



# **BOTSWANA RENEWABLE ENERGY STRATEGY AND ROAD MAP**

**PRESENTED TO THE RENEWABLE ENERGY DIALOGUE  
BETWEEN BOTSWANA AND ITALY  
GICC, GABORONE.**

**06<sup>th</sup> JULY 2017**

**DEPARTMENT OF ENERGY  
MINISTRY OF MINERAL RESOURCES, GREEN  
TECHNOLOGY & ENERGY SECURITY**

# 2.0

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# 4.0 Introduction and Background

1. Botswana has abundant solar energy resources, receiving over 3,200 hours of sunshine per year,
2. Therefore, the Government undertook a number of studies and projects, including;
  - i. Renewable Energy Feed-in Tariffs (2011)
  - ii. Solar Water Heating (2005)
  - iii. Biomass Potential (2007, 2009)
  - iv. Prefeasibility and feasibility studies for Concentrated Solar Thermal (CST) Technologies (2009, 2013), and
  - v. Construction of a 1.3MW solar photo-voltaic plant (completed in 2012) and
  - vi. Provision of RE products and services through BPC Lesedi (solar home systems; efficient biomass cooking stoves, rechargeable lanterns, etc.)

## 5.0 MOTIVATION FOR THE RE STRATEGY & RELATED STUDIES

### HOWEVER:

1. The contribution of RE in the energy supply continues to be insignificant at less than 1%.
2. Continuous imports of expensive power
3. Unclear roadmap to guide the GoB and the private sector on investment and utilization of RE technologies.
4. Need to adhere to international obligations on climate change.
5. Lack of informed and ministry wide approved RE targets.

## 6.0

## ACTION TAKEN BY MMGE

Therefore, MMGE embarked further on a number of studies, including:

- i. Botswana RE Strategy (World Bank)
- ii. Jatropha Propagation and Field Trials
- iii. Green Rural Electrification Feasibility Study (Cronimet and GIZ);
- iv. Botswana Sustainable Energy For All Action Agenda (AfDB)

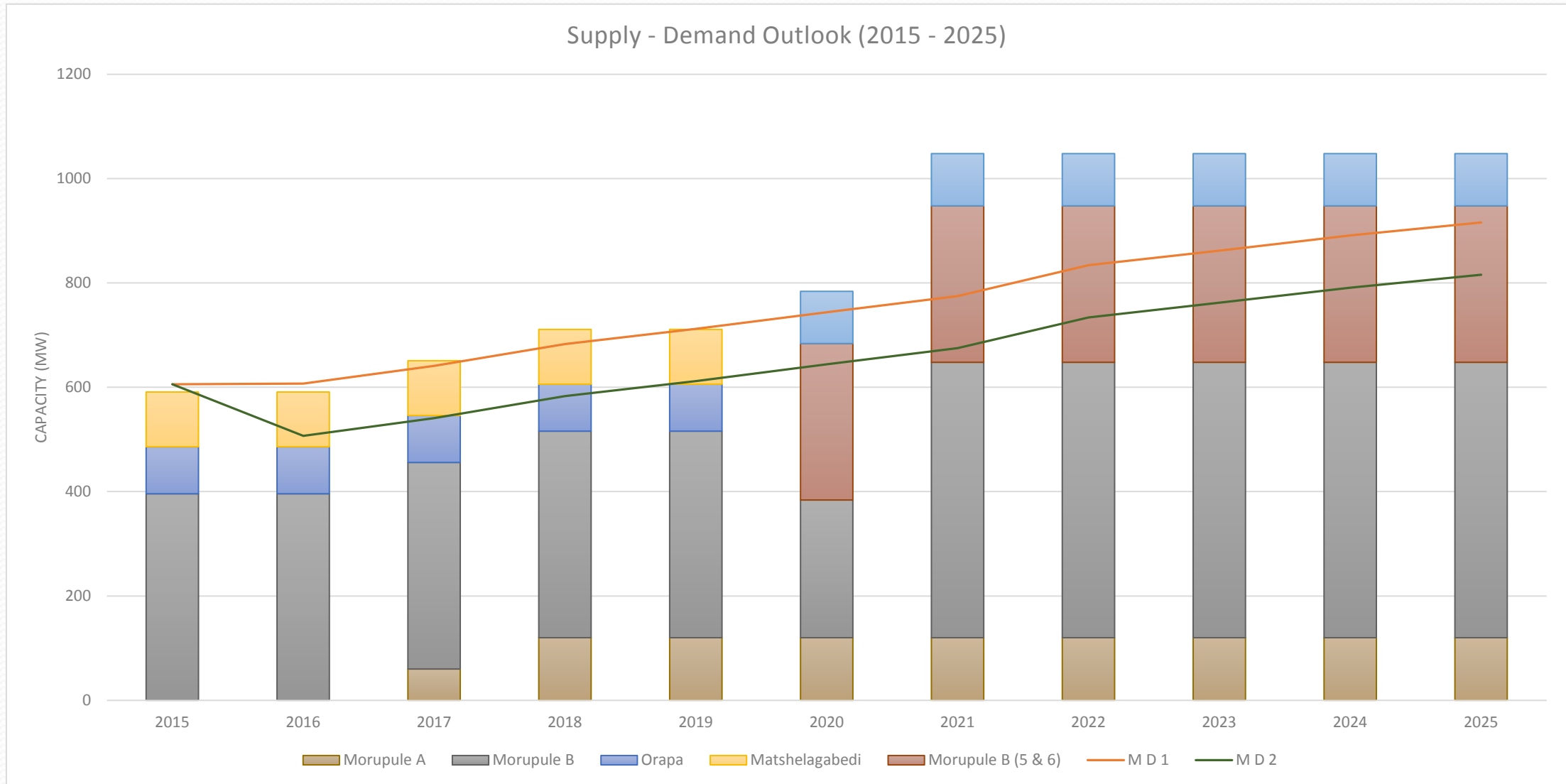
## **7. BOTSWANA RE STRATEGY (WORLD BANK):**

### **OBJECTIVE:**

**Provide support to Government of Botswana in developing a framework to unlock country's RE potential**

- a) Resource assessments
  - i. Solar
  - ii. Wind
  - iii. Biomass
- b) Power Sector Expansion modeling
- c) Roadmap

# 12. POWER SECTOR EXPANSION PLAN)





# 13. The Carbon Price

- Rewards the lower CO<sub>2</sub> emission impact of renewable energy generation when compared with traditional fossil fuels e.g. coal
  - i.e. imposes a cost for emitting CO<sub>2</sub> into the atmosphere
- Applied to respective generation technology options during modelling
  - Least-cost technology then selected for procurement
- Cost of externalities can be bought down by global funds
- Including cost of carbon emissions in least cost modelling is current standard practice

## 14. FINDINGS (Power sector Expansion)

- Coal is least cost option when externality costs are neglected
  - Standard practice is to include externality costs
- Assuming good performance of Morupule B, addition of units 5 & 6 provide sufficient capacity for meeting domestic demand
- With carbon price at RSA Price Scenario, renewables deployment from mid-2020s

## 15. GRID TIED UTILITY SCALE SOLAR POWER PLANT

### DISCUSSION

- a. Cost of renewables falling quickly and technologies being developed to enable storage and improve dispatch ability**
  - i. Botswana needs to get prepared to reap maximum benefit
  - ii. Requires RE policy and targets to work towards and to contribute to international climate change obligations
  - iii. International funding for coal-based generation on the decline
- b. Under NP Scenario renewable energy generation could make up more than 20% of generation mix by 2030.**
- c. Solar PV and CSP preferable to imports and better option to mitigate energy supply shortfalls should coal capacity expansion run behind expectations**

## 16. FINDINGS OF THE RE STRATEGY ON – OFF GRID SOLAR (STAND ALONE SOLAR HOME AND INSTITUTIONAL SYSTEMS )

1. 145 000 out of 242 000 households can be reached by end of 2021 if this initiative is started in 2017.
2. This equates to 60% of total off-grid market or a total installed capacity of approximately 30MW.
3. Based on affordability and power requirements, the majority of the households fall within tier 3 under the UN SE4ALL which entails multi-point lighting and/or cell phone or radio charging capabilities plus TV, fan, and low power appliances (e.g. refrigerator)
4. Preferred implementation model is through a **joint venture** with a contractual partnership between the government and a competitively-selected experienced industry player. The total estimated cost of the project is 50 Million (US Dollars).

## 17. ACTION BEING TAKEN ON THE STAND ALONE SOLAR HOME AND INSTITUTIONAL SYSTEMS

1. Joint Venture model between the GoB and private sector.
2. Immediate Rollout of products and packages to provide energy services to 145 000 households (60% of off-grid customers) in 5 years.
3. Ensure that 100% of public facilities (schools, health posts, and local government facilities) have access to modern energy services by 2021
4. Exploring sources of co-funding the project.

## 18. GREEN RURAL ELECTRIFICATION FEASIBILITY STUDY (CRONIMET, A GERMAN CONSULTANCY COMPANY AND GIZ).

(1 of 3.)

### OBJECTIVE

- To investigate the feasibility of hybridizing diesel powered mini grids with RE solutions.

## 19. FINDINGS OF THE GREEN RURAL ELECTRIFICATION FEASIBILITY STUDY (MINI-GRIDS) (2 of 3.)

1. Six sites were selected as a representative sample
  - i. Seronga Site – covering 10 villages
  - ii. Khwee Site – covering 3 villages
  - iii. Mogome Site – covering 2 villages
  - iv. Sepako Site - covering 3 villages
  - v. Zutswa Site - covering 1 village
  - vi. Bere Site - covering 1 village
  
2. Will result in close to 60% savings on the current per unit cost of diesel power generation of BWP 3.22 per kWh (Seronga Plant) excluding lubrication costs and maintenance.

## 20. ACTION BEING TAKEN ON GREEN RURAL ELECTRIFICATION (3 of 3.)

1. To proceed with the implementation of the six selected sites through engagement of an IPP.
2. Indicative tariff for the sampled sites
  - i. Seronga Site – P1.17/kWh
  - ii. Khwee Site – P1.09/ kWh
  - iii. Mogome Site – P1.29/kWh
3. More mini grids will be developed to increase the contribution of RE, increase access and meet any other supply demand mismatches.
4. PV/Diesel hybrid plants will be implemented immediately for them to be operational from June 2019. The transactional advisory cost will be funded from the current allocation of DDF. More detailed costs will be determined during the engagement process of the IPP.



## 21 Biofuels Development (Jatropha) (1 of 2)

1. GoB and Japanese Govt has undertook 5 year research on Jatropha (April 2012 – April 2017) – Southern
2. Preliminary findings have shown the highest yielding tree giving 739 seeds.
3. This translates to production of 450 liters of biodiesel per hectare.
4. Attainment of higher yields would lead to scale-up and commercial production

# 22 Way Forward: Biofuels Development (Jatropha)

## (2 of 2)

1. Findings of the research will be used to scale-up and commercialize the production of biofuels in Botswana through
  - i. Cultivation of small to medium scale commercial Jatropha Plantations;
  - ii. Breeding and evaluation of high yield & stress tolerant Jatropha varieties (incl transfer of GMO from Japan to Botswana)
  - iii. Biodiesel Processing through a Scalable Automated Multiple Feedstock Biodiesel Processing Plant for Jatropha, indigenous oil crops and beef tallow;
  - iv. Blending and on-road vehicles testing;
  - v. Evaluation of socio-economic and environmental impacts of Jatropha biodiesel oil production; and
  - vi. Create enabling environment for commercializing biodiesel production and private sector engagement

# 23. Energy Efficiency Programme

## 1) PUBLIC BUILDINGS

- i. Energy Efficiency Retrofitting (Audits done in 7 Buildings)
- ii. Annual Electricity Bill: P1.66 Million, Potential Annual Energy Savings: P613 397.64
- iii. Energy Audits 2017/18: (20 Buildings)

## 2) ENERGY SAVINGS FOR UTILITIES

2017/18 Audits for booster pump stations, HVACs etc.

## 3) TRANSPORT SECTOR

- i) Public awareness campaigns
- ii) Studies to inform policy making

## **24. Increased RE Utilization**

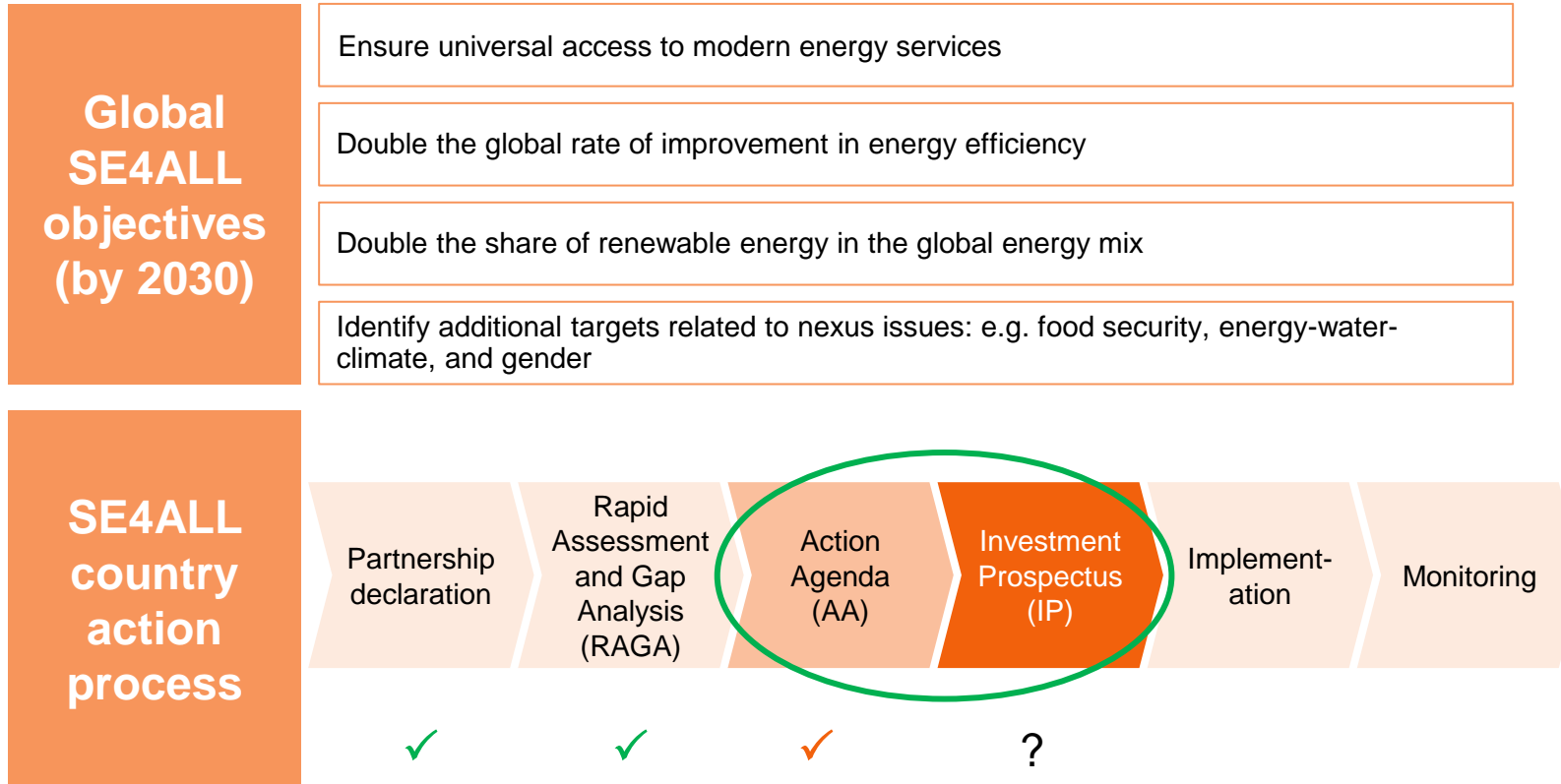
### **1) Solar Water Heating (SWH) Programme**

- i. 2015 Presidential Directive**
- ii. Assessment of installed SWH systems;**
- iii. Collaboration: with UB and Austria (SOLTRAIN)**

### **2) PV Solar Water Pumping Programme**

- i. collaboration with WUC**
- ii. Mini grids around boreholes**

# 25. SE4ALL INVOLVES GLOBAL GOALS THAT INSPIRE COUNTRY ACTION PROCESSES



# 26.

# SE4ALL

# NEXT STEPS

## Validation of AA, IP, and future SE4All Coordination

### Finalise Action Agenda:

- Finalise SE4All targets
- Produce 2<sup>nd</sup> draft AA for technical and high-level validation
- Final AA submitted for formal government approval

### Finalise Investment Prospectus:

- Finalise prioritisation of projects
- Develop IP
- Draft IP for technical and high-level validation
- Submission of final IP

### Establish M&E procedures (DoE)

- Review and update the targets & prioritisation of actions
- Monitor and evaluate progress on actions and policies
- Monitor progress of Investment Prospectus

### Oversight and coordination

- Standing committee of MMGE, Ministry of Environment, Ministry of Finance, NSO.

## 27. ROADMAP

- a) Roadmap enables Botswana to benefit from the rapid technological developments that are bringing renewables at par with conventional base load technologies
  - i. Policy
  - ii. Targets and implementation plan
- b) Responsibility for planning and implementation should be clearly laid out in the legislative framework
  - i. Planning should be a precondition for procurement approval
  - ii. Conduct necessary preparation to reduce project development risk and costs associated with lack of clarity when developers are selected
  - iii. Dedicated coordinating team (IPP unit) within Ministry (or DoE) with support of international transaction advisors (legal, financial, technical)
  - iv. Procurement to adhere to principles of economy, efficiency and transparency (in region Zambia and South Africa provide lessons - superior outcomes to direct contracting)
- c) Take advantage of global funds (e.g. Green Climate Fund) which buy down the cost of externalities like climate change implications

1. RE definitely has a role to play in the overall country's energy mix as they;
  - i. Increase access to modern energy in areas where there is no grid and where it is uneconomic to connect to the grid.
  - ii. Diversify energy sources and ensure security of supply
  - iii. Set the country into a low carbon development path.
  - iv. Ensure that the country meets its international obligations on climate change.
  - v. Stimulate the creation of 'green' jobs,
  - vi. promote a competitive manufacturing industry and
  - vii. allow for revenues to be kept within the country.



2. In the pursuance of RE portfolio due regard should be given to the following factors that influence its role:
  - i. Abundance of the coal resource
  - ii. Existence of more efficient combustion technologies
  - iii. Competitiveness of current and future tariffs to avoid or limit subsidies
  - iv. Deployment of RE technologies in relation to the geographical spread of the load centres
  - v. Capacity and capability to develop and enforce RE standards and specifications



**27**

**THANK YOU**