

RENEWABLES READINESS ASSESSMENT BOTSWANA



EXECUTIVE SUMMARY

This Renewables Readiness Assessment (RRA) identifies **13 key actions** that could significantly impact the energy transition in Botswana:

- 1) **Promote and facilitate implementation of a clear long-term vision for renewable energy development**
- 2) **Operationalise the regulatory authority**
- 3) **Establish a grid code that is conducive to variable renewable power**
- 4) **Revise the tariff-setting structure**
- 5) **Define a clear regulatory framework to manage risks involved in private sector participation**
- 6) **Perform a location-specific (pre-feasibility) study for renewable energy generation and streamline permitting processes**
- 7) **Conduct a study on the capability of the grid to absorb power from VRE sources**
- 8) **Integrate rural electrification strategies into a single, comprehensive document and consolidate rural electrification activities**
- 9) **Support the growth of solar rooftop and home systems through strong incentives and policy instruments**
- 10) **Develop a strategy for renewable energy and agriculture**
- 11) **Develop a strategy for renewable energy in the transport sector**
- 12) **Promote the role of renewable energy for heating, cooling and cooking**
- 13) **Develop local human capacities along the project value chain**

EXECUTIVE SUMMARY

Botswana is an arid to semi-arid country of 582,000 square kilometres located in Southern Africa. It is a landlocked developing and upper-middle-income country with a population of 2.3 million inhabitants, of which 30% live in rural areas. Access to electricity stands at 65% (81% in urban areas and 28% in rural areas). The country's total energy supply of 2.9 Mtoe in 2017 consists of oil products (35%), coal (44%), (traditional) biofuels and waste (19%) and imported electricity (2%). Electricity is mainly produced from coal, or from petroleum products imported mainly from South Africa.

Botswana's gross domestic product (GDP) has almost tripled since 2000, whilst its total final energy consumption (TFEC) has increased by 45%. Botswana is gradually recovering from an economic downturn in 2015, during which the country suffered from a negative growth owing to a decline in diamond exports, severe drought and energy shortages. Subsequently, the Government of Botswana adopted an Economic Stimulus Programme in order to boost growth and promote both economic diversification and job creation. The recovery has been supported by the development of non-mining sectors such as communications, trade, transport and tourism. Although diamond mining remains the primary source of wealth and development, in recent years the tourism sector has expanded thanks to the country's wildlife preservation practices and large game refuges (prior to the onset of the COVID-19 pandemic in 2020).

As is the case in most countries of the region, Botswana's power system is characterised by unreliable power supply, lack of investment, poor maintenance and high service costs. To meet its peak power demand, Botswana imports power from the Southern Africa Power Pool (SAPP) – mainly from South Africa – and when imports are not available, resorts to the use of costly backup diesel power plants.

Botswana's total primary energy supply (TPES) is fossil-based and largely reliant on oil products and coal, complemented by biomass and waste energy. A large proportion of TFEC comes from biomass energy in the form of traditional wood fuel (27.8%). Botswana relies heavily on fossil fuels for its electricity generation, depending on two major coal-fired power plants (Morupule A and B) and a number of diesel plants. Until recently, Botswana relied on electricity imports to meet up to 94% of its demand. With the ongoing recovery of the Morupule B plant, the share of electricity imports in total supply has decreased to about 15%.

The country possesses considerable renewable energy potential, most notably solar, wind and bioenergy; however, these remain largely unexploited, despite the country's ambitious plans for integrating renewable energy into its energy system. In the Integrated Resource Plan (IRP) launched in December 2020, it was announced that renewable energy should account for at least 15% of the energy mix by 2030, whilst the country's Vision 2036 calls for a 50% renewable energy contribution to the energy mix by March 2036.

With a view to supporting progress toward these targets, and more generally to assist Botswana on its path towards the integration of a higher, more diversified share of renewable energy in its national energy mix, this Renewables Readiness Assessment (RRA) identifies the following critical actions that could significantly impact the energy transition in Botswana:

1. Promote and facilitate implementation of a clear long-term vision for renewable energy development

Steady renewable energy capacity increases require a clear vision, embodied in appropriate and implementable planning. In this regard, Botswana can succeed in its uptake of renewable energy by transforming vision and roadmaps into binding commitments that contain specific renewable energy technology targets. It is also important that the targets outlined across different policy and strategy documents are aligned to provide a consistent, long-term signal to potential investors.

2. Operationalise the regulatory authority

Botswana has embarked on the path to regulatory reform, embodied by the establishment of the Botswana Energy Regulatory Authority (BERA) in 2017; however, the Authority remains largely non-operational. Operationalising BERA will require a guaranteed, sustainable and independent budget, as well as sufficient political independence and capacity to hold utilities to account for their financial and operational performance.

3. Establish a grid code that is conducive to variable renewable power

Under the authority of the BERA, grid codes prioritising access to the grid for electricity generated from renewables, as well as its dispatch based on marginal cost, should be developed to govern all current and future electricity generators. These codes should replace the BPC operational manual that currently governs transmission and will serve to provide transparency concerning grid access by independent power producers (IPPs). The BPC is currently a vertically integrated utility, potentially transitioning towards a single buyer model.

4. Revise the tariff-setting structure

The process of defining tariffs now falls under the supervision of BERA; they will be set based on a transparent methodology applied by its Electricity Committee that will include some level of performance management. The current price setting mechanism is apparently based on 'rate of return' rather than 'incentive-based' regulation, raising concerns regarding the pass-through of inefficiencies to end-consumers in Botswana. Now that the Botswana Power Corporation (BPC) has achieved full cost recovery, some incentives for performance management should be introduced to the methodology, reflecting aspects such as quality of service and new policy paths (concerning electrification, GHG emissions, security of supply, etc.). There is also scope for customising tariffs to match the spatial or temporal profile of consumption.

5. Define a clear regulatory framework to manage risks involved in private sector participation

Although improving, the recourse to BPC for the procurement and off-take relating to the national renewable energy strategy has limitations. In theory, IPPs could participate in adding new generation capacity; but in practice, power purchase agreements (PPAs) have yet to materialise. A key issue associated with IPP contracts is the need to balance risks against off-take, the absence of which may lead to windfall profits from unaffordable tariffs at one end of the spectrum, or the inability of the private sector to engage into the programme – and the stalling of the private sector development of renewable energy – at the other. A regulatory framework that balances the risks and rewards between the IPP and BPC therefore must be defined and developed.

6. Perform a location-specific (pre-feasibility) study for renewable energy generation and streamline permitting processes

Experience has demonstrated that efficient investments will build on an integrated spatial master plan. Investments in renewable energy generation require the collection of 1-2 years of bankable resource data, and potentially investments in distribution or transmission assets. Timely investments therefore require careful strategic planning in future project locations to avoid uncertainties, and subsequent delays and higher costs in the procurement phase. The first step is to perform a detailed geospatial analysis (pre-feasibility), as proposed by IRENA and the World Bank.

Also, the permitting process in Botswana must be made more transparent; for example, by establishing frameworks for environmental impact studies, grid connection studies and cost provisions for grid connections.

7. Conduct a study on the capability of the grid to absorb power from VRE sources

In addition to location-specific pre-feasibility studies, a comprehensive dynamic grid impact study is required, based on dynamic (time-dependent) simulations with detailed cost assumptions that consider new technologies and advanced dispatch strategies. A means to regularly update the IRP based on these findings is also needed, building on grid stability studies of the power system and realistic assessments of the penetration potential of renewable energy – including grid reinforcement and storage on a cost-efficiency basis. Potentially, the study could also help BERA develop grid codes and regulations for merit-order dispatch, accounting for the specific characteristics of variable renewable energy (VRE) sources.

Strategic planning built on an integrated spatial master plan supported by credible data will facilitate timely investments in renewable energy.

8. Integrate rural electrification strategies into a single, comprehensive document and consolidate rural electrification activities

The need to add both small-scale distributed generation at scale, and a rural electrification programme to the IRP has also been suggested. During stakeholder consultations, the mini-grids, smart grids, waste-to-energy and solar home systems market segments were seen as potentially large, untapped market segments able to drive investment, jobs, entrepreneurship and gender equity. Limited private sector engagement and competition exists in this sector in Botswana, which sets it apart from current practices across sub-Saharan Africa.

9. Support the growth of solar rooftop and home systems through strong incentives and policy instruments

Guidelines for rooftop solar installation are undergoing development and will provide an alternative mechanism to increase the uptake of solar energy as well as facilitate private sector participation. Attractive incentives should be put in place to support the adoption of this technology. Policy instruments such as net-metering and feed-in tariffs for roof-top solar projects would help facilitate market access for investors. The government also needs to finalise the feed-in tariffs.

The growth in demand for solar home systems was highlighted during stakeholder workshops. Dedicated planning, business models and implementation mechanisms supporting private sector engagement should be developed to promote this market segment. Furthermore, the government should establish national quality standards aligned with international standards, enhance local certification capabilities, facilitate affordable payment schemes and consider gender equity in the energy sector.

10. Develop a strategy for renewable energy and agriculture

The agriculture sector in Botswana is predominantly subsistence based, mainly due to traditional farming methods, regular droughts and limited infrastructure. In this sector, solar water pumping, biogas for cooking and lighting, and bioenergy (biodiesel) for transport were identified as relevant areas to explore. To improve uptake of these energy services, financial resources should be mobilised; affordable, locally available technologies should be developed; and regulations and incentives established.

11. Develop a strategy for renewable energy in the transport sector

No incentives currently exist to encourage bioenergy in transport, despite the existence of biodiesel standards, given the absence of specific legislation to trigger enforcement. The local market is considered to be small and unable to achieve economies of scale due to limited use in the transport sector. The Department of Energy (DOE), with technical support from the University of Botswana (UB) and the Department of Agricultural Research (DAR) of the Ministry of Agricultural Development and Food Security, are engaged in a research project that seeks to stimulate the development of the local Biofuel industry.

In this sector, solar electric navigation was also mentioned in consultations, as a demonstration is ongoing for solar tourist boats. However, the potential for market scale-up is limited. Currently, no plans for electric road transportation have been identified, nor has an electric vehicle strategy been defined. Considering the strong dynamics of this market worldwide, it is suggested that Botswana develop an e-mobility strategy.

12. Promote the role of renewable energy for heating, cooling and cooking

The need for increased uptake of renewable based heating, cooling and cooking was highlighted in the RRA stakeholder workshops. This can be achieved by raising awareness of the technologies among residents, building local manufacturing and installation capacities, and introducing the skills needed to develop bankable proposals to increase access to finance by renewable energy companies. Local financial institutions should also be encouraged to provide finance to support private investments in renewable energy solutions. This can be facilitated by providing training to financial institutions on renewable energy project appraisals. Financial incentives can also be provided by government to ensure that citizens can afford renewable energy services.

13. Develop local human capacities along the project value chain

There are also opportunities to develop competencies in the maintenance and repair of renewable energy equipment, particularly given the severe lack of training and availability of trained personnel in remote areas. Private sector engagement in the management of training facilities can be enabled through public-private partnerships (PPPs) for off-grid supply and mini-grids.

Also, building local capacity within BPC and BERA is important and will provide Botswana with the technical capacity to operate a power system with high shares of renewables. Capacity building should include capabilities in power system modelling, simulation studies, reserve sizing, flexibility analysis, economic dispatch and VRE forecasting, etc., so that Botswana can identify and address future challenges to the system.



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The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future. It serves as the principal platform for international co-operation, a centre of excellence and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.

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