Deliverable 2.1

Botswana
Technology Needs Assessment Report
Climate Change Mitigation
ENERGY SECTOR
September 2022

UN environment programme | copenhagen climate centre
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CTCN
CLIMATE TECHNOLOGY CENTRE & NETWORK

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ACRONYMS AND ABBREVIATIONS

A	Ampere
BEMS	Building Energy management System
BERA	Botswana Energy Regulatory Authority
BITRI	Botswana Innovation Technology and Research Institute
BIUST	Botswana international University of Science and Technology
BOBS	Botswana Bureau odf Standards
BPC	Botswana Power Corporation
BUR	Biennial Update Report
C&I	Commerce and Industry
CBM	Coal Bed methane
CFL	Compact Fluorescent Lamp
COP	Conference of Parties
CP4	Conference of Parties 4
CSP	Concentrated solar Power
DBES	Department of Building Engineering Services
DMS	Department of Meteorological Services
DOE	Department of Energy
EE	Energy Efficiency
EMS	Energy management System
GCF	Green Climate Fund
GEF	Global Environmental Facility
GHG	Green house HGas
GJ	Giga Joule
GW	GigaWatt
HEPS	High Energy Performance Standards
HVAC	Heating Ventilation and Air Conditioning
INDC	Intended National Determined Contribution
IRP	Integrated Resource Plan
kW	Kilo watt
LED	Light Emitting Diode
LFG	Land Fill gas
MCA	Multicriteria Analysis
MENT	Ministry of Environment, Natural Resources and Tourism
MEPS	Minimum Energy Performance Standards
MSW	Municipal Solid Waste
MW	Mega watt
NAMA	Nationally Appropriate Mitigation Actions
NDC	Nationally Determined Contribution
NDC-D2	Nationally Determined Contribution- Deliverable 2
NDP	National Development Plan
NEES	National Energy Efficiency Strategy
NEP	National Energy Policy
PfC	Power factor Correction
PV	Photo Voltaic
RE	Renewable Energy
RES	Renewable Energy Strategy
RTS	Roof Top Solar
SADC	Southern African Development Community

SDG	Sustainable Development Goal
Se4ALLE	Sustainable Energy for All
SME	Small and Medium Enterprises
SOLTRAIN	Southern African solar thermal training & demonstration initiative
SSDG	Small Scale Distributed Generation
TAP	Technology Action Plan
TNA	Technology Needs Assessment
TNC	Third National Communication
TORs	Terms of Reference
UNDP	United National Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WG	Working Group

EXECUTIVE SUMMARY

This energy sector Deliverable 2.1 Report for Botswana has been prepared to support Botswana to update its Technology Needs Assessment (TNA) of 2004 and develop a technology road map for prioritized technologies to address climate change challenges in the most critical sectors of the economy.

This TNA exercise follows the GCF support that was provided to Botswana as part of their Readiness to participate effectively in accessing GCF funding. Botswana mapped their needs to conduct a TNA for Botswana encompassing the three stages of TNA Report, Barrier Analysis Report and Technology Action plan. This report comprises the first stage towards preparing the TNA Mitigation Report under Activity 2.2, focussing on the energy sector.

In the GCF exercise, Botswana identified Renewable Electricity, Energy in the Built Environment, and Industry Energy Process as the target subsectors for this TNA mitigation analysis

The initial exercise conducted by the contracted national energy sector expert entailed reviews of national, regional and international relevant policies/strategies/plans and technology sources to inform the final choice of sub-sectors and a potential list of technologies that could eventually be prioritized for the TNA Report.

The process to scope the sub-sectors and technologies, was participatory involving the 8 key energy sector stakeholders that included the Department of Energy (DoE), the electricity utility- BPC, the energy regulatory authority-BERA, Department of Infrastructure Development- Buildings (DID), Botswana Bureau of Standards (BOBS), technology Research institute (BITRI), Botswana International University of Science and Technology (BIUST), Business Botswana entity (Steam energy) and Solar Industry association of Botswana. The principals of these institutions nominated Working Group Members totalling 15 since some organizations presented two members. The WG work with the national energy sector expert to deliberate on the sub-sector scoping and technology prioritization process.

Following stakeholder consultations and a review of the existing national development, climate change, and energy policies the sub-sectoral focus within the energy sector is still on Renewable Electricity, Energy in the Built Environment and Industry Energy Process as the target subsectors for this TNA mitigation analysis.

1 INTRODUCTION

1.1 About the TNA project

Technology transfer has been under focus since the Rio Summit in 1992, where issues related to technology transfer were included in Agenda 21 as well as in Articles 4.3, 4.5 and 4.7 of the United Nations Framework Convention on Climate Change (UNFCCC). These were subsequently discussed in Conference of Parties 1 (COP 1) in Berlin and COP 4 in Buenos Aires with Decision 2/ CP4 requiring the Global Environment Facility (GEF) to provide funding to developing country Parties to enable them identify and submit to the COP, their prioritised technology needs, especially as concerns key technologies needed in particular sectors of their national economies conducive to addressing climate change and minimising its adverse effects and GHG emissions.

Following this, GEF provided funding to 92 countries between 2000 and 2004 for the first round of Technology Needs Assessments (TNAs) through its enabling activities phase II (also known as "top-ups") programme. It is through this, that the Government of Botswana conducted it's first TNA in 2004. This current TNA initiative is supported through the Climate Technology Centre and Network (CTCN) using the Green Climate Fund (GCF). The proposal to update the Technology Needs Assessment (TNA) project was developed and submitted to the Green Climate Fund (GCF) by the National Designated Authorities in Botswana, the Ministry of Finance and Economic Development in Botswana, in collaboration with the National Designated Entity to the UNFCCC, the Botswana Institute for Technology Research.

The assessments involve amongst others, in-depth analysis and prioritisation of technologies, analysis of potential barriers hindering the transfer of prioritised technologies as well as issues related to potential market opportunities at the national level. National Technology Action Plans (TAPs) agreed by all stakeholders at the country level are prepared consistent with both the domestic and global objectives. Each TAP, which will outline essential elements of an enabling framework for technology transfer consisting of market development measures, institutional, regulatory and financial measures, and human and institutional capacity development requirements, will also include a detailed plan of action to implement the proposed policy measures and estimate the need for external assistance to cover additional implementation costs. Thus, the detailed plan of action will serve as the base for the subsequent preparation of fundable project ideas.

TNAs are central to the work of Parties to the Convention on technology transfer and present an opportunity to track an evolving need for new equipment, techniques, practical knowledge and skills, which are necessary to mitigate GHG emissions and/or reduce the vulnerability of sectors and livelihoods to the adverse impacts of climate change.

1.2 Botswana TNA Project Context

Botswana participated in the 2000-2004 Phase and has a standing TNA report (2004). The purpose of this TNA project is to support Botswana update its Technology Needs Assessment (TNA) of 2004 and develop a technology road map for prioritized technologies to address climate change challenges in the most critical sectors of the economy.

The project will deliver the following three outcomes:

- Outcome 1. Institutional capacity and coordination mechanisms in place to govern and coordinate climate action and finance

- Outcome 2: Country Programming process that will contribute to the development of short-term and long-term solutions that aid climate change resilience and build the necessary capacity in terms of environmental systems
- Outcome 3: Climate finance strategies strengthened, private sector mobilised, and project pipeline enhanced.

These outcomes will be achieved by providing support:

1. To identify and prioritize through country-driven participatory processes, technologies that can contribute to mitigation and adaptation goals of the participant countries, while meeting their national sustainable development goals and priorities (TNA).
2. To identify barriers hindering the acquisition, deployment, and diffusion of prioritized technologies.
3. To develop Technology Action Plans (TAP) including policy briefs specifying activities and enabling frameworks to overcome the barriers and facilitate the transfer, adoption, and diffusion of selected/prioritized technologies in Botswana.

Further, the TNA process will develop Sectoral Policy Briefs and Financial Support recommendations for attracting funding to implement selected technologies in priority areas of national relevance and engaging the private sector.

This report presents the climate change Mitigation aspects for Botswana for the energy sector.

1.3 Existing National development, energy and climate change policies

This Chapter examines the various development, energy sector and climate change policy instruments that have been produced after TNA 2004. These instruments informed the updating of the Botswana TNA in relation to climate change mitigation and how the updated TNA can enhance national development priorities and meet relevant regional and international goals.

The section below presents the relevant national development objectives, energy sector policy instruments and climate change policy, strategies, Acts and how all these three facets of the economy can inform the development of the Botswana TNA.

1.3.1 National Development Objectives

Vision 2036 – Achieving Prosperity for All

Botswana's Vision 2036 sets a target of 50% renewable in the electricity system by 2036. In the longer-term, it is anticipated that renewable energy will make a significant contribution towards Botswana's greenhouse gas emissions targets, which, under the UNFCCC, has been set at 15% reduction relative to business as usual by 2030.

Botswana aims to be energy secure and have various safe and clean energy sources and it also aims to be a net energy exporter. This will be made possible by the use of renewables to complement non-renewable resource use. Much attention will be on energy efficiency which will work as a management strategy to meet the increasing energy demand. Technologies that improve energy efficiency and minimize emission of greenhouse gases are to be used. Public-private partnerships and investments will be promoted through the creation of a conducive environment and adequate policies and legislation.

The vision thus emphasizes on the identification and immediate implementation of feasible and viable mitigation (and adaptation) measures to reduce the country's GHG emission and hence its carbon footprints. Consequently, the country aims to achieve a low carbon footprint in its quest for high income country status.

National Development Plan 11 Volume 1 April 2017 – March 2023.

National Development Plans are the vehicles by which Botswana implements and achieves the Vision.

Botswana's strategy for economic growth and employment creation, within the current 11th National Development Plan (NDP 11, 2017-2023), identifies areas for intervention across mitigation and adaptation technology, including sustainable management of natural resources, and relieving pressure on the social and economic systems.

Specific to the energy sector, the NDP 11 aims at lowering the energy imports, by increasing energy saving in all sectors around the country. It forecasts more involvement of IPPs in the energy mix and more usage of indigenous sources of energy (including fossil resources). With the declining costs of RE across the globe, a niche has been identified in the solar market. NDP 11 recognizes the instruments that have been produced and t will guide development of the energy sector towards clean energy and addressing climate change mitigation.

Botswana Domesticated Sustainable Development Goals Indicators Baseline[1]

Following the adoption of the 2030 Development Agenda titled "Transforming our world: the 2030 Agenda for Sustainable Development", with its 17 Sustainable Development Goals (SDGs), 169 associated targets and 232 indicators, countries have started tracking their performance whether they are moving towards their targets.

This Stats Brief presents baseline data of the Botswana Domesticated Sustainable Development Goals (SDGs) Indicator Framework indicators. This framework includes all global SDGs indicators that are applicable to Botswana and considered 2016 base year.

Key SDGS relevant for the energy sector is the SDG7 [2]. Botswana under the SDG7 aims by 2030, to ensure access to affordable, reliable, sustainable and modern energy for all, to intensify the share of RE in the energy sector, double energy efficiency's rate of development and advance international collaboration to enable clean energy, research and technology access. This embraces RE, EE and advanced and cleaner fossil-fuel technology. It also aims to promote investment in energy infrastructure and clean energy technology.

With regard to SDG 13 that relates to "Take urgent action to combat climate change and its impact", Botswana's emphasis is on Adaptation and no mention of the Mitigation aspects.

1.3.2 Energy Sector Policy/Strategy

National Energy Policy (NEP) APRIL 2021

The National Energy Policy (NEP) aims to "create an energy system that would ensure secure and reliable supply of modern energy services for all the sectors of the economy and to significantly reduce energy-related

[1] SUSTAINABLE DEVELOPMENT GOALS INDICATORS STATS BRIEF 2018

[2] Ensure access to affordable, reliable, sustainable and modern energy for all

atmospheric emissions by the year 2040". To that end the NEP focuses on the delivery of reliable, affordable energy for sustainable development, and better access to efficient and effective uses of energy resources. Key relevant strategies that the NEP seeks to implement that can inform the Botswana TNA for Climate Change Mitigation are:

- The development of grid and off-grid solar in the bid to increase solar energy in the national electricity energy mix
- Initiatives related to production and use of energy derived from bio-energy resources will be promoted and facilitated in order to offset the country's carbon footprint
- Exploration of wind potential and aid wind power development,
- Energy efficiency and conservation initiatives will be supported with a view to minimize energy wastage and to offset emissions from conventional power generation.

Renewable Energy Strategy (RES) for Botswana (Feb 2017)

The Botswana RES presents motivation to address some notable key features of grid electricity that is currently dominated by coal with some use of liquid fossil fuel and imports from neighbouring South Africa with barely 0.15% of the mix being contributed from solar PV, although a number of off-grid renewables have been promoted in the past, particularly solar and bioenergy systems (biomass, biogas/landfill gas and biofuels). Even the off-grid contribution is quoted as small (<1.5MW).

The RES presents the opportunities presented by building on lessons of the past, learning from utility-scale global advancement of solar (PV and CSP) and wind power plants and the declining prices of these technologies and the abundant solar resources in the country.

Apart from pointing at the continued use of conventional fuel plants, on renewables, the RES presents fixed and tracking solar PV, CSP solar tower, wind, battery storage within the context of its proposed Capacity Expansion Plan.

SE4ALL Action Agenda and Investment Prospectus (2017)

Botswana's vision for SE4All is to improve the equity, efficiency, sustainability and security of the energy sector by setting and achieving ambitious country-level SDG7 goals.

The SE4ALL Action Agenda recognizes the importance of building new power generation with a significant contribution of renewable energy. The aligned Investment Prospectus presents Solar Home System Program and Framework for PV Procurement.

On the EE, the SE4ALL aims for 18% reduction in final energy relative to baseline levels by 2030 hence requiring doubling of the rate of efficiency improvement compared to that achieved in the past decade in line with the global energy efficiency (EE) targets for SE4All. The investment prospectus presents requirements for Energy Audits to support EE initiatives.

International Renewable Energy Agency (IRENA) Renewable Readiness Assessment (RRA) for Botswana (2021).

The aim of the policy is to ensure Botswana explores new and renewable energy sources and that it is energy self-sufficient and secure. It also aims for Botswana to be an energy regional exporter. It will also drive energy efficiency and use of clean energy sources in line with the developed Integrated Resource Plan (IRP). Similar initiatives comprise the Biogas Pilot Project (implementation stage), the Off Grid Solar Programme, (early stages of development and implementation), and the Rooftop Solar PV Programme, (implementation). The target is to have renewables contribute 15% of the national energy mix by 2030, and to reduce greenhouse gas emissions as

a commitment to the United Nations Framework Convention on Climate Change (UNFCCC). Objectives comprise developments in capacity building; energy sector regulation; and the development of operative enactment frameworks for energy projects and programmes such as the IRP, off-grid solar solutions and the National Electrification Programme.

Integrated Resource Plan for Electricity for Botswana (2020)

Integrated Energy Planning and developing and Integrated Resource Plan (IRP) are an integral part of the energy planning process in Botswana as guided by its 11th National Development Plans (NDP 11) and other sector policies and ambitions. The IRP outlines the least cost development plan for a period of 20 years (year 2020 to 2040) and was informed by the RES, National Energy Efficiency Strategy (NEES) and SE4ALL Action Agenda. The IRP mentions an energy mix that has 15% renewable electricity by 2030. Currently, it is at 2%.

The main supply side strategic objectives of the IRP are:

i. Diversification of sources of electricity generation
ii. Competitiveness in electricity sector
iii. Security of electricity supply
iv. Self-sufficiency in electricity generation and becoming a net electricity exporter
v. Mitigation of environmental impact, through various methods such as using low carbon technologies in coal.[1]

Both clean coal technologies and inclusion of the Solar PV, CSP and wind were considered in the scenarios presented in the IRP with the objective to ensure reliable electricity generation systems and a high level of social equity, and also deliberative environmental protection.

1.3.3 Climate Change Policy/Strategy

Various climate change related policies and strategies are presented here to paint the status and climate action ambition for Botswana that can also inform the TNA.

Third National Communication (2019)

The Third National Communication (TNC) is the latest submitted Botswana National communication and has informed the development of the NDC both in the context of adaptation and mitigation. Some of the recommendations from the TNC mitigation include:

- Developing a national mitigation strategy and action plan with inputs from *NAMAs and INDCs*
- Developing resource and financial mobilisation strategy for the climate mitigation sectors with emphasis of using funds collected from the petroleum sector and using it to finance and *subsidise solar appliances and projects*
- Strengthen collaboration between Climate Change focal point, Department of Energy, BITRI and BPC to facilitate a platform for coordinated implementation of the projects[3]
- Conduct a thorough financial and economic analysis for mitigations to achieve cost-effectiveness. For instance, it is cost-effective *to install solar streetlights or building a mini* solar PV station and power conventional LED streetlights
- The government to play an active role of encouraging Public Private Partnership and act as a guarantor for mitigation projects

[3] These organizations have been selected as part of the Energy sector Working Group (see Chapter 2)

- TNC identifies several factors that create barriers within the market that affects the energy sector and climate investment.
- Challenges of investment in renewable energy in terms of upfront costs, and challenges in terms of quality assurance associated with product deployment.
- lack of knowledge of water demand management and energy and housing standards and limited awareness of business models and instruments across SMEs and industry to stimulate take-up of technologies.
- The anticipated outcome that has the greatest contribution to meeting Botswana's energy transition

These are issues that are considered in the TNA.

Climate Change Policy (2020)

With regard to Climate Change Mitigation, the objective of the policy is to mainstream climate change into development planning, promote low carbon development pathways and ultimately reducing the country's GHG emissions. To that effect, the policy calls for the various governmental departments and the private sector to identify mitigation projects/efforts and prepare mitigation plans for the GHG emission reductions and co-benefits to the national economy.

Another important aspect that is emphasised in the policy is consideration of carbon markets and trading.

Botswana's First Biennial Update Report (October 2019)

The BUR is aligned with the TNC and mentions some of the intended GHG Mitigation options for the energy sector that include Botswana GHG inventory for the year 2015 is presented as an update of GHG inventory contained in the Third National Communication for the year 2014.

Mitigation actions identified for the energy sector included:
- Solar Power station
- Solar geysers
- Waste to energy biogas
- Efficient appliances e.g., CFLs and LEDs and fridges
- Solar street lamps

These technologies have also been included in the long list of technologies derived from desk study.

Nationally Appropriate Mitigation Actions (NAMA) (2016)

Under mitigation, the key areas to be considered in the NAMA were Emission Reduction and Energy Efficiency and Conservation. Emission reduction options included the shift to gas from coal; nuclear; renewable; biomass and carbon capture and storage. Under energy conservation and efficiency projects and programmes will target the mass transport systems, transport, building and low energy appliances. Similar GHG Mitigation measures as indicated in the BUR are presented in the NAMA.
The NAMA recognizes that some of these mitigation measures have been known for a long time but faced barriers to financing mitigation projects that include:

- Lack of enabling and conducive environment for operations of the mitigation projections.
- High and long-term investment nature of the projects.
- Existing subsidies on substitutes of climate mitigation projects.
- Existence of externalities and public good nature of the environment.
- Competing developmental priorities and limited resources.
- Stiff competition for available climate change funds.

- Lack of trained personnel to develop climate change proposals .

Policy instruments to support operations of climate mitigation projects in the energy sector are presented that included:

- Removal of subsidies on coal power electricity generation
- Introduce REFIT
- Introduce subsidies on solar generated electricity
- Introduce subsidies on solar appliances
- Tax exemptions on environmentally friendly and energy efficient houses
- Government as guarantor on climate loans

Intended Nationally Determined Contribution (INDC) (2015)

The INDC submitted in 2015 indicated that 71% of Botswana's GHG emissions reported were attributed to the energy sector in 2015. The largest two categories were electricity generation and road transport, constituting 55% and 26% respectively. In relation to the energy sector mitigation, the country's guiding principles include:

- increase the renewable energy in the national energy mix deploying *Solar Power, solar street lights, solar energy appliances, solar water pumps, solar water heaters*
- improve energy efficiency and efficiency in use of natural resources with key mitigation measures encompassing *Energy efficiency lighting and efficient refrigeration*

Nationally Determined Contribution (NDC) (2022 draft)

The adopted mitigation target of Botswana in the NDC is -15% below the baseline in 2030. To achieve the pledged mitigation, 30 measures were identified to contribute to the emission reduction. Most mitigation measures are targeted towards the energy sector, mainly by installing solar *photovoltaic and concentrated solar power, wind plants; solar street lights, green tourism, retrofitting of old buildings, solar geysers; LED streetlights and biogas.*

1.4 Energy sector and GHG Emissions in the energy subsectors

1.4.1 Energy Sector

There are various energy sources in use in Botswana and electricity is generated mainly from coal with 732MW of thermal capacity from coal alone. Diesel follows suit with 160MW capacity. Botswana has to supplement its electricity generation capacity from imports. Renewable energy in form of solar is being promoted but require enhancement to make any reduction in fossil fuel based electricity.

Electricity is largely consumed in industry, and the built environment (commercial and residential) hence any energy efficiency to reduce electricity demand would come from these sectors.

1.4.2. GHG Emissions

In 2015, the Energy Sector accounted for approximately 73.8% of total national direct GHG emissions (without LUCF). This sector is the major source of GHG emissions at the national level mainly from energy industries (power generation) that contributed 50% of the energy sector GHG emissions and nearly 54% in 2030. Apart

from the transport sector that contributed 25% of the energy sector emissions, Commercial, and residential GHG emissions were about 20% in 2015 and nearly 16% in 2030.

The depiction of the various energy sources contributing to the. GHG baseline is in Figure 2.

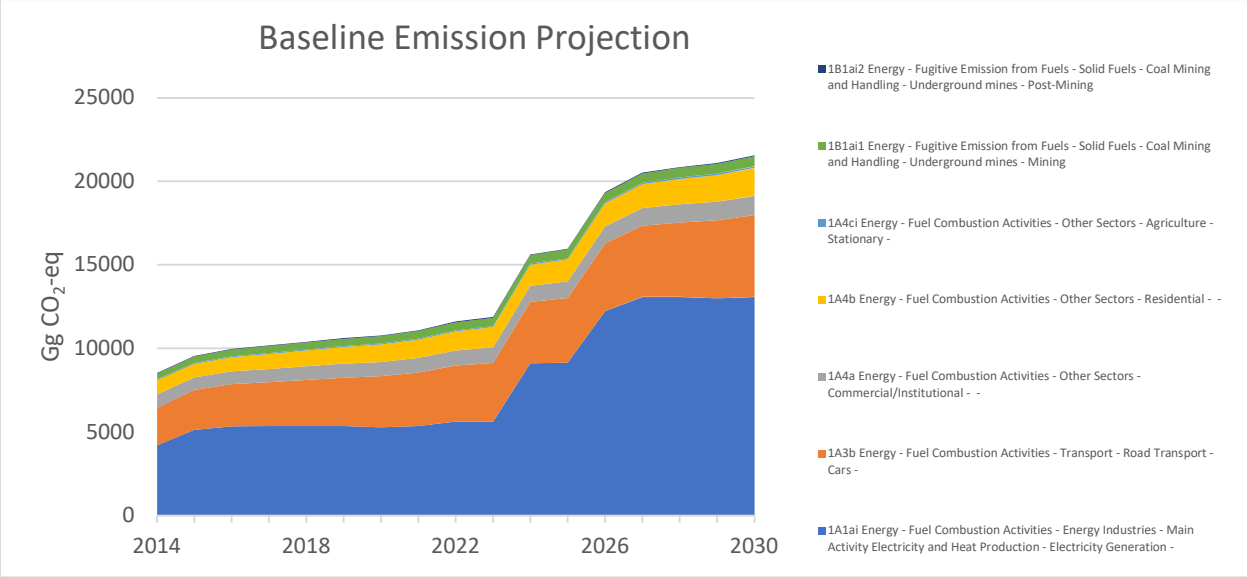


Figure 2: Projection of baseline GHG emission for the energy sector

The predefined subsector selection is therefore targeted to reduce GHG emissions from power production through RE electricity and from the demand sectors (industry, built environment) through energy efficiency.

1.5 Sector Selection

The sub sectors considered for the Botswana TNA for the energy sector were selected during preparation of the GCF project Document[4] for the updating of the Botswana TNA (2004) and include:

- Renewable Electricity
- Energy Efficiency in the Built Environment
- Industrial processes (energy)

These energy sub sectors were subsequently validated following a national consultative process and deliberations that have ensued in this TNA process with relevant stakeholders with regard to what aspects to focus on in relation to the specific technologies to be considered and selected.

[4] Update the technology needs assessment and develop a technology road map for prioritized technologies to address climate change challenges in the most critical sectors of the economy . Botswana. Ministry of Finance and Economic Development: UNEP – The Climate Technology Centre and Network (CTCN) 31 August 2019

2 INSTITUTIONAL ARRANGEMENTS FOR THE TNA AND STAKEHOLDERS INVOLVEMENT

2.1 National TNA Team

The TNAs follow a country-driven approach, involving a wide range of stakeholders in the process. Working with national partners, the TNA process offers support to Botswana in the form of national capacity building, elaboration of national technology needs and preparation of national Technology Action Plans. The TNA for Botswana will, besides identifying and prioritizing key technologies, develop technology roadmaps through Technology Action Plans (TAPs) for prioritized technologies to address climate change challenges in the most critical sectors of the economy in line with its NDC.

In the case of Botswana, the institutional framework for the TNA is established within the Ministry of Environment, Natural Resources and Tourism (MENT) and is being coordinated by the Department of Meteorological Services (DMS) which is the climate change Focal Point. Creation of the TNA Committee was initiated and led by the DMS and the identified and nominated Members of the National TNA Steering Committee are presented below (Table 1).

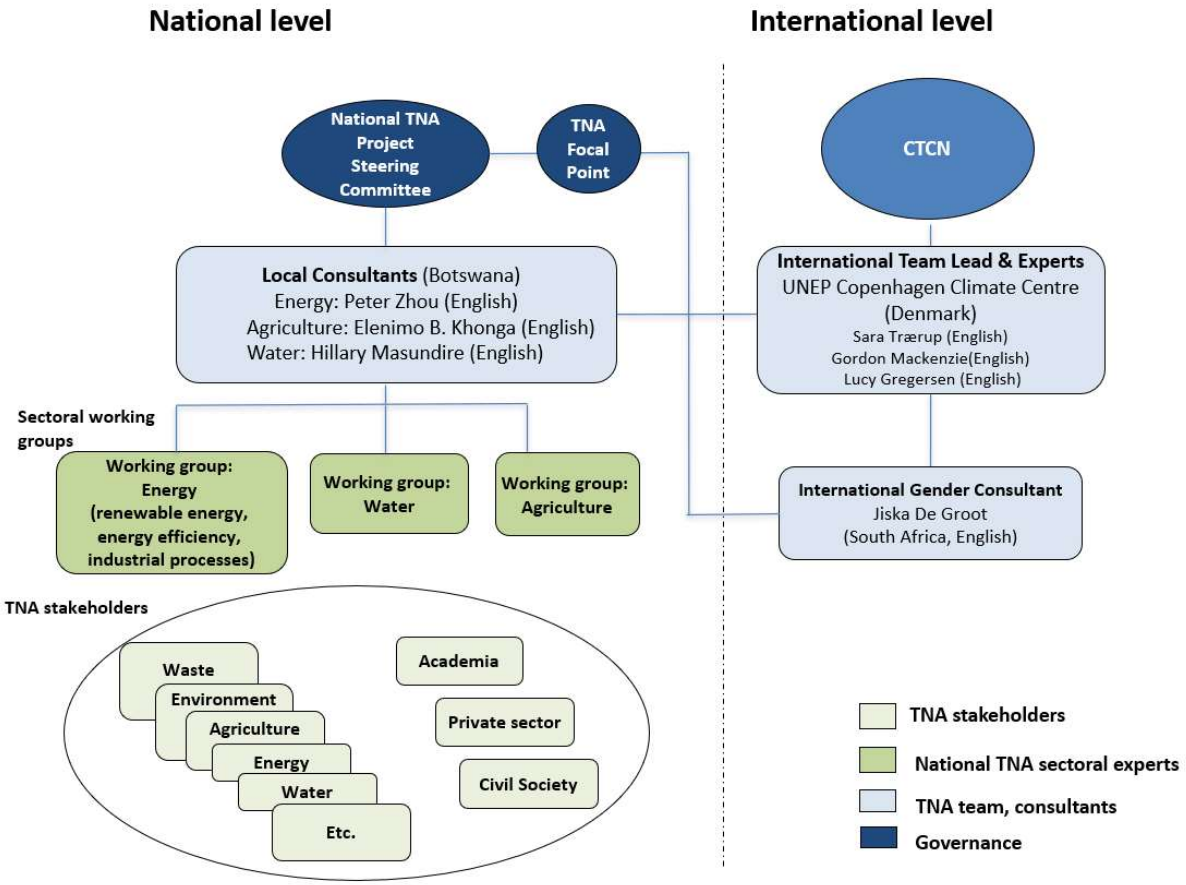
Table 1 Selected organizations for the TNA Subcommittee

Organization	Type of Stakeholder
1. Dept. of Energy	Government Institution
2. Dept. of Water and Sanitation	Government Institution
3. Dept. of Project and Infrastructure Planning	Government Institution
4. Dept. of Animal Production	Government Institution
5. Dept. of Agricultural Research Statistics and Policy Development	Government Institution
6. Dept. of Agricultural Research	Government Institution
7. Dept. of Crop Production	Government Institution
8. Ministry of Finance and Economic Development (NDA)	Government Institution
9. Dept. of Waste Management and Pollution Control	Government Institution
10. Ministry of Nationality, Immigration and Gender	Government Institution
11. Ministry of Tertiary Education, Research, Science and Technology	Government Institution
12. Ministry of Local Government and Rural Development	Government Institution

13.	Botswana Climate Change Network	Network of Community Based Organizations, Non-Governmental Organisations, Research, and Private Sector
14.	Botswana Energy Regulatory Authority	Government Institution
15.	Solar Industries Association Botswana	Private Sector
16.	BOCONGO	Non-Governmental Organisations

The Sectoral working Groups such as the Energy Sector WG were formed under the National TNA Committee to allow for a wider participation of key stakeholders. The interactions of the National TNA Committee, Working Groups, national and international consultants and participants is depicted in Figure 1.

Figure 1 Structure of stakeholder participation



The WG was intended to provide inputs to: identify and prioritise technologies and validating final selection thereof, development of Technology Action Plan (TAP) (incl. barriers), and review TAP for each sector.

The selection of the WGs was done with support of DMS and had 20% female representation o of nominated experts being female representation. The national consultant approached the identified organizations asking for nominated experts that would participate in the WG. The nine relevant energy sector organizations were approached and 5 of them officially seconded 2 or 3 experts to participate in the WG. Of the nine organizations, 4 were parastatal (BPC- electricity utility, BERA-energy regulator, BOBS-Bureau of Standards, BITRI-Innovation Technology and Research institute) and 2 government (Department of Energy, Department of Infrastructure Development), 2 private (Steam Energy member of Business Botswana; Solar Association of Botswana) and one academia (BIUST- Botswana International University of Science and Technology) and these are the recognized key energy sector recognized stakeholders in the country.

The list of energy sector organizations identified for the working Group and the already participating and nominated experts from these organizations are presented in Table 2 and Annex 2 respectively.

Table 2 Identified stakeholder organizations for the energy sector mitigation working Group

	Stakeholder organization	**Sector**	**Relevance**
1	Business Botswana	Private	Industry energy efficiency and Processes
2	Botswana Bureau of Standards	Semi public	EE and RE appliance/equipment Standards
3	Botswana Energy Regulatory Authority	Semi public	RE/EE Standards regulation; sector and tariff regulations
4	Botswana International University of Science and Technology	Academic	RE and Energy efficiency research
5	Botswana Innovation, Technology, Research Institute	Semi public	Technology, Research and Innovation- RE
6	Botswana Power Corporation	Semi public	Utility (RE power plants, EE-Transmission and Distribution losses)
7	Department of Energy	Public	Policy Formulation and implementation- RE/EE section
8	Department of Infrastructure Development	Public	EE in buildings
9	Solar Industry Association of Botswana	Private	RE. Equipment Suppliers, Project Development and Implementation

The activities of the WG were facilitated by the sector/national consultant/expert to refocus the energy subsectors and undertake the process of selection and prioritization of the technologies for the three energy subsectors.

2.2 Stakeholder Engagement Process Followed in the Overall TNA-Overall assessment

The stakeholder engagement process started with a desk study by the national consultant of key Botswana policy/plan/strategies as indicated in Section 1.2 leading to identification of a long list of technologies for RE, EE and Industry energy subsectors.

Several WG meetings were conducted starting with an inception report to finalization of the sub-sector and technology prioritization. All meetings were held virtually as per the preference of the participating experts and to observe COVID-19 protocols.

2.3. Consideration of Gender Aspects in the TNA Process

Two aspects of the gender that were considered were participation of male and females in the WG and the consideration of benefits to both genders in formulation of the selection criteria for technologies and weighting.

The nomination of the WG members was done by the organizations but after being sensitized about the importance of gender balance. The WG group started up with 20% female participants.

Table 3 WG meetings undertaken, agenda and outcomes

Timing/dates	TNA WG meeting/Consultant	Agenda
	Consultant	Reviews of national, regional and international policies, plans
Tue 22 Feb 2022 11am - 12pm	TNA Working Group Inception	Agenda: 1. Expert introductions 2. Project Introduction and where WG will be involved 3. Planning next meeting for Prioritization of energy subsections and priority technologies 4. AOB
Tuesday, March 8·10:00am – 12:00pm	Energy Sector TNA Meeting- Technology selection and prioritization	2. WG reflect on RE, EE in built area and Industrial process in terms of where to focus 2. WG members present their list of RE or EE or Industrial process technology choices (also refer to shared Draft Report 2.1) 3. WG collate long list of RE, EE and Industrial processes projects (hopefully not too long-avoiding repetitions) 4. WG prioritise total of 10-12 technologies from these three subsections.

3 ANNEXES

Annex 1: List of References and Bibliography

1. BERA (2020). Botswana Rooftop Solar Programme. http://www.bera.co.bw/downloads/Electricity/Botswana%20Rooftop%20Solar%20Guidelines%201-Pager.pdf
2. Biennial Update Report (BUR) 2019
3. Botswana Climate Change Policy
4. Botswana NDC-Evaluation Report D2 2020; 2022
5. Botswana Update the technology needs assessment and develop a technology road map for prioritized technologies to address climate change challenges in the most critical sectors of the economy UNEP – The Climate Technology Centre and Network (CTCN) 31 August 2019
6. Economic Consulting Assocatesi 2018 – renewable energy strategy of Botswana
7. GoB (2016) Vision 2036- Achieving Prosperity for All Published by LENTSWE LA LESEDI (PTY) Gaborone, Botswana
8. GoB (2019) Botswana's Third National Communication to the United Nations Framework Convention on Climate Change.
9. GoB (2021) National Energy Policy. Ministry of Mineral Resources, Green Technology and Energy Security., Government Printers. Gaborone Botswana
10. BOTSWANA CLIMATE CHANGE RESPONSE POLICY Draft Dec 2020
11. Grenada technology needs assessment mitigation report February 2018
12. https://unfccc.int/sites/default/files/resource/BOTSWANA%20THIRD%20NATIONAL%20COMUNICATION%20FINAL%20.pdf
13. Identifying and prioritising technologies for mitigation - A hands on guidance to multi-criteria analysis (MCA) UNEP DTU Partnership September 2015
14. INDC 2015: https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Botswana/1/BOTSWANA.pdf
15. Irena (2021), renewables readiness assessment: Botswana, international renewable energy agency, Abu Dhabi ISBN: 978-92-9260-352-6
16. Integrated Resource Plan for Electricity for Botswana Final Report Volume I &II: Energy demand analysis 2020/2019
17. Multi-criteria analysis: a Manual: January 2009 Department for Communities and Local Government: London https://www.gov.uk/government/organisations/ministry-of-housing-communities-and-local-government
18. NAMA 2016 BOTSWANA'S NATIONALLY APPROPRIATE MITIGATION ACTIONSwww.el-mondo.com
19. National Development Plan 11 Volume 1April 2017 – March 2023 :ISBN: 978-99968-465-2-6
20. *National Energy Efficiency Strategy For Botswana Final, 2018:* Danish Energy Management, 2018 – National Energy Efficiency Strategy of Botswana
21. Renewable Energy Strategy for Botswana Draft Final Report February 2017 Submitted to World Bank by: Economic Consulting Associates 3EDLR
22. *Republic of Seychelles TECHNOLOGY NEEDS ASSESSMENT REPORT – MITIGATION 14 February 2017*
23. Se4ALL https://www.se4all-africa.org/seforall-in-africa/country-data/botswana/
24. Southern African solar thermal training & demonstration initiative is a regional initiative on capacity building & demonstration of solar thermal systems in the SADC region
25. TNA Step by Step A guidebook for countries conducting: a Technology Needs Assessment and Action Plan: ISBN 978-87-93458-38-3 UNEP DTU Partnership Copenhagen, Denmark www.unepdtu.org

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