub>2</sub>, NO<sub>2</sub> and PM10 baseline concentrations due to the existing Morupule Power Plant are summarized in Table 8.1/ B.8/ Annex 8.

3.2.5 Specifications for the Morupule B Power Station require achievement of World Bank emissions standards. While Botswana has not established emissions standards for power stations, the *Air Pollution (Prevention) Act 1971* requires the application of best practicable means to control emissions. World Bank emissions standards are more stringent than the maximum permissible limits specified by the Botswana authorities for Morupule A's current boiler operations. The EIA for Morupule B found that current emissions from Morupule A may be causing occasional local exceedances of Botswana air quality standards for ambient sulphur dioxide concentration, suggesting that it may not be possible for Morupule B to meet ambient air quality standards without reductions in emissions from Morupule A. The Morupule B Power Station has a relatively small contribution to the high SO<sub>2</sub> concentrations as shown in Table 8.2/B8/Annex 8.

3.2.6 Prior to making a decision regarding investment in sulphur dioxide emissions control at Morupule A, BPC intends to undertake both an environmental audit of current operations and a two-year air quality monitoring study to better define the issues to be addressed and possible solutions. Based on the results of the two-year air quality monitoring campaign, BPC will implement measures as necessary to ensure that the joint operation of Morupule A and B does not lead to exceedances of the World Bank or Botswana air quality standards.

3.2.7 Additionally, a Regional Environmental and Social Assessment is also planned to consider the cumulative and trans-boundary impacts of all planned coal-fired power investments on both sides of the Botswana/South Africa border. The TORs for these two studies have been finalized and will be financed by the World Bank or BPC. It is expected

that the study would recommend some retrofit to the existing Morupule A plant to install emission reduction measures particularly for the SO<sub>2</sub>, NO<sub>x</sub> and PM10.

### **Climate Change**

3.2.8 Botswana's current CO<sub>2</sub> emissions have been calculated at approximately 2.0 tonnes of CO<sub>2</sub> emissions per person per year. This figure includes present coal production and use, all fuels, gas and firewood. The average figure for CO<sub>2</sub> emissions per person per year for middle-income countries is 3.8 tons. Botswana is a net sink for greenhouse gases at negative 29.4 million tonnes of CO<sub>2</sub>/annum. The BPC project will contribute to Greenhouse Gas emissions primarily as a result of emission of CO<sub>2</sub> from the burning of coal. The gross Greenhouse Gas Footprint of the project is estimated to be approximately 4 million tonnes CO<sub>2</sub> equivalents per annum. Morupule B project would reduce it to negative 25 million tonnes of CO<sub>2</sub>/annum. Currently, Botswana's Greenhouse Gas Footprint is negative and will remain negative after the addition of the CO<sub>2</sub> equivalents from this project.

3.2.9 The Morupule Power Station greenhouse gas contribution may be placed within the context of national greenhouse gas emissions by making reference to the greenhouse gas emissions inventory included in the National Communication to the United Nations Framework Convention on Climate Change (UNFCCC, 2002). The Air Quality Impact Report compiled by Airshed Planning Professionals in 2004 indicated that the current Morupule Power Station contributed approximately 32.6%, 0.3% and 0.01% of the country's total CO<sub>2</sub>, NO<sub>2</sub> and CH<sub>4</sub> emissions respectively.

3.2.10 The GoB is implementing a renewable energy based electrification project to avoid green house gases. The project aims at reducing Botswana's energy-related CO<sub>2</sub> emissions by promoting renewable and low Green House Gas (GHG) technologies as a substitute for fossil fuel (fuel wood, paraffin and coal) utilized in rural areas. The activities proposed in the project are designed to remove barriers to the wide-scale utilization of renewable energy and low GHG technologies to meet the basic electricity needs of individual households in terms of lighting, power for radio-cassette/TV and income-generating activities.

### **Gender**

3.2.11 Botswana has ratified most of the international conventions relating to gender equality. The Abolition of Marital Power Act (passed in 2004) is the most important piece of legislation. This Act has made women equal to men in marriage, property holding, domicile and guardianship of minor children. Going forward, the budget support program funded by ADB, would impact positively on women through budgetary allocation to pro-poor sectors (education, health, agriculture and social welfare programs) which account for 48% of total expenditure. The program would support women empowerment by increasing the contribution of the services sector to women employment from 75% in 2007 to 78% in 2009/10.

3.2.12 An energy-and-gender audit (2006) conducted by the Gender and Energy Network of Botswana (GENBO) found that the women users are not involved in policy formulation and technology development. Moreover, there also is a lack of disaggregated data for gender mainstreaming during planning. As the energy needs are different depending on gender and socio-economic status, there is a need to take these differences into consideration during policy and program formulation and implementation. To correct the situation, the "Energy Policy" funded by USAID envisages the creation of a gender-disaggregated database on

energy development within the country, mainstreaming gender and socio-economic status in all “Energy Policy” and programs and accelerate the representation of women at all levels and in all spheres of the energy service provision industry.

3.2.13 At BPC, women are well represented. BPC Board (2008) is composed of four female and three male members. The female staff represents 19.40% of the total employees and 24% of the executive committee, senior and middle management. In partnership with the Bank’s relevant departments, a dialogue with GoB during the supervision mission will include, among others, the gender based budgeting to be considered in the planning activities to further reinforce gender mainstreaming in BPC.

3.2.14 The project will contribute to increase the household electricity access rate in conjunction with GEF funded Renewable Energy based electrification and the electrification program funded by the Government of Norway and Sweden. With the increased electricity access rate at household level women and children will be able to use the time for studying, knowledge building and income generating activities. Modern energy services availed will reduce women’s burden of domestic chores and it will inspire some of them to start small & medium enterprise such as food and beverage processing. Facilitated by electricity, the penetration of ICT will increase, which is critical for women’s education, empowerment, and participation in markets. The empowered women will be able to engage to public life; they will have their voices heard and views included in the formulation of policies and programs with respect to their needs for type of service, and choice of technology.

## **Social**

3.2.15 The project will result into significant positive social impact due to the discontinuation of load shedding and to additional customers that will benefit from modern electricity for heating, cooling, cleaning and communication. At the same time, better communication through cell phones, television and internet will create opportunities for trading, education and empowerment.

3.2.16 The construction of the lines from Morupule B to Phokoje and to Isang will require a labour force of around 350. Each contract will require around 40 to 50 skilled workers who will be brought in with the contractor. Most of the labour force will therefore be unskilled and sourced from a labour broker or labour department locally. A proper construction camp that is comprised of portable cabins will be built to accommodate the entire labour force during this time. These camps are usually fenced, have gate control and proper security. Various impacts have been identified for both the construction and operational phases of the project.

## **4. IMPLEMENTATION**

### **4.1 Implementation arrangements**

4.1.1 **Project Implementation Arrangements:** The Government of Botswana will be the borrower of the Loan and BPC, which is 100% owned by GoB, will be the beneficiary and the project executing agency. The MoMEWR will be leading in the preparation of the feasibility study of CSP.

4.1.2 BPC has established an internal Executive Committee for project oversight and bottleneck redressing. An experienced Project Manager was recruited externally for the

overall coordination of the project's implementation: power plant, transmission lines & substations and safeguards. The Project Manager reports to the CEO of BPC. A project implementation organigram is included in B3.4/Annex 4. A Strategic Project Unit (SPU) has been created for the implementation of the Morupule B power plant, while the existing Transmission Business Unit (TBU) will be responsible for the implementation of the transmission lines and substations. The TBU will be reinforced by employing two electrical engineers to coordinate, monitor and supervise the implementation of the transmission lines and substations.

4.1.3 Regarding Safeguards, BPC will establish a Safeguards Unit which will be responsible for the overall implementation, administration and enforcement of the ESMPs. BPC will appoint an Environmental Liaison Officer (ELO) to monitor the implementation of and compliance with the ESMP for the duration of the works. In addition, a Chief Safeguard Officer will be appointed and will undertake regular audits of the construction sites and during the operational phase. He will also be responsible for ensuring BPC's continuing compliance with the ESMP. BPC will ensure that the ESMP specifications are included in all tender documents issued for civil works, transmission lines and substations and activities on site, and will monitor and enforce adherence to these requirements by the contractors. The appointment of an Environmental Liaison Officer and a Chief Safeguard Officer is a condition for first disbursement of the loan. Their recruitment is underway.

4.1.4 The Project Manager is responsible to coordinate the works and monitor the progress of SPU, TBU and the Safeguards Unit. BPC has prepared a draft Project Procedure Manual, which will be finalized in consultation with the Bank.

4.1.5 BPC was assisted by a set of international consultants to prepare design and tender documents for the construction of transmission lines and substations as listed below:

- Southern Transmission lines: Merz and McLellan (Botswana)
- Isang Substation : TAP/KEC Consortium
- Northern Transmission Line : PB Power

Furthermore, BPC will recruit a consultancy firm for supervision of construction of the ADB funded transmission line and substation.

4.1.6 Fitchner is supervising the construction of the power plant. For the Water development system, the recruitment for design engineer recruitment is in progress. A Consultancy firm will also be recruited for the preparation of the ESIA and RAP for the Water System.

4.1.7 Finally, an inter-ministerial Steering Committee, headed by the Permanent Secretary, MoMEWR, will be established. The establishment of the Steering Committee will be a condition to first disbursement. The Bank will be provided with the composition and the TOR of the Steering Committee.

4.1.8 **Implementation Schedule:** Unit 1 is expected to be commissioned in January 2012, 33 months from the date of the commencement date of the contract. Units 2, 3, & 4 will be commissioned at intervals of three months each. The ADB funded transmission line and substation will be completed over a period of 24 months from the contract award date. The project implementation timeline and the supervision schedule are summarised in B.9/Annex8.

**4.1.9 Procurement arrangements:** All procurement of goods, works, and services financed by the Bank, will be in accordance with the Rules of Procedures for the Procurement of Goods and Works, Rules of Procedures for the Use of Consultants. At the request of the Borrower, the Bank has authorised BPC to proceed with Advance Contracting pending Board approval of the project. An information note on the approval of AC has been distributed to the Board. Since ADB is funding the transmission lines and substations in partnership with the World Bank, BPC has requested the Bank to harmonize the procurement documents and processes with the World Bank. Consequently, the World Bank's Standard Bidding Document for Design, Supply and Installation has been adapted and harmonized with ADB procurement rules and procedures for use in procuring ADB funded components, as detailed in the B 5/Annex 8.

**4.1.10 Disbursement Arrangements:** The Mission discussed the disbursement methods to be applied for the Bank funded components of the project. With regards to the direct payment method, BPC expressed concern that delays in disbursing payments to contractors will lead BPC making the interest payment to the contractors. GoB therefore opted for a combination of (a) Direct Payment Method and (b) Replenishment Method. The details are given in B4.2/Annex8.

**4.1.11 Financial Management, audit and reporting:** BPC has detailed Policies and Procedures in place for the approval, recording and reconciliation of all financial transactions, which are discussed in the section B.4. BPC's financial management policies and systems are appropriate to ensure that funds made available by the Bank for the financing of the Morupule B project are used and accounted for in an effective and reliable manner.

4.1.12 BPC publishes financial statements audited by international auditors (currently Deloitte) within 5 months of its Year End. Following the Bank's requirements, a separate audit report will be produced for the components financed by the Bank. The project's audited accounts shall be submitted to the Bank within six months of the financial year-end. Furthermore, the Project will also fall within the normal review program of the Bank's Internal Audit, financial and fiduciary control.

## **4.2 Monitoring**

4.2.1 The main deliverables of the project are (i) 600 MW coal fired power plant (ii) 317 km 400 kV transmission line (iii) a new 400/220 kV substation at Isang, and stable national electricity grid with improved stability and reliability of electricity supply to consumers. The key project outcome is that Botswana becomes self-sufficient in terms of power generation.

4.2.2 The progress of *project outputs* during construction will be measured using the Consultant's monthly reports which will indicate the progress of works relative to the work plan. During the commissioning phase, the EPC contract for the power plant contains a number of tests that need to be passed. The performance of the transmission lines will also need to be tested prior to the contractor being released. Separately, the achievement of the *project outcomes* will be measured using sector statistics compiled by BPC and MoMEWR. Finally, compliance with environmental and social guidelines will be assessed and confirmed by DEA. Quarterly Progress Reports (QPRs) detailing the progress of the Project's implementation will be submitted to the Bank.

## **4.3 Governance**

4.3.1 Botswana has repeatedly been the top sub-Saharan African (SSA) country on a number of governance indices. MoMEWR has studied a set of different drivers to improve

the structure of the electricity industry and raise the bar for the operational efficiency of BPC: (i) Public Governance; (ii) Private Generation; (iii) Competition; and eventually (iv) Privatisation of BPC. The reform strategy of public governance was adopted as an interim measure and the operations of the Botswana Power Corporation were restructured in Strategic Business Units (Generation, Transmission, Corporate Services, Customer Services and Supply, and Rural). The process was completed in July 2007 and it contributed to improved performance and increased accountability being expected from each unit. Furthermore, the Electricity Supply Act was amended in December 2007 in order to attract private sector investors in the electricity sector. The privatisation of BPC is a long-term objective and GoB is implementing a number of sector reforms towards this objective.

4.3.2 MoMEWR has the authority to appoint the Board of Directors, including the Chairman. BPC's Chief Executive Officer is appointed by the Board, with the approval of the MoMEWR. As discussed earlier, GoB is committed to establishing an independent regulator for the electricity and Water sectors in order to allow BPC to operate as a commercially viable entity as well as to attract private investors in the sector.

4.3.3 With regards to financial governance, in line with industry best-practice BPC rotates its auditors in order to avoid potential conflicts of interest (while Price WaterhouseCoopers audited the FY08 accounts, Deloitte is currently auditing the FY2008-09 accounts). Moreover, the internal and external auditors have unrestricted access to the Chairman of the Audit Committee and the internal audit manager has direct access to the Botswana Directorate of Corruption and Economic Crime.

#### **4.4 Sustainability**

4.4.1 The project as conceptualized is technically sound, socially acceptable and environmentally sustainable. All project components including the construction of the high voltage transmission lines and substations to be financed by the Bank will be based on standard state of art technology. The Power Plant Technology is based on the Circulating Fluidized Boiler (CFB), which is more sustainable than the pulverized coal fired boilers. Similar, the 400 kV transmission and substation technology has already been field tested in the country. The project design has considered the site conditions, climate conditions and the internationally accepted technical standards to avoid failure.

4.4.2 Assisted by international consultants, BPC is well positioned to implement this project. Technical assistance for the implementation of the power plant, associated components and overall project management (SO<sub>x</sub> emissions and air quality monitoring and management, project management, training and workshops for Project Management Unit (PMU) will be provided by the World Bank.

4.4.3 BPC is going to operate and maintain the CFBC technology for the first time. The EPC contractor will be engaged to provide O&M services in the first two years to avoid risk of failure. The proposal is focussed on the safe operation of the station in the initial period, coupled with the training of local staff. CNEEC-SBW will provide approximately 240 staff who will train approximately 300 new BPC staff. It is intended that after that time, the plant would be fully operated by BPC staff, thereby greatly contributing to national capacity building. Besides, necessary spare parts for operation and maintenance have been planned and will be procured.

4.4.4 The Executing Agency is unlikely to face any difficulty in maintaining and operating the transmission facilities because BPC has considerable experience in operating similar

projects. Finally, being the least cost generation option of sufficient scale to serve the country's demand for power, the project is both financially and economically viable, as discussed in the analysis detailed in B.7/Annex 8.

## **4.5 Risk management**

4.5.1 Key project risks during both construction and operation are summarized below:

### Construction Risks

4.5.2 Key risks during construction are related to the capacity of BPC, the performance of the EPC contractor, coordination of the works and coal supply from MCL.

4.5.3 The Capacity of BPC has been reinforced through the recruitment of an experienced Project Manager responsible for overall project management to ensure good coordination between the project's various contractors and to control the quality of the works executed. Moreover, BPC has appointed different experienced consultants for the implementation of the project's various components. Besides, BPC is currently recruiting experienced professionals to work on the implementation of the project. Furthermore, the Bank through supervision missions will support BPC in early detection of bottlenecks and removal of the same.

4.5.4 The EPC contract for construction of power plant has been awarded to China National Electric Equipment Corporation and Shenyang Boiler Works (CNEEC-SBW) and is to be implemented over 42 months. The EPC consortium is experienced in building similar power plants. To ensure that the plant is built within the stipulated period, the EPC contract contains a clause dealing with penalties for liquidated damages, which will be invoked if the contractor fails to commission the plant within 42 months from the commencement date.

4.5.5 The Coal Supply Agreement for the supply of coal from MCL, which is a local public-private coal mining company, is being negotiated. It is expected that the contract for the supply of coal will be signed by October 2009.

4.5.6 The 400 kV Morupule B–Phokoje line (Northern Transmission line), which is being funded by the IBRD is expected to provide the commissioning power (25MW) to Morupule B. A delay is anticipated in the commissioning of the line due to delays in procurement. The line was expected to provide the commissioning power to Morupule B. To mitigate this risk, BPC is taking actions to advance the construction of the inter-tie between Morupule B and Morupule A to supply the power for commissioning of Morupule B power plant.

### Operational Risks

4.5.7 Given the new type of boiler and cooling technology, BPC needs assistance from the EPC contractor in the operation and maintenance of the plant. To avoid the operations risks, the EPC contract stipulates that plant operation and maintenance will be the responsibility of the EPC contractor for a period of two years from the completion date of the power plant. Thereafter the plant would be fully operated by BPC staff.

### Environmental, social and health risks

4.5.8 Overall impacts are deemed to be manageable. BPC will monitor the performance of the contractors through relevant Environmental Management and Resettlement Action Plans.

4.5.9 Plant emissions: The computer simulation of cumulative impacts combined emissions from the existing Morupule A and the proposed Morupule B Plants, particularly the sulphur dioxides (SO<sub>x</sub>) shows that the World Bank Guideline limits will be marginally exceeded. The World Bank is discussing with BPC the implementation of an air quality monitoring for the

airshed (collect actual data) to assess the possible mitigation. This will most likely involve the installation of the Flue Gas Desulfurization (FGD) units in the existing plant.

4.5.10 To evade conflict-related risks which may arise due to influx of expatriate works from neighboring countries and China, BPC will appoint a community outreach expert to avoid conflicts among workers. The community outreach expert will interface and interact with the parties to consult with them as required to address the issues. Furthermore, the World Bank is supporting the outreach activities for HIV prevention.

#### Climate Change Risk

4.5.11 The greenhouse gases produced impose a risk to climate. This risk is being addressed by helping GoB to adopt a low carbon path through investment in energy efficiency, solar home systems and Concentrating Solar Power. The energy efficiency programs are being funded by DANIDA. The UNDP/GEF is funding the rural electrification programs based on renewable energy. The Bank will fund the feasibility study of 200 MW Concentrating Solar Power plant, thereby paving the way for harnessing solar energy.

### **4.6 Knowledge Building**

4.6.1 The project comprises a number of technical assistance components: (i) Tariff policy and establishment of a regulatory authority for the power and water sectors, including capacity building; (ii) Communication program; (iii) Feasibility studies for Concentrating Solar Power and Carbon Capture Readiness including implementation approach and plans; (iv) Training for safeguards monitoring and management; and (v) Coal / CBM strategy development and implementation. With the completion of the above studies, the Government will be adequately empowered to initiate actions to prepare a lower carbon path for development.

4.6.2 In addition, the project focuses on the building of capacity through skill transfer and knowledge management as summarised below:

*(a) Transmission systems:* Technical Assistance on transmission network (automatic generation control (AGC) system software, system harmonic studies, control area establishment and training) will be funded by the World Bank.

*(b) Power Plant Consultant (Fichtner):* The Fichtner contract makes provision for a formalised on the job training programme and a formal training and study tour for six BPC technical staff in their design office in Stuttgart.

*(c) Power Plant – EPC contractor:* A detailed training requirement is included in the EPC contract to provide the training to BPC staff in and out of the country. The training program is estimated to cost US\$1.3 million.

## **5. LEGAL INSTRUMENTS AND AUTHORITY**

### **5.1 Legal instrument**

The legal instruments used for the project is:

- A Loan agreement to be entered into between the Republic of Botswana and ADB

### **5.2 Conditions associated with Bank's intervention**

- (A) Conditions Precedent to Entry into Force of the Loan

The entry into force of the Loan Agreement shall be subject to the fulfilment by the Borrower of the provisions of Section 12.01 of the General Conditions Applicable to Loan Agreements and Guarantee Agreements of the Bank as amended.

(B) Undertakings

The Borrower undertakes to prepare an electricity pricing policy and establish the sector regulatory authority by the end of 2011.

(C) Conditions Precedent to First Disbursement of the Loan

The first disbursement of the Loan shall be subject to the following conditions:

(i) Providing evidence to the Bank of either (a) the actual payment, to the people affected by the Project, of the amounts for the resettlement and compensation as set out in the Resettlement Action Plan (RAP) with respect to the components to be financed by the Bank, or (b) the establishment and the maintaining, directly or through its Executing Agency, with a financial institution acting as an escrow agent and acceptable to the Bank, of an indemnification escrow account in which the same amounts (or their outstanding part) will be deposited for the purpose of the payments indicated in the RAP until the last of such payments is effected;

(ii) Providing evidence to the Bank of: (a) the recruitment of two electrical engineers to reinforce the Transmission Business Unit to ensure the coordination, monitoring supervision and timely implementation of the project; and (b) the appointment of an Environmental Liaison Officer and a Safeguards Officer to reinforce the Safeguards implementation;

(iii) Providing evidence to the Bank of the opening of Special Accounts for each of the following contracts: (a) transmission line (b) Substations (c) Reactive Compensation and (d) Start-up fuel for commissioning of the generating units in accordance with the Bank's guidelines;

(iv) Providing evidence to the Bank of the IBRD loan having been approved;

(v) Providing evidence to the Bank of the establishment of the Inter-ministerial Steering Committee headed by the Permanent Secretary of the Ministry of Minerals, Energy and Water Resources; and

(vi) Providing evidence to the Bank of the Coal Supply Agreement having been executed between BPC and MCL.

### **5.3 Compliance with Bank Policies**

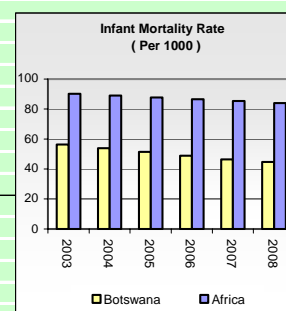
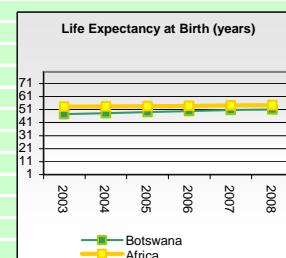
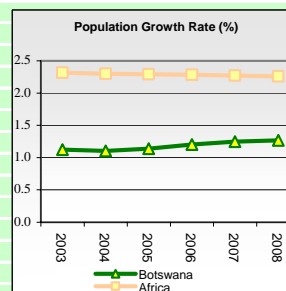
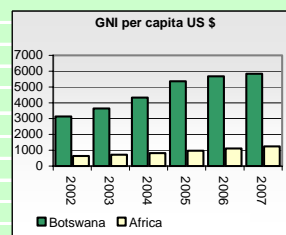
This project complies with all applicable Bank policies, particularly the Public Sector Lending Policies, Integrated Environmental and Social Assessment Procedures, Bank's Policy on Resettlement and Involuntary Displacement, and Bank's crosscutting themes of Gender, Governance, Poverty and consultations with stakeholders.

**6. – RECOMMENDATION**

The Management recommends that the Board of Directors approve the proposed loan of UA 139.30 million and a MIC grant of UA 0.6 million to the Government of Botswana for the purposes and subject to the conditions stipulated in this report and in the Loan Agreement.

## Botswana Morupule B Power Project Country's comparative socio-economic indicators

|   | Year    | Botswana | Africa | Developing Countries | Developed Countries |
|---|---------|----------|--------|----------------------|---------------------|
| <b>Basic Indicators</b>                               |         |          |        |                      |                     |
| Area ('000 Km <sup>2</sup> )                          |         | 582      | 30 323 | 80 976               | 54 658              |
| Total Population (millions)                           | 2008    | 1.9      | 985.7  | 5 523.4              | 1 226.3             |
| Urban Population (% of Total)                         | 2008    | 59.7     | 39.2   | 44.0                 | 74.4                |
| Population Density (per Km <sup>2</sup> )             | 2008    | 3.3      | 32.5   | 23.0                 | 49.6                |
| GNI per Capita (US \$)                                | 2007    | 5 840    | 1 226  | 2 405                | 38 579              |
| Labor Force Participation - Total (%)                 | 2005    | 46.0     | 42.3   | 45.6                 | 54.6                |
| Labor Force Participation - Female (%)                | 2005    | 44.9     | 41.1   | 39.7                 | 44.9                |
| Gender -Related Development Index Value               | 2006    | 0.660    | 0.482  | 0.694                | 0.911               |
| Human Develop. Index (Rank among 174 countries)       | 2006    | 126      | n.a.   | n.a.                 | n.a.                |
| Poverty Headcount Ratio at National Line (% of Pop.)  | 2003    | 30.3     | 34.3   | 25.0                 | ...                 |
| <b>Demographic Indicators</b>                         |         |          |        |                      |                     |
| Population Growth Rate - Total (%)                    | 2008    | 1.3      | 2.3    | 0.3                  | 1.2                 |
| Population Growth Rate - Urban (%)                    | 2008    | 2.5      | 3.3    | 2.5                  | 0.5                 |
| Population < 15 years (%)                             | 2008    | 34.2     | 40.9   | 16.6                 | 27.4                |
| Population >= 65 years (%)                            | 2008    | 3.5      | 3.4    | 16.7                 | 8.0                 |
| Dependency Ratio (%)                                  | 2008    | 60.7     | 79.5   | 47.7                 | 53.9                |
| Sex Ratio (per 100 female)                            | 2008    | 99.1     | 99.3   | 94.3                 | 101.5               |
| Female Population 15-49 years (% of total population) | 2008    | 26.8     | 24.2   | 24.3                 | 25.8                |
| Life Expectancy at Birth - Total (years)              | 2008    | 51.0     | 54.5   | 76.7                 | 67.5                |
| Life Expectancy at Birth - Female (years)             | 2008    | 50.9     | 55.6   | 67.5                 | 80.3                |
| Crude Birth Rate (per 1,000)                          | 2008    | 24.7     | 35.7   | 11.0                 | 20.1                |
| Crude Death Rate (per 1,000)                          | 2008    | 14.1     | 13.0   | 10.4                 | 8.6                 |
| Infant Mortality Rate (per 1,000)                     | 2008    | 44.7     | 83.9   | 7.1                  | 48.5                |
| Child Mortality Rate (per 1,000)                      | 2008    | 64.4     | 137.4  | 8.8                  | 72.3                |
| Total Fertility Rate (per woman)                      | 2008    | 2.9      | 4.6    | 1.6                  | 2.5                 |
| Maternal Mortality Rate (per 100,000)                 | 2005    | 380.0    | 683    | 450                  | 9                   |
| Women Using Contraception (%)                         | 2000    | 44.4     | 29.7   | 61.0                 | 75.0                |
| <b>Health &amp; Nutrition Indicators</b>              |         |          |        |                      |                     |
| Physicians (per 100,000 people)                       | 2007    | 28.0     | 39.6   | 78.0                 | 287.0               |
| Nurses (per 100,000 people)                           | 2007    | 236.5    | 120.4  | 98.0                 | 782.0               |
| Births attended by Trained Health Personnel (%)       | 2006    | 94.0     | 51.2   | 59.0                 | 99.0                |
| Access to Safe Water (% of Population)                | 2006    | 96.0     | 64.3   | 84.0                 | 100.0               |
| Access to Health Services (% of Population)*          | 2004    | 95.0     | 61.7   | 80.0                 | 100.0               |
| Access to Sanitation (% of Population)                | 2006    | 47.0     | 37.6   | 53.0                 | 100.0               |
| Percent. of Adults (aged 15-49) Living with HIV/AIDS  | 2007    | 23.9     | 4.5    | 1.3                  | 0.3                 |
| Incidence of Tuberculosis (per 100,000)               | 2006    | 551.0    | 315.8  | 275.0                | 19.0                |
| Child Immunization Against Tuberculosis (%)           | 2007    | 83.0     | 83.0   | 89.0                 | 99.0                |
| Child Immunization Against Measles (%)                | 2007    | 79.0     | 83.1   | 81.0                 | 93.0                |
| Underweight Children (% of children under 5 years)    | 2004    | 5.9      | 25.2   | 27.0                 | 0.1                 |
| Daily Calorie Supply per Capita                       | 2004    | 2 084    | 2 436  | 2 675                | 3 285               |
| Public Expenditure on Health (as % of GDP)            | 2005    | 4.3      | 2.4    | 1.8                  | 6.3                 |
| <b>Education Indicators</b>                           |         |          |        |                      |                     |
| Gross Enrolment Ratio (%)                             |         |          |        |                      |                     |
| Primary School - Total                                | 2007    | 112.2    | 99.6   | 106.0                | 101.0               |
| Primary School - Female                               | 2007    | 112.0    | 92.1   | 103.0                | 101.0               |
| Secondary School - Total                              | 2005    | 76.5     | 43.5   | 60.0                 | 101.5               |
| Secondary School - Female                             | 2005    | 77.0     | 40.8   | 58.0                 | 101.0               |
| Primary School Female Teaching Staff (% of Total)     | 2007    | 77.6     | 47.5   | 51.0                 | 82.0                |
| Adult Illiteracy Rate - Total (%)                     | 2007    | 17.1     | 38.0   | 21.0                 | 1.0                 |
| Adult Illiteracy Rate - Male (%)                      | 2007    | 17.2     | 29.0   | 15.0                 | 1.0                 |
| Adult Illiteracy Rate - Female (%)                    | 2007    | 17.1     | 47.0   | 27.0                 | 1.0                 |
| Percentage of GDP Spent on Education                  | 2005    | 8.2      | 4.5    | 3.9                  | 5.9                 |
| <b>Environmental Indicators</b>                       |         |          |        |                      |                     |
| Land Use (Arable Land as % of Total Land Area)        | 2005-08 | 0.6      | 6.0    | 9.9                  | 11.6                |
| Annual Rate of Deforestation (%)                      | 2000-08 | 0.9      | 0.7    | 0.4                  | -0.2                |
| Annual Rate of Reforestation (%)                      | 2000-08 | ...      | 10.9   | ...                  | ...                 |
| Per Capita CO2 Emissions (metric tons)                | 2005-08 | 2.3      | 1.0    | 1.9                  | 12.3                |



Sources : ADB Statistics Department Databases; World Bank: World Development Indicators;

last update : March 2009

UNAIDS; UNSD; WHO; UNICEF, WRI, UNDP; Country Reports

Note : n.a. : Not Applicable ; ... : Data Not Available.

**Botswana – Morupule B Project**  
**ADB's portfolio in the country as at June 2009**  
**List of active projects (loans and grants) by Sector (million of UA)**

| Project Title  | Window   | Approved Date | Signature Date | Effectiveness Date | Completion Date | Approved Amount | Cancelled Amount | Disbursed Amount | Net Commitment | Disbursement Ratio (%) |
|--|----------|---------------|----------------|--------------------|-----------------|-----------------|------------------|------------------|----------------|------------------------|
| <b>Agriculture</b>   |          |               |                |                    |                 |                 |                  |                  |                |                        |
| Pandamatenga   | ADB Loan | 7-Sep-2008    | 28-Apr-2009    | Not yet effective  | 31-Dec-13       | 37.3            | 0.0              | 0.0              | 37.3           | 0.00                   |
| Capacity Building for MOA  | MIC      | 27-Feb-2007   | 17-May-2007    | 17-May-2007        | 31-Dec-09       | 0.3             | 0.0              | 0.2              | 0.3            | 71.02                  |
| Improved Water Management System for Pandamatenga                  | AWF      | 18-Jun-2007   | 12-Jul-2007    | 12-Jul-2007        | 31-Dec-09       | 1.1             | 0.0              | 0.8              | 1.1            | 74.42                  |
| Agricultural Sector Review   | MIC      | 16-Feb-2007   | 14-May-2007    | 17-May-2007        | 30-Apr-09       | 0.5             | 0.0              | 0.1              | 0.5            | 19.37                  |
| <b>Sub-Total: Agriculture</b>                                      |          |               |                |                    |                 | <b>39.1</b>     | <b>0.0</b>       | <b>1.1</b>       | <b>39.1</b>    | <b>2.77</b>            |
| <b>Transport</b>   |          |               |                |                    |                 |                 |                  |                  |                |                        |
| Kanzangula Bridge  | MIC      | 5-Feb-2007    | 4-Dec-2007     | 4-Dec-2007         | 31-Dec-09       | 0.6             | 0.0              | 0.5              | 0.6            | 86.60                  |
| Kanzangula Bridge  | IPPF     | 1-Dec-2006    | 17-May-2007    | 17-May-2007        | 31-Dec-10       | 1.5             | 0.0              | 0.4              | 1.5            | 27.75                  |
| <b>Sub-Total: Transport</b>  |          |               |                |                    |                 | <b>2.1</b>      | <b>0.0</b>       | <b>0.9</b>       | <b>2.1</b>     | <b>44.97</b>           |
| <b>Multi-Sector ( excl. Economic Diversification Support Loan)</b> |          |               |                |                    |                 |                 |                  |                  |                |                        |
| Institutional strengthening of local authorities                   | MIC      | 31-Jan-2008   | 11-Sep-2008    | 21-May-2009        | 31-Dec-09       | 0.3             | 0.0              | 0.0              | 0.3            | 0.00                   |
| Vision 2016  | MIC      | 1-Nov-2008    | 1-Jun-2008     | 21-May-2009        | 1-Dec-10        | 0.2             | 0.0              | 0.0              | 0.2            | 0.00                   |
| Corporate Governance Code  | MIC      | 1-Mar-2007    | 1-Mar-2007     | 2-Jul-2007         | 31-Dec-08       | 0.2             | 0.0              | 0.0              | 0.2            | 0.00                   |
| <b>Sub-Total: Multi-Sector</b>                                     |          |               |                |                    |                 | <b>0.7</b>      | <b>0.0</b>       | <b>0.0</b>       | <b>0.7</b>     | <b>0.00</b>            |
| <b>Total excl. Economic Diversification Support Loan</b>           |          |               |                |                    |                 | <b>41.8</b>     | <b>0.0</b>       | <b>1.3</b>       | <b>1.8</b>     | <b>72.22</b>           |
| <b>Economic Diversification Support Loan (EDSL)</b>                |          |               |                |                    |                 |                 |                  |                  |                |                        |
| EDSL program   | ADB      | 2-Jun-2009    | --             | --                 | --              | 1,000.0         | --               | --               | --             | --                     |
| <b>Grand Total</b>   |          |               |                |                    |                 | <b>1,041.8</b>  | <b>0.0</b>       | <b>1.3</b>       | <b>1.8</b>     | <b>72.22</b>           |
| <b>MIC Total</b>   |          |               |                |                    |                 | <b>2.1</b>      |                  |                  |                |                        |
| <b>ADB Total</b>   |          |               |                |                    |                 | <b>1,037.3</b>  |                  |                  |                |                        |
| <b>AWF Total</b>   |          |               |                |                    |                 | <b>1.1</b>      |                  |                  |                |                        |
| <b>IPPF Total</b>  |          |               |                |                    |                 | <b>1.5</b>      |                  |                  |                |                        |

**Notes:**

Mmamabula Independent Power Producer Project currently under consideration by OPSM. Amount to be provided will depend on single obligor limit and the Bank's appetite

**Botswana – Morupule B Project**  
**Key related projects financed by the Bank and other development partners in the country**

| <b>Funding Organisation</b>  | <b>Type of Assistance</b>       | <b>Name of Project</b>   | <b>Amount</b>  | <b>Year</b>   |
|--|---------------------------------|--|----------------|---|
| International Atomic Energy Agency                                       | Technical Assistance            | Energy Economics and Electricity Expansion Planning                      | USD 120,000    | Started in 2007 expected to complete in 2009; though continuation is expected |
| GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit) (GmbH) Germany | Financial & Technical Expertise | Biomass Energy Strategy Development                                      | EUR 100,000    | 2007/08   |
| USTDA  | Financial & Technical Expertise | Financial advisory assistance for the proposed Mmamabula Project         | USD 359,921    | 2007  |
| UNDP/GEF   | Financial assistance            | Implementation of the Renewable energy based electrification Programme   | USD 20 million | Started in 2006 expected to complete in 2010                                  |
| DANIDA (Danish International Development Assistance, Denmark)            | Financial and Technical         | Energy Efficiency and Energy Conservation in Building Sector in Botswana | DKK 10,174,157 | Started in June 2004<br><br>Expected to complete in 2009                      |

**Morupule B Project**  
 Map of Botswana showing key generation and transmission assets (proposed and existing)

