

Terminal Evaluation of GEF funded project Promoting production and Utilization of Biogas from agro-waste in South-Eastern Botswana

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Final Report

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Acronyms and Abbreviations

AfDB	African Development Bank
AWP	Annual Work Plan
BERA	Botswana Regulation Authority
BDC	Botswana Development Corporation
BITRI	Botswana Institute for Technology, Research and Innovation
BMC	Botswana Meat Commission
BPC	Botswana Power Corporation
CSOs	Civil Society Organizations
DWMPC	Department of Waste Management and Pollution Control
DOE	Department of Energy (MMGE)
EAD	Energy Affairs Division (which became the DOE)
EiB	European Investment Bank
ESMF	Environmental and Social Management Framework
GCC	Gaborone City Council
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	Greenhouse Gases
GoB	Government of Botswana
GSSU	Global Shred Services Unit (UNDP)
IWM	Integrated Waste Management
KBL	Kgalagadi Breweries Limited
KDC	Kgatleng District Council
KwDC	Kweneng District Council
LEA	Local Enterprise Authority
LPG	Liquified Petroleum Gas
LTC	Livestock Technical Committee
MoAFS	Ministry of Agriculture & Food Security
MENT	Ministry of Environment Natural Resource Conservation and Tourism (previously MEWT Ministry of Environment Wildlife and Tourism)
MLGRD	Ministry of Local Government and Rural Development
MMGE	Ministry of Mineral Resources, Green Technology and Energy Security
M&E	Monitoring and Evaluation
MSP	Multisector stakeholder platform
MTR	Mid-term Review
NDB	National Development Bank
NDC	Nationally Determined Contributions
NIM	National Implementation
PIF	Project Identification Form
PIR	Project Implementation Reviews
PMU	Project Management Unit
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PSC	Project Steering Committee
RDCs	Rural District Councils
ReFIT	Renewable Energy Feed in Tariffs
SDC	South District Council
SEDC	South-East District Council
SDGs	Sustainable Development Goals
SESP	Social and Environmental Screening Procedure (UNDP)
TE	Terminal Evaluation
TEA	Trade Effluent Agreement
TOC	Theory of Change
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Program
WUC	Water Utilities Company

Acknowledgements

The evaluators would like to express their gratitude to all the stakeholders who kindly participated in this Terminal Evaluation, as set out in Annex 2. A special thank-you is extended to the Project Manager and UNDP M&E specialist who greatly facilitated the Terminal Evaluation process.

Executive Summary

Project Information Table

Project Details		Project Milestones	
Project Title:	Promoting production and utilization of bio-methane from agro-waste in South-Eastern Botswana	PIF Approval Date:	
UNDP Project ID (PIMS #):	5299	CEO Endorsement Date:	
GEF Project ID (PMIS #):	5628	ProDoc Signature Date	8 April 2016
Award ID:	00098758	Date project manager hired:	May 2017
Country(ies):	Botswana	Inception Workshop date:	20 April 2017
Region:	Africa	Mid-term Review date:	May 2019
Focal Area:	Climate Change	Terminal Evaluation Completion date:	February 2021
GEF-5 Focal Area Objective:	CCM-3	Planned Operational Closure date	January 2022
Trust Fund:	GEF TF		
Implementing Partner:	1/ Botswana Institute for Technology, Research and Innovation (BITRI) from Project Inception – November 2020; 2/ Department of Energy from December 2020 to closure		
Financial Information			
Project	at CEO endorsement (USD)		at TE (USD)
[1] UNDP contribution	200,000		356,936
[2] Government	16,484,000		No data at TE. Commitments reduced to USD 1,734,000 ¹ MTR estimate – USD 867,000
[3] other multi -/ bi-laterals	-		-
[4] Private Sector	-		-
[5] NGOs	-		-
[6] Total co-financing	16,648,000		867,000 (MTR estimate)
[7] GEF financing (excl. PPG)	2,632,300		2,216,221 ²
TOTAL PROJECT COSTS [6+7]	19,316,300		3,261,689 ³

Notes: 1/ No quantitative data provided to TE on co-financing actually provided by Government. However, USD14,500,000 of pledged funds (USD 4,600,000 from the Botswana Development Corporation, and USD10,150,000 from the Botswana Meat Commission) related to the medium-scale bio-digesters which did not go ahead so are not applicable. This reduced the amount of co-financing committed to USD1,734,000. The MTR estimated contributes at USD867,000; 2/ Disbursements as of 1 March 2022; 3/ Estimated at USD1,045,468. This is based on 50% of UNDP contributions (USD 178,468) on assumption that MTR estimate on co-financing includes UNDP contributions, plus co-financing realized at MTR stage (USD867,000). No quantitative data provided to TE on actual co-financing from Government.

Project Description

The **objective** of the Project 'Promoting production and utilisation of biogas from agro-waste in South-Eastern Botswana' (referred to as the 'Biogas project') was to facilitate low-carbon investments and public-private partnerships in the production and utilization of biogas from agro-waste in the districts of South-eastern Botswana (Kgatleng, Kweneng, South-East and Southern districts).

The Project set out to facilitate the establishment of the first workable biogas plants in Botswana. Small- and medium-scale biogas digesters were to be constructed to demonstrate that, with private investment, biogas technology is applicable and commercially viable in Botswana. The demonstration plants were also to build capacity in design, construction, operation, investment and regulation. It was expected that by the end of the Project, local investors would have gained sufficient capacity and confidence to support biogas technologies in the commercial sector.

The Project was organized around 3 components:

- Component 1- Institutional strengthening and capacity building for biogas investment and improved agro-waste management and regulation;
- Component 2 - Facilitation and establishment of the first biogas plants in Botswana;
- Component 3 - Facilitation and establishment of appropriate biogas utilization platforms in at least two districts of South-Eastern Botswana

The Biogas Project was implemented by the Government of Botswana (GoB), in collaboration with the UNDP, initially through the Botswana Institute for Technology Research and Innovation (BITRI), and then following the Mid-Term Review (MTR) through the Ministry of Mineral Resources, Green Technology and Energy Security (MMGE), Department of Energy (DOE). The total Project budget at design was USD 19,316,300.

Evaluation Rating Table

Table A presents the evaluation ratings for the Project. Overall the Project is rated as Moderately Unsatisfactory.

Table A: Evaluation Ratings

Monitoring & Evaluation (M&E)	Rating
M&E design at entry	Satisfactory
M&E Plan Implementation	Moderately Unsatisfactory
Overall Quality of M&E	Moderately Unsatisfactory
Implementation & Execution	Rating
Quality of UNDP Implementation/Oversight	Satisfactory
Quality of Implementing Partner Execution	Moderately Unsatisfactory
Overall quality of Implementation/Execution	Moderately Satisfactory
Assessment of Outcomes	Rating
Relevance	Highly Satisfactory
Effectiveness	Unsatisfactory
Efficiency	Unsatisfactory
Overall Project Outcome Rating	Moderately Unsatisfactory
Sustainability	Rating
Financial resources	Moderately Unlikely
Socio-political/economic	Moderately Unlikely
Institutional framework and governance	Moderately Likely
Environmental	Likely
Overall Likelihood of Sustainability	Moderately Unlikely

Note: Outcomes, Effectiveness, Efficiency, M&E, I&E Execution, Relevance are rated on a 6-point rating scale: 6 = Highly Satisfactory (HS), 5 = Satisfactory (S), 4 = Moderately Satisfactory (MS), 3 = Moderately Unsatisfactory (MU), 2 = Unsatisfactory (U), 1 = Highly Unsatisfactory (HU). Sustainability is rated on a 4-point scale: 4 = Likely (L), 3 = Moderately Likely (ML), 2 = Moderately Unlikely (MU), 1 = Unlikely (U)

Key findings, conclusions and lessons learned

The Project is considered to be highly relevant. The Government is committed to transition from coal to renewables, and biogas is seen as part of this effort. The Project also supports youth employment, and access to affordable energy for all. Furthermore, it clearly aligns with the UNDP Country Program 2022-2026 and International Agreements, notably the United Nations Framework Convention on Climate Change (UNFCCC).

The Project that was implemented is significantly reduced in scope to that set out in the Project Document, and the Project was unable to fully achieve its objective, even with the 1 year extension. The Project implemented less than half of its planned outputs and 61% of its activities, many of which needed to be downscaled or revised. Of the 17 Project targets only 4 have been achieved.

The Project was not able to secure the interest and finance needed to build the three medium-scale bio-digesters¹. Despite considerable efforts over the first three years of Project, no medium-scale digesters were agreed to, largely due to the large capital outlay required and the inability to define a viable financing mechanism. It was also intended that a proposal would have been finalized for a commercial large-scale centralized biogas plant with a facility to upgrade to bio-methane and utilization; however such a facility proved not to be technical feasible due to insufficient waste at the Project site.

The Project is left with an underspend of around USD 416,000; money that could have been allocated to the roll out of more small-scale bio-digesters (especially if this activity had started on time), or to support the foundational work needed to provide a springboard for a medium-scale bio-digester through an agreed and funded follow-on initiative. The Project is ending with continued uncertainty around the viability of medium-scale bio-digesters.

The Project has however successfully facilitated the establishment of small-scale biogas plants in the study area (albeit at a significantly reduced number than intended). 200 small-scale digesters have been constructed and there is a strong interest in their further adoption. Households are using bio-digesters to convert animal manure into biogas to meet their cooking and, to a lesser extent, lighting needs. Beneficiaries of the small-scale biogas plants have consistently reported livelihood and lifestyle benefits. The 200 small-scale biogas plants are estimated, at the current rate of utilization, to reduce CO₂ emission by a total of 155t CO₂/annum.

Other notable successes include: (i) institutional advancements with the Project supporting the development of Biogas Standards, Biofuels Guidelines, an update of the Renewable Energy Feed-In Tariffs, development of the Integrated Waste Management Bill as well as a Green Certification Framework; (ii) the training of masons; (iii) building awareness of the biogas technology among stakeholders; and, (iv) the collaborative manner in which the Project was implemented building cross ministerial relationships critical to the waste-energy agenda and engaging with the private sector.

At Project closure there is still some way to go to setting the foundation for a sustainable, commercial biogas industry in Botswana. With the lack of funding for **medium-scale digesters**, electricity generation from biogas has not yet been possible. The biogas is currently being used for cooking, lighting and heating only. Medium-scale biogas plants are still at the early stages of development in Botswana and a conducive policy environment for the private sector needs to be in place for the biogas market to develop.

¹ The Project was designed to establish three medium-scale biogas plants with an installed capacity of 1 MW each, financed by private-sector partners, commercial banks and Government partners (BMC or BDC).

While the Project has had some success in creating an enabling environment for the adoption of bio-digesters, key legislation and policies are yet to be approved (ReFIT and Integrated Waste Management Act). The establishment of these and other policies and financial incentives are a prerequisite for the market development of agro-waste management and biogas technology.

The shortcomings of the Project can be explained by a number of factors including project design, the impacts of COVID-19 and project management challenges. The Project was hindered from the outset by an overly ambitious project design, which also did not adhere clearly enough to the sequence in which activities needed to be undertaken to introduce biogas as a new technology. The target of 1,000 small-scale bio-digesters was unrealistic as was the target of construction 3 medium-scale bio-digesters in 4 years, given that Botswana was starting at the very beginning of the process and that the private sector was unlikely to cover all the costs (risks) of a new technology. While COVID-19 impacts affected all aspects of project implementation, it is noted that Project delivery was significantly delayed before COVID-19 hit. Disbursements in the first year of the Project were 8%, reaching only 24% by mid-term. The slow delivery during the first half of the Project is explained by difficulties hiring staff and an Implementing Partner whose core expertise is in research and development not in implementation on the ground. The small-scale biogas plants were meant to have been rolled out in Year 1 of the Project, but for various reasons this did not start in earnest until 2021. Project implementation could have been accelerated with a fully staffed Project Management Unit throughout the Project and more day to day support from Government technicians.

The Project did not pay enough attention to the documentation of lessons learnt / knowledge management. While it was not possible build medium-scale biogas plants within the Project timeframe, the Project's experiences are important in laying the groundwork for potential future market development. However, they are not clearly synthesized / documented. This is also true of the small-scale bio-digesters. One of the strategic elements set out in the Project Document was the facilitation and establishment of appropriate utilization and knowledge platforms, these knowledge platforms do not appear to have been established and would have supported the sustainability of the Project's outputs.

Of great concern is the sustainability of the Project's outputs, with no concrete plan agreed to move forward with the small-scale and medium-scale digesters and critically no funding earmarked for this. For the small-scale biogas plants, excitement and interest has been created and demand is considered to be high across the country. It is therefore critical to keep momentum and maintain the expertise that has been built. However, resources have not been secured to ensure a seamless continuation of the work.

Key lessons

Poor project design affects implementation. Specific design lessons from this Project include: (i) a detailed Theory of Change taking into consideration country circumstances is needed to underpin design and implementation; and, (ii) Proposals should be closely designed with stakeholders (Government, Private Sector and beneficiaries) and technical experts (national and international) to facilitate successful implementation.

The role of the private sector needs to factor strongly in project design and implementation. The private sector needs to play a central role in implementation from the outset as major players in development. Opportunities for partnerships with private sector (with UNDP and Government) should be explored in detail at the design stage and awareness built around their potential role. A focus on state owned institutions may limit uptake of market opportunities.

The right mix of expertise and adequate core staff is needed to ensure effective and efficient delivery. The Project could have benefitted from technical support from a finance specialist, bio-digester specialist / Chief Technical Advisor (CTA). Given the delays the Project faced and the need to accelerate delivery in its final eighteen month, the PMU should have been fully resourced, and additional resources brought on board to ensure Project outputs and lessons learnt were strongly presented.

Revision of Theory of Change at mid-term would have sharpened the Project's focus. Many of Project's assumptions did not hold invalidating large part of the Results Framework. The Results Framework and the Theory of Change should have been revised early on in the Project's life as it became evident that a re-orientation of the Project's strategy and focus was needed to increase its efficiency and effectiveness. Such a re-evaluation may have allowed for the roll out of more small-scale digesters along with a period of monitoring, and a detailed synthesis of the lessons learnt.

Importance of demonstrating a new technology - 'seeing is believing.' It is very hard to generate interest in a new technology that has not be tried and tested *in-situ*, especially when that technology requires significant capital outlay and incentives and mechanism to share the financial risk are not in place.

Incentives are needed to kick start new technologies. For the small-scale bio-gas plant beneficiaries the need for incentives relate to affordability issue and the fact that many agricultural and energy initiatives are subsidized in Botswana. For the medium-scale digesters incentives are needed to mitigate risk and encourage investments given the high capital outlay. Such Government / policy incentives are justified based on the social and environmental benefits.

An exit plan should be developed in the final year of the project. Sustainability of the Project's outputs is a key concern and considered to be at risk. Early discussions (18 months before the Project's closure) were needed on the sustainability of the Project's outputs and the barriers to this culminating in the development of an agreed exit plan.

Knowledge should be carefully managed throughout project. Knowledge management is important for all projects, but particularly pertinent for Project's introducing innovative approaches / technologies. Methodical capturing and synthesising of the knowledge generated on all aspects of introducing the biogas technology are needed.

Small-scale biogas plants

- It is important to be clear from the outset on the costs involved and the requirements regarding feed.
- There is a need to have a support system and a monitoring program to check the efficacy of the plant beyond the Project period.
- Biogas is preferred to solar by the small-scale biogas plant beneficiaries, but may not be popular with potential users who are not familiar with the technology. An assessment of solar versus biogas needs to be presented and discussed with beneficiaries at the conceptualization stage to encourage uptake.
- Training of beneficiaries of the small-scale biogas plants on the construction of the plant, how biogas works and its uses, operation and maintenance is important to enable them to become ambassadors for the technology and to independently run their plants.
- Local companies could be supported to provide materials, including stoves and lights which are not readily available locally to support up-scaling of the technology.

Engagement of women should be promoted and gender specific targets included in the Results Framework such that results can be measured and demonstrated. For the

success of the small-scale biogas plants, women should be engaged from the outset in each household as they are responsible for the collection of firewood and cooking. Generally projects should develop a gender action plan for the delivery of gender activities and gender targets should feature in the Results Framework.

Recommendations summary table

Table B provides a summary of the TE's recommendations to strengthen the sustainability of the Project's outputs.

Table B: Recommendations Table

Ref	TE Recommendation	Entity Responsible	Timeframe
1	Category 1: Strategic planning		
1a	Develop a specific Theory of Change for small-scale and medium-scale bio-digester development to better target and plan action post project, and understand the barriers along the causal chain that require addressing	DOE with MENT	April 2022
1b	Consider establishing a multi-stakeholder national biogas working group to develop a strategy for medium-scale digesters and small-scale digesters, within the context of Botswana's wider renewables strategy. This could consist of Government agencies, private sector (including finance sector), UNDP, donors, technical experts. A sub-group on finance / Investment facilitation platform (which was planned but not established under the Project) could be established to work on developing viable financing options (based on a review of all potential financing options – Government support, policy incentives, donor support, private sector finance).	DOE with MENT	April 2022
2	Progress development of enabling policy / legal environment		
2a	Support enactment of the Integrated Waste Management Bill.	DOE with MENT	2022
2b	REFIT- officially adopted.	DOE with MENT	2022
3	Finance		
3a	Undertake a review of financial and economic instruments that could be used to support the uptake of biogas at various scales (but with a focus on medium-scale bio-digesters) and set out agreed viable options developed with all parties (Government, donors, private sector). This should build on international practices.	DOE	2022
3b	Prepare concept notes for funding of medium-scale bio-digesters.	DOE	2022
3c	Support Green Climate Fund (GCF) / Adaptation Fund accreditation. Currently no institution in Botswana is accredited to the GCF and this could be used to crowd in private sector finance.	DOE	2022
3d	Reach out to development partners (Banks, Funds) to seek investment support based on Concept Notes prepared.	DOE, with support of UNDP	2022
4	Medium / large scale biogas plants		
	Develop a national strategy and action plan on medium-scale biogas covering, for example: <ul style="list-style-type: none"> • Demonstration plant – where locate? how finance? • Private sector engagement / Public Private Partnerships • Specific feasibility studies, following successful demonstration • Development of finance packages 	DoE, and partners	2022

Ref	TE Recommendation	Entity Responsible	Timeframe
5	Small-scale biogas plants		
5a	Develop roll-out / scale up strategy and finance plan building on the DOE concept note and further explore funding options to ensure momentum on the small-scale bio-digester program is maintained. The Finance plan should consider how to include the most vulnerable in the uptake of small-scale biogas plants.	DOE	April 2022
5b	Develop monitoring plan and maintenance guide for beneficiaries to be used beyond the Project. This is needed to ensure construction quality and maintenance and maintain demand	BITRI	April 2020
6	UNDP Support		
6a	Consider building up staff capacity at UNDP to support transition to renewables through on-going policy support, development of project proposals and assistance the raising of finance.	UNDP	April 2022
6b	Consider working with the Government on GEF 8 proposal on renewable energy, including biogas.	UNDP / GoB	2022
7	Private Sector		
7a	Continue the relationship building that has been started by the Project with the private sector with the objective of realizing marketable opportunities and financing options. For example, banks still need to be convinced that the technology works, there is sufficient market demand and there are serviceable financial products.	DoE, UNDP	2022
7b	To support the provision of soft loans by the NDB, the results of the small-scale biogas plants, such as ability of customers to repay loans should be monitored and share with the banks.	DoE, UNDP, NDB	2022
8	Government champion		
	DoE to champion biogas at Senior Government level. There is the capacity for biogas to play a bigger role as part for the drive on renewables and green economy, and a Government champion is needed to drive this.	DoE	On-going
9	Knowledge management and lessons learned		
	Collate and synthesize lesson learnt by the Project, by scale of technology, and present in a range of reader friendly materials (e.g. pamphlets for beneficiaries of small-scale bio-digesters, synthesis of lessons learnt by the Project on development of medium-scale bio-digesters). This is in addition to awareness raising videos and operating manual developed for beneficiaries.	PMU, BITRI, DoE	March 2022
10	On-going education and awareness raising		
	Support for on-going awareness raising is important to help facilitate the uptake of small-scale biogas plants country-wide.	DoE, MENT	On-going

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1 Introduction

1.1 Purpose and objective of TE

In accordance with the United Nations Development Program (UNDP) and the Global Environment Facility (GEF) Monitoring and Evaluation (M&E) policies and procedures, all full-sized UNDP- supported GEF-financed projects are required to undergo a Terminal Evaluation (TE), within 6 months of operational closure.

The objectives of the Terminal Evaluation (TE) of the Project ‘Promoting production and utilisation of biogas from agro-waste in South-Eastern Botswana’ (hence forth referred to as the ‘Biogas project’) are to:

- assess achievement of the Project’s results;
- draw lessons that can both improve the sustainability of benefits from the Project and aid in the overall enhancement of UNDP programming;
- assist the Government of Botswana in its efforts to rollout the project and/or technology to the rest of the country; and
- assess the impacts of COVID-19 on the attainment of project goals².

The Project started on the 20th January 2017 and is in its 5th year of implementation. A Mid-term review (MTR) was completed in May 2019. Originally designed as a 4 year project, following a recommendation for a 1 year no-cost extension by the MTR and an extension request from the Ministry of Mineral Resources, Green Technology and Energy Security (MMGE) in July 2020 the Project was extended by 1 year, up to January 2022.

The Biogas Project is being implemented by the Government of Botswana (GoB) in collaboration with the UNDP. The Biogas Project was initially implemented through the Botswana Institute for Technology Research and Innovation (BITRI), however following the Mid-Term Review (MTR), project implementation moved to the Ministry of Mineral Resources, Green Technology and Energy Security (MMGE), Department of Energy (DOE). The total Project budget is USD 19,316,300.

The Project is focused on the South Eastern Region of Botswana, and is being implemented in the Kgatleng, Kweneng, South-East and Southern districts.

1.2 Approach

The TE was undertaken over the period November 2021 – March 2022 by an independent international consultant and an independent national consultant. The TE was conducted according to the guidance, rules and procedures established by UNDP and GEF as reflected in the UNDP Evaluation Guidance for GEF Financed Projects³.

The evaluation was framed around the following key criteria - **relevance, effectiveness, efficiency, sustainability and impact**. The Evaluation Matrix, which sets out the evaluation questions covering each of these criteria along with indicators, sources and methodology, is presented in Annex 4.

² Botswana implemented its first nationwide lockdown from 2 April 2020– 22 May 2020, which included the suspension of all international and inter-zonal travel, and imposition of curfews for movement within the country, with the exception of essential services. There were no nationwide lockdowns in Botswana in 2021. While international and inter-zonal travel is currently permitted, the Government of Botswana continues to implement restrictions on movements and gatherings as necessary such as limiting the number of interzonal movement permits and application of curfews.

³ UNDP Guidance For Conducting Terminal Evaluations of UNDP-Supported, GEF-Financed Projects’ (UNDP, 2020)

Further specific questions / clarifications addressed through the evaluation process identified at the Inception phase of the TE are:

- What effective has COVID-19 had on Project implementation and how has the project adapted to the challenges presented by COVID-19?
- To what extent has the design of the Project hampered progress and focus?
- Has Project implementation and management improved since mid-term when significant changes were made?
- Are effective waste-management policies and guidelines with operational regulations in operation, and how instrumental has the Project being in developing these ?
- What progress has been made on Public Private Partnerships (PPPs), Renewable Energy Feed-in-Tariffs (ReFIT) and Power Purchasing Agreements (PPAs) since Mid-term? What barriers remain to the establishment of Public Private Partnership?
- How has the Project advanced issues around financing of bio-digesters at all scales (small-medium-large) and what barriers remain? Has the Project found realistic solutions to the financing of biogas systems?
- To what extent has capacity to design and develop biogas projects in South-Eastern Botswana been enhanced?
- What evidence is there of increased incomes / livelihoods through the use of small-scale digesters, especially for women?
- What evidence is there that the Project has had an impact on gender?
- As noted in the MTR, co-funding to the value of USD14,750,000 is very unlikely to materialize as it is associated with the direct costs of constructing, financing and operating medium-scale digesters which is not possible by project closure. How has co-financing been tracked by the Project and are co-financiers still prepared to fund such activities after the project period?
- The lessons learnt from the Project will be very important for Botswana and other countries in the region. How has the impact of small-scale digesters been monitored? How are lessons and knowledge, practices in general being documented and disseminated (e.g. on financing medium sized digesters, process and market maturity)?

The TE is based on a review of key documents and stakeholder consultation interviews. Documents reviewed include: the Project Document, UNDP Social and Environmental Screening Procedure (SESP), Project reports including annual Project Implementation Reviews (PIRs), Combined Delivery Reports (CDRs), technical reports, national strategic and legal documents. Annex 3 provides a list of the documents reviewed.

The stakeholder interviews were a combination of virtual interviews via zoom or Teams and face to face (in-person) consultations. While ideally the International Consultant would participate in all interviews to hear stakeholder feedback first-hand, as she was not able to travel to Botswana due to COVID-19 restrictions the in-person interviews were led by the national consultant. The in-person interviews were critical, focussing on the beneficiaries of the small-scale digesters and masons, many of which could not be interviewed remotely. The two processes ran in parallel given the limited time to undertake the TE which was further constrained by the holiday season falling mid-way through the evaluation.

Annex 2 provides a list of the people interviewed as part of the TE. The Zoom interviews led by the international consultant covered members of the Project Steering Committee (PSC), UNDP staff, Government Ministries and departments. A list of key stakeholders was developed with the help of the Project Manager from which 25 stakeholders were selected by the evaluator across the various stakeholder groups and invited for interview by the Project Manager. Only 11 people accepted the interview request and were thus interviewed.

Field visits were undertaken from the 22nd to 29th November 2021 by the national consultant during which time face to face interviews were held with beneficiaries, mason trainers and masons trained by the Project. The small-scale digester sites were also visited.

At the time of the field work, based on information provided to the TE, 120 small biogas plants were in operation. Interviews with 12 beneficiaries were planned (10% of beneficiaries) – 6 male and 6 female. The beneficiaries were randomly selected with the number to be interviewed by district weighted based on the number of small-scale biogas plants per district (Table 1).

Table 1: Distribution of Small biogas plants

District	Number	%	No. selected for interview
Kweneng	61	51%	5 (3 m / 2 f)
Kgatieng	21	21%	2 (1 m / 1 f)
South East	5	5%	2 (1 m / 1 f)
Southern	33	28%	3 (1 m / 2 f)
Total	120		12 (6m / 6 f)

Source: Project data

There are 77 Masons trained by the project (27% of which are female). 20 masons were randomly selected to be interviewed (12 male and 8 female), of which it was possible to interview 15 masons, either in-person if they were working near to a beneficiary selected for interview, or by phone. A set of questions for the beneficiaries and masons were prepared in advanced to guide the interview discussions. Travel and in-person consultations were aligned with current COVID-19 regulations in Botswana. Given that the International Consultant was unable to travel to Botswana, the National Consultant to the extent possible provided an insight of activities on the ground through pictures and videos.

The TE followed a collaborative and participatory approach ensuring close engagement with the Project Team, government counterparts, the UNDP Country Office and other key stakeholders. The TE has been conducted in accordance with the principles outlined in the United National Evaluation Group (UNEG) 'Ethical Guidelines for Evaluations'. A workshop was held on the 8th December (via Teams) where the preliminary findings of the TE were presented. The draft TE report was distributed to all key stakeholders for review, and all comments received were taken into consideration in finalizing this report. A final report was submitted on 11 February 2022, but then updated on the 8 March with additional financial information provided by the PMU.

The timeline for completion of the TE was tight for a range of reasons including: (i) COVID-19 adds a layer of complexity to the evaluation (e.g. the International Consultant could not visit Botswana and needed to review and incorporate inputs from the National Consultant covering interviews /site visits that she has not been involved in); (ii) key inputs by the Project Manager / core project team were needed during a period in which they were busy with other activities required to close the Project, compounded by the fact that the PMU was understaff from late 2020; (iii) a number of key documents and information requested were not provided until January, with key financial information provided in March; and, (iv) the TE overlapped with the holiday period mid-December to early-January, which impacted people's availability to participate in the TE process.

1.3 Structure of report

The rest of this report is organized as follows: Section 2 provides a description of the Project as context to the TE; Section 3 presents the TE findings in relation to project design, project implementation and project results; and, Section 4 concludes and presents the lessons learned and TE recommendations.

2 Project Description

2.1 Context

The emission of greenhouse gases (GHGs) produced by the environmentally unsustainable disposal of agro-waste products combined with the use of imported fossil fuels is identified as a key problem in Botswana. The Biogas Project was initiated following the recognition that waste was not seen as a resource in Botswana despite its potential to contribute to renewable energy generation. Better waste management would also address a number of other environmental pressures.

Several waste streams for consideration in biogas production are available at agro-industrial facilities and household level including chicken manure, cow dung and goat/sheep droppings. For example, with a total human population of just over 2.1 million people and a cattle population of 2.22 million (Statistics Botswana, 2012), a significant volume of cow dung and is produced annually (3 kg dung / Livestock Unit /day).

The Biogas Project, is an initiative that cuts across the energy sector and the waste management sector contributing to a range of Government objectives, namely (and discussed in more detail below):

- provision of equitable access to energy for all
- reduction of greenhouse gas (GHG) emissions
- increasing the contribution of renewable energy in the energy mix
- reduction of the reliance on electricity imports
- reduction of deforestation
- preservation of the environment through better management of waste, and,
- valorization of waste.

When the Project was conceptualized electricity generation stood at 444 GWh (excluding emergency generation from diesel), with electricity use per capita being 1,528 kWh. Botswana was producing 80% of its electricity needs through a state-owned entity, Botswana Power Corporation (BPC), with the rest coming mainly from Eskom in South Africa, EDM (the electricity company of Mozambique) and the Southern African Power Pool (SAPP). The country's installed generating capacity stood at 892 MW, of which 132 MW was under maintenance. In late 2014, national access to electricity was 69%, and was expected to increase to 80% by 2016. The cost of power generation in Botswana is higher than the tariff charged to customers. The difference between production cost and income is covered by a Government subsidy (Project Document).

At the Project design stage, the renewable energy mix connected to the grid was documented to be about 1% (Project Document). It now stands at 2%. An ambitious target of 25% of renewables by 2030 was set by the Government, although a Government-commissioned study on potential feed-in tariff options, undertaken in 2011, concluded that the cost of producing electricity from renewable energy is higher than that generated by coal. The Government indicated that it would consider financial support for renewable energy,⁴ including through a feed-in tariff, ideally in a context where coal-produced electricity prices are market-based without subsidies. Investment by project developers in renewable energy technologies, including biogas, that can produce electricity at a lower cost than the derived cost-reflective tariff was also being encouraged (Project Document).

The Project is designed to address a number of critical environmental issues including: (i) the unsustainable management of waste products including the treatment of effluents from agro-waste, the disposal of agro-waste at landfill sites, offensive odours and the promoting of fly

and rodent breeding' environments⁵; and, (ii) unsustainable consumption of wood-fuel. Wood-fuel is a major source of energy (for cooking, space heating and lighting) for rural and low-income urban communities, representing around 80% of their energy use. Impacts include deforestation, soil erosion and flooding, habitat destruction, increased GHG as well as water-cycle disruption. The Project Document notes the prominence of women in wood collection and cooking; both of these tasks would be alleviated through enhanced access to modern energy services.

At Project inception, Botswana had only around 15 biogas plants, many of which were non-functional, and no methane from abattoirs or landfills was being utilized. The Project Document concluded that 'Botswana DoEs not have a good track record on biogas and that there are no examples of successful working biogas plants'. This situation was attributed to an out-of-date waste management policy, the lack of a national energy policy or renewable energy strategy, the lack of clear guidance on investment in renewable energy technologies, low levels of skills, no dedicated investment facilitation platforms or training programs to support the diffusion of low-carbon agro-waste technologies, **no suitable demonstration projects** for technology penetration and insufficient knowledge among various stakeholders (Government, private companies, farmers, communities, women, consumers) about the benefits of biogas and the available technologies. The Project therefore sought to support the development of a conducive environment to attract and enhance investment from the private sector towards the development of the biogas sector in Botswana. The biogas plants supported by the Project were to play an important role in paving the way for follow-up investments in biogas by the private sector.

2.2 The Project

The **objective** of the Project was to facilitate low-carbon investments and public-private partnerships in the production and utilization of biogas from agro-waste in the districts of South-eastern Botswana.

The project has four strategic and synergistic elements, as set out in the Project Document:

1. Creating an enabling environment that supports the market development of agro-waste management and biogas technology, stimulating investments in biogas technology and increasing uptake of such technologies through new policies, tools and financial incentives.
2. Institutional and private-sector strengthening and capacity development for biogas technology development and servicing, and improved agro-waste management and regulation through awareness-raising, training and dissemination sessions.
3. Facilitation and establishment of biogas installations: these include small,⁶ medium⁷ and utility-scale⁸ biogas plants in South-Eastern Botswana.

⁵ For example, Botswana's beef industry is a key foreign exchange earner, an important source of livelihoods, and is interwoven into the social and economic fabric of the country. The slaughtering of cattle, primarily through the abattoirs under the control of the Botswana Meat Commission (BMC), produces large quantities of agro-waste, including animal faeces, blood, fat, animal trimmings, stomach contents and urine. These waste products are not being sustainably managed and have resulted in adverse environmental impacts (MTR, 2019), including: (i) in most cases, large-scale abattoir effluent is discharged into anaerobic evaporation ponds, many of which are in a poor state of repair or unlined. Degrading manure emits GHGs and pollutes the groundwater with nitrates; (ii) effluent from improvised or slaughter slabs are often discharged into open pits or rivers; (iii) Other types of solid waste from abattoirs (fecal matter and waste produced during carcass processing and offal handling) are often directed to the evaporation ponds via wastewater and are later transported to the local landfill by the district council; (iv) Farm waste and solid waste from small abattoirs is heaped or disposed of at landfills, with little or no utilization; and, (v) Municipal Solid Waste (MSW) and abattoir wastewater is pumped/transported to other drainage locations or transported to landfills in diesel-powered refuse collection vehicles (Project Document).

⁶ Ranging from 4-300 m³ and operated by small-scale (agro-business), livestock producers, households, schools and other institutions.

⁷ Ranging from 300-5,000 m³ and operated by medium-size agro-industry.

⁸ Over 5,000 m³ and typically centralized co-digestion of multiple waste streams and multiple ownership.

4. Facilitation and establishment of appropriate utilization and knowledge platforms⁹.

The Project is organized around 3 components with associated outcomes as summarized in Table 2. The Project's Theory of Change is discussed in detail in Section 3.1.

Table 2: Project Components and Outcomes

Components	Outcomes
Component 1: Institutional strengthening and capacity building for biogas investment and improved agro-waste management and regulation	Outcome 1.1: Increased capacity of Government, private sector and community stakeholders to develop, finance and implement PPPs in the agro-waste sector. Outcome 1.2: Increased capacity of Government authorities to properly monitor and enforce waste management regulations in the agro-industrial sector. Outcome 1.3: Autonomous support systems in place for the replication and scale-up of agro-waste technologies post-project
Component 2: Facilitation and establishment of the first biogas plants in Botswana.	Outcome 2.1: Increased investment in biogas technologies and low-carbon practices in the agro-waste, small-scale farming and institutional (e.g. schools) sectors.
Component 3: Facilitation and establishment of appropriate biogas utilization platforms in at least two districts of South-Eastern Botswana ¹	Outcome 3.1: Increased investment in less GHG-intensive energy systems using biogas

Source: Project Document

Note: The TOR for the TE (Annex 1) refers to component 3 as 'Setting up of utilization and knowledge platforms', as set out in strategic component Number 4 above. However, reference to knowledge platforms is not made explicit in the Logical Framework.

The total Project budget was USD 19,316,300 (Table 3). This includes a grant of USD 2,632,300 from the Global Environment Facility (GEF), USD 200,000 from UNDP, and USD 16,684,000 in co-financing.

⁹ Stakeholders were intended to meet periodically to exchange information and experiences; topic experts were to be invited to prepare tailor-made training; lessons-learned and best practices were to be documented and disseminated at district, national and international level.

Table 3: Overview of Project Finance

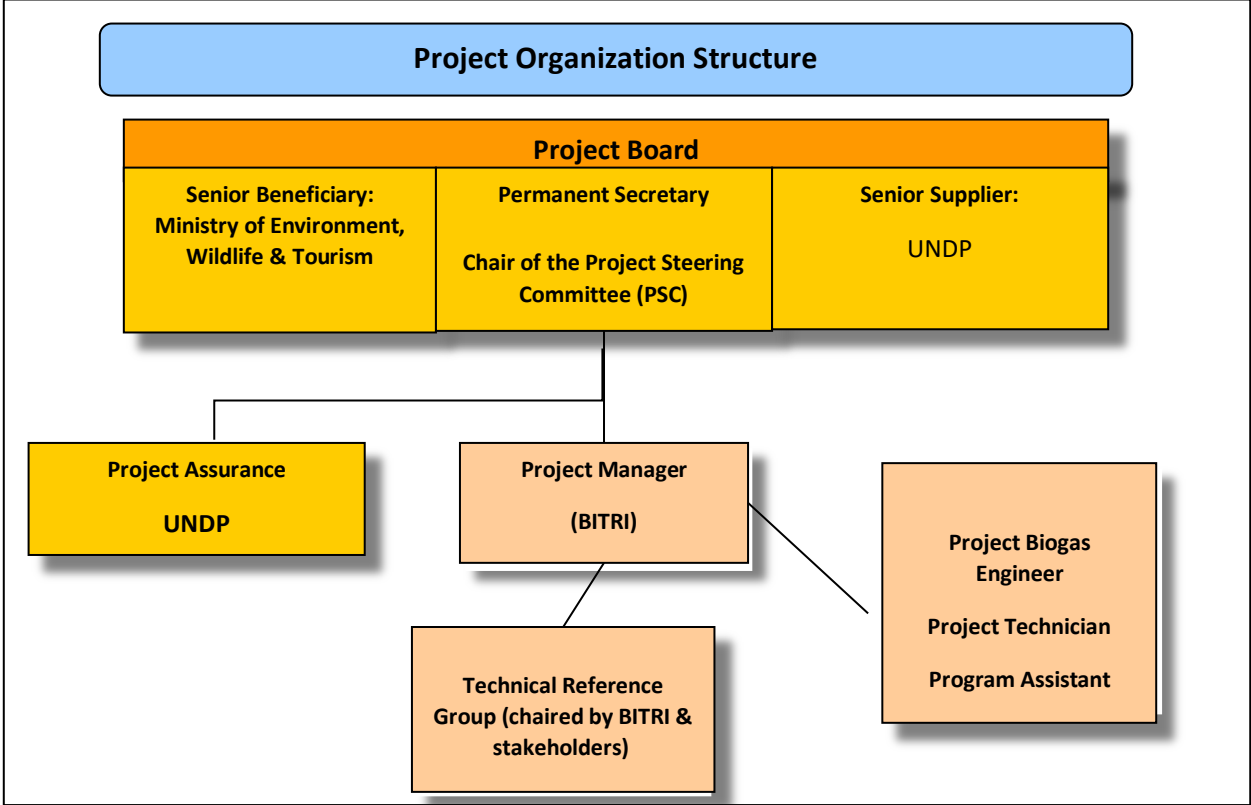
Organization	Commitment USD	Notes
GEF	2,632,300	
UNDP	200,000	Grant to cover project management costs
Botswana Innovation Technology & Research Institute (BITRI)	200,000	Total of USD 200,000 in-kind contribution (USD 50,000 over 4 years) including at least two researchers and office space. BITRI was the executing agency up to the Mid-term
Department of Waste Management and Pollution Control (DWMPC)	1,459,000	USD 309,000 grant to support to IWM policy USD 250,000 – in-kind support to Development of Integrated Waste Management (IWM) policy USD 750,000 IWM policy enforcement (in-kind) USD 150,000 in-kind support for development of National Environmental Fund
Botswana Development Cooperation (BDC)	4,600,000	Loan finance, subject to presentation of commercially viable proposals to Corporation and meeting terms and conditions of BDC
Botswana Meat Commission (BMC)	10,150,000	USD 3,000,000 in capital investment USD 1,000 in-kind to support development of Integrated Waste Management Policy USD 2,350,000 in operating costs for feedlots and biogas digesters (over 3 years)
Ministry of Environment, Wildlife and Tourism (MEWT)	75,000	In-kind support for the Environmental Management Plans, Environment Impact Assessments, demonstration projects and knowledge management and sharing aspects of the project
TOTAL	19,316,300	

Source: Project Document

Figure 1 presents the Project's organizational chart at project design. Up to mid-term the Ministry of Environment, Wildlife and Tourism as represented by the Botswana Institute for Technology, Research and Innovation (BITRI) was the Implementing Partner. Following the MTR, the Implementing Partner changed to the Ministry of Mineral Resources, Green Technology and Energy Security (MMGE), Department of Energy (DOE).

Other key stakeholders involved in the Project include the Department of Waste Management and Pollution Control (DWMPC), Ministry of Local Government and Rural Development (MLGRD), Botswana Power Corporation (BPC), Botswana Energy Regulatory Agency (BERA), District Councils, and the Water Utilities Corporation (WUC). The day-to-day management of the project was carried out by a Project Management Unit (PMU) housed at BITRI and under the overall guidance of the Project Steering Committee.

Figure 1: Organizational chart at design



Source: Project Document

Note: The organization chart was not updated by the Project following the change in Implementing Partner to the DOE.

3 Findings

3.1 Project Design/Formulation

3.1.1 Analysis of Results Framework: project logic and strategy, indicators

The Project design was overly ambitious and not grounded in a logical Theory of Change (TOC) or country circumstances.

As noted in the MTR, the overall design combines actions on the ground with efforts aimed at creating an enabling framework to support growth and investment in the technology. The Project design acknowledged that to achieve the Project's outcomes, especially in relation to the medium and large-scale digesters, an enabling environment needed to be established that supported the integration of biogas into a range of policy waste and energy initiatives. This include the Integrated Waste Management Act, and the possibility of electricity sales through the proposed Power Purchase Agreements (PPA) or Renewable energy feed in tariffs (ReFIT) frameworks¹⁰ (discussed in more detail below). The Project design also recognised the importance of increasing the capacity of the government as well as the private sector. The Project Document notes that 'biogas technology in Botswana DoEs not have a robust track record and there will be insufficient capacity at the beginning of the project to run this high-end technology'. However, it stated that capacity could be developed within the timeframe of this Project.

The **Project logic and strategy** assumed that raising awareness and creating an enabling environment would be sufficient to ignite uptake of bio-digesters at all levels. As designed the Project did not support demonstration sites for the small-scale bio-digesters or include any financial incentives at any of the proposed pilot sites to spread the risk for early market movers / adopters of the technology. That is, while it was a pilot project it was assumed that households / companies would entirely use their own funds to construct the biogas plants. Further, the Project logic and strategy did not adequately reflect the sequencing of steps required to introduce and develop a new technology¹¹. For example, that people are unlikely to fund something they have not seen and is untested, that the development of Public Private Partnerships (PPP) frameworks should not precede effective demonstrations of the technology and that technologies need to be pushed before the market can be expected to pull them. It also underestimated the time needed for change to happen.

As a result, the Project struggled from the outset at implementation. Given the novelty of biogas technology in Botswana and that previous attempts to introduce the technology had not fared well, the Project had to spend a lot of time building an understanding of the technology and convincing people of its benefits. Generating interest in biogas was further complicated by the fact that many agricultural and energy programs in Botswana are free or supported by incentives, a factor not considered in Project design.

The Theory of Change (TOC) presented in the Project Document is weak and cannot in fact be categorized as a TOC (Figure 2). The TOC should set out the process of how a project's

¹⁰ The Project design recognized that the provision of **performance-based incentives** was an important marketing tool, needed to stimulate development of the sector and that such incentives should be linked to pre-defined quality standards to support private sector investment in biogas technology and its construction. The GEF project proposed a performance-based incentive as a bridging arrangement until the REFIT was operational.

¹¹ The MTR sets out the different stages to the maturation of a technology (Research and Development (R&D), demonstration, pre-commercial, supported commercial, commercial).

outputs¹² will lead to the project outcomes¹³ (to be achieved within the project timeframe) and place the project on the path to achieving its objectives¹⁴. These causal relationships are not set out and the TOC appears to confuse the connection between outputs/outcomes/objectives. The TOC should further define the external factors that influence change along the major pathways i.e. factors that affect whether one result can lead to the next. These include assumptions (which are not within the project's control) and drivers (which are to some extent controlled by the project). It would also have been instructive for the TOC to specify the causal links for each scale of digester (small, medium, large) separately, given the specific challenges and timeframes facing the technology at its various scales. This would have laid out the requirements and linkages at each stage of the technology development – awareness and capacity building, design, piloting/demonstration, roll-out, lesson learning and adaptation.

Other design weaknesses include: (i) the understanding of costing and markets was insufficient; and, (ii) more stakeholder engagement was needed at the design stage to better scope the Project and understand financing.

Figure 2: Theory of Change as presented in the Project Document



Source: Project Document

The TOC DoEs *not* link to Logical (Results) Framework presented in the Project Document, discussed further below.

Results Framework

A number of targets in the Results Framework are *not* SMART (Specific, Measurable, Achievable, Relevant, Time-bound), in that they proved to be unachievable within the Project timeframe. No mid-term targets were set, and no formal revisions were made to the Results Framework either at the Inception Phase or following the MTR. The exception to this is that the number of small-scale bio-digesters to be installed was revised down from 1,000 to 200, with the approval of the JSC (it is not clear if this change was approved by the GEF). Table 4 sets out the indicators, targets, assumptions and risks. Targets 2b and 7a / 2b and 7b are

¹² A project's **outputs** relate to the availability of new goods and services to intended beneficiaries, and /or gains in knowledge, abilities and awareness of individuals or within institutions.

¹³ An outcome is the use (i.e., uptake, adoption, application) of an output by intended beneficiaries, observed as a change in institutions or behaviors, attitudes or conditions.

¹⁴ The TOC may also set out Intermediate states, which are the changes required beyond project outcomes needed to contribute towards the achievement of the intended impact of the project.

duplicates and could have been revised at Project Inception or at the MTR to remove this overlap.

The Results Framework is overly ambitious. The Project Document set a target of 1,000 small-scale biogas plants within the Project timeframe, which was unrealistic, especially given uptake was contingent on stakeholder buy-in and the technology was not well understood¹⁵. The three proposed medium-scale digesters were based on the assumption that organizations such as the BMC would be willing to engage and finance the digesters, despite the high capital outlay required for an un-proven technology in the context of Botswana. It also assumed a conducive policy environment for business investments would be developed within the Project timeframe, but the approval of policy is unpredictable and often a lengthy process, and while the Project has supported the development of policies, key incentives to encourage uptake of the medium-scale bio-digesters are yet to be formally adopted.

In a number of cases it is not possible to clearly link activities to output indicators and targets¹⁶. The indicators and targets are largely focused on the end stage of the uptake of biogas technology (e.g. the biogas plants installed and operational, or financial institutions investing in biogas plants) rather than on the steps needed to build the foundation for the successful evolution of biogas in Botswana. There is only one target on capacity building (related to the training of masons) and no targets related to awareness raising or knowledge management and dissemination. This is despite the fact that the first sub-outcomes under Outcome 1 are about capacity; targets related to Outcome 1.1. and 1.2 focus on the legislative / enabling framework. The fact that many targets assume the successful uptake and finance of medium and large-scale bio-digesters made it impossible for the Project to perform well in terms of its progress towards expected outcomes and its objectives as discussed in detail in Section 3.3. There are no targets measuring broader development impacts such as income generation or gender equality, which could have been included under Indicator 2 - Project beneficiaries.

Table 4: Overview of Indicators and Targets at design

Description of Indicator	End of project target level	Assumptions / Risks
Objective: To facilitate low-carbon investments and public-private partnerships in the production and utilization of bio-methane from agro-waste in the districts of South-Eastern Botswana.		
1. Amount of reduced CO ₂ emissions as a result of investments facilitated by the project.	Installations in place and operating to achieve direct and indirect reductions of 1.9 million tonnes CO ₂ .	
2. Project beneficiaries	a/ Minimum of 3 medium-scale agro-industries installed and operational; b/ 1,000 small-scale agro-businesses utilizing agro-waste streams for biogas digestion; c/ at least 2 District Councils utilizing organic waste for biogas digestion. d/ at least 2 companies constructing biogas digesters e/ 75 masons trained and employed.	
3. Energy generation using biogas	350,000 MWh	
4. Number of new development partnerships with funding for improved	3 Public-Private Partnerships in place to facilitate biogas investment.	

¹⁵ The MTR noted that the first small-scale biogas digester was assumed to be installed on the same terms as the thousandth small-scale digester. Despite being a pilot project, there was no staggered approach to sales starting, for instance, with subsidized options and becoming increasingly commercial over time.

¹⁶ For example, PSC minutes December 2018 notes that for the Large Scale bio-digester the activity and output are not linked and advised the activities to be more aligned to Policy.

Description of Indicator	End of project target level	Assumptions / Risks
sustainable energy solutions		
Outcome 1 <ul style="list-style-type: none"> Increased capacity of Government, private sector and community stakeholders to develop, finance and implement PPPs in the agro-waste sector. Increased capacity of Government authorities to properly monitor and enforce waste management regulations in the agro-industrial sector. Autonomous support systems in place for replication and scale-up of agro-waste technologies post-project. 		
5.Extent to which policies and regulations for waste management in the agro-sector are adopted and enforced.	a/Specific guidelines on low-carbon alternatives and utilization technologies for agro-waste and wastewater developed and disseminated. b/ Framework agreement for at least 3 public-private partnerships (PPPs) in the waste sector and biogas related in place and implemented. c/ Up-to-date regulations developed and adopted for the successful monitoring of effluent flows. d/ Financial institutions invest in at least 3 biogas plants.	Assumptions: DWMPC will formulate an updated Waste Management Policy that includes CO ₂ reduction. The project's barrier removal strategy can be successfully implemented. The Government maintains the commitments it has stated in Parliament and in Botswana's Intended Nationally Determined Contributions (INDC) Sustained O&M of digester units to ensure ongoing usage. Councils will pursue their legal ability and stated interest in entering into PPPs.
6.Number of beneficiaries (owners/users of biogas)		
Outcome 2: Increased investment in clean-energy technologies and low-carbon practices in the agro-waste sector.		
7.Increased investment in clean-energy technologies and low-carbon practices in the agro-waste sector.	a/ 1,000 small-scale biogas digesters constructed and operational. (revised at mid-term) b/ Three medium-sized biogas digesters constructed and operational. c/ Finalized proposal to construct a centralized biogas digester of an estimated 15,000 m ³ or larger with facility to upgrade to bio-methane and utilization. d/ At least 3,000 m ³ biogas per annum and 3 MW of electricity installed.	Assumptions: The proposed legal and regulatory improvements pass swiftly through the Government approval process. Adequate demand for, and competitively priced financing products able to provide, long-term financing. Banks' requirements for securities within clients' limits. Risks: The investment in biogas technology is no longer deemed bankable; Focus on other technologies for waste management.
Outcome 3: Increased investment in less GHG-intensive energy systems using biogas.		
8.Total investment (US\$) in biogas technology.	At least three financial institutions have incorporated the financing of biogas technology in their national portfolios.	

3.1.2 Assumptions and Risks

The Project Document provides a detailed table of risks and proposed mitigation actions. A high-level risk identified at design was that the agro-waste industry in Botswana would be slow to adopt new technologies to address waste management from agro-waste. It recognized that the sector required incentives or enforcement to attract investors in waste management / biogas technologies, given the high investment cost for construction and operating biogas installations¹⁷. To mitigate this risk, the Project was to support the development of the **Integrated Waste Management Policy** and the development and introduction of financial incentives, including the ReFIT, with the aim of reducing the financial risks for investors and ensuring bankable projects. Further, the Project was to advocate for the development of a level playing field whereby Independent Power Producers could supply through the grid under commercial conditions. The Project Document also identified as a high risk the fact that the time for approval by Parliament of the **Integrated Waste Management Policy** could be lengthy, delaying the implementation of the policy. To mitigate this risk, a detailed work plan with DWMPC, Councils and other stakeholders was to be agreed to support multi-stakeholder platforms, which could be used to express the importance of having the Policy in place.

3.1.3 Lessons from other relevant projects incorporated into project design

According to the Project Document 'The international experiences and lessons learned from catalyzing local renewable energy development have been taken into account in the design of this new project. The applicable parts of the information collected and the work and contacts initiated during the previous projects will be fully utilized, thereby not losing or duplicating the work already done'. However, what those experiences and lessons are is not clear. The Project Document would have benefited from an overview of the legal, regulatory, institutional barriers and practical challenges to the successful development of a biogas sector utilizing agro-waste in other countries. This would have informed an understanding of how other countries have built up their biogas programs in practice.

3.1.4 Planned stakeholder participation

In developing the Project Document, three stakeholder workshop were held as well as follow up meetings. The third workshop was used to validate the Project design. Most stakeholder had a high interest in the Project at the design stage. As noted above, a number of institutions also committed co-financing at the design stage. However, there is no evidence that potential beneficiaries (households) were consulted at the design stage regarding the small-scale bio-digesters; such consultations could have led to more realistic targets being set and helped to define the development process.

The Project Document provides an overview of waste management and energy institutions involved in organic waste management, related technologies such as biogas and research and innovation and their planned role in the Project. Key stakeholders are:

- **Ministry of Environment, Wildlife and Tourism (MEWT)** is the national implementing entity.
- The **Department of Waste Management and Pollution Control (DWMPC)** under the MEWT, is leading work on an Integrated Waste Management Policy (which at design was expected to be concluded in 2016). They were to undertake a review of the Botswana Strategy for Waste Management 1998 and the Waste Management Act 1999 to include biogas / bio-methane and develop an Integrated Waste Management Policy with support from the Project.
- The **Department of Environmental Affairs (DEA)**, under the Ministry of Environment, Wildlife and Tourism, is the custodian of the Environmental Assessment Act (EAA) and

¹⁷ The cost of generating electricity from biogas is higher than the cost of electricity supplied by Botswana Power Corporation for large-scale business (0.43 BWP/kWh) (Project Document).

other environmental legislation and multilateral agreements such as the UNFCCC. It is the focal point for implementation of action plans related to the Sustainable Development Goals (SDGs) and GEF focal point in Botswana. DEA was to review biogas demonstration plants' EIAs, and facilitate awareness creation through two divisions: the Environmental Information Management Unit, which is responsible for online publications; and the Environmental Education and Awareness Unit, which uses print, television and radio to disseminate environmental education.

- **Ministry of Local Government and Rural Development (MLG&RD), and District Councils** were to participate in demonstration of biogas as a replacement fuel for diesel, support PPPs between the private sector and Government (Councils), undertake a review of waste management practices with regard to landfills and contribute finance for construction of biogas digesters in primary schools, particularly the Kgatleng and Lobatse Councils.
- **Ministry of Minerals Energy and Water Resources.** The Energy Affairs Division (EAD)¹⁸ was to participate in policy reviews (Component 1) and develop a RE feed-in-tariff for the benefit of biogas.
- Botswana Power Corporation (BPC).
- The **Botswana Institute of Technology Research and Innovation (BITRI)** is a publicly funded research and development institution / parastatal under the Ministry of Infrastructure, Science and Technology (MIST). At design BITRI was delegated daily operational responsibility for the Project. It was to host the PMU, coordinate policy reviews with DWMPC, DEA, EAD and others, collect information from demonstration plants as well as local communities where the demonstration plants are based (monitoring and evaluation).
- The Minister of Infrastructure, Science and Technology was to bring the required political will and support to the Project through budget approvals and regular updates to the Office of the President.
- The **Botswana Innovation Hub (BIH)**, under the Ministry of Infrastructure, Science and Technology, provides facilities to domestic, regional and global companies undertaking research and development activities and promoting technology-based innovation and entrepreneurship. They were to host bio-methane training activities and help develop an investment facilitation platforms for further agro-waste technology diffusion.

Parastatals and Private Sector:

- **The Botswana Meat Commission (BMC)**, a parastatal responsible for the slaughter and marketing of all beef exports¹⁹, were to: (i) participate in the planning for the Project's main demonstration biogas plant at the BMC premises; (ii) contribute resources towards construction of the biogas plant; and, (iii) participate in the development of the Integrated Waste Management Policy. While the BMC were willing at the design stage to finance their own biogas plant, it was also recognized that they would require additional financial support for construction of the digester.
- **BioSys Botswana Pty Ltd** is a limited liability company established to develop the waste-based renewable energy sub-sector in Botswana. The company has developed preliminary plans to develop the **BioSys Energy Park**. Based on preliminary discussions with BioSys, UNDP and Barclays Bank they indicated that they would provide a commercial loan of up to USD 2 million for a biogas plant, assuming a positive feasibility study and a successful outcome to its standard financial due diligence.
- **Weltec Biopower GmbH**, a German company, is a biogas plant construction

¹⁸ The EAD became the Department of Energy during Project Implementation.

¹⁹ The facilities at BMC headquarters in Lobatse are constructed as an integrated complex of abattoir, canning, tanning and waste treatment/by-products plant to handle a throughput of up to 8,000 cattle and 500 small stock per day.

company. Weltec Biopower is a partner of BioSys in the proposed development of the BioSys Energy Park and at design agreed to provide a range of in-kind support (preliminary feasibility study and technical advisory support) for any future biogas project, on the assumption that it will be the chosen technology supplier for any tendered plant. It was anticipated that Weltec could compete with other biogas technology providers to conduct a feasibility study on the design, construction and operation of medium-scale biogas plants on a cost-recovery basis.

- The **Organic Fertilizer Manufacturers of Botswana (OFMB)** is the first large-scale organic fertilizer company in the country. It was anticipated that the Government's **Integrated Support Program for Arable Agricultural Development (ISPAAD)** could be targeted as an awareness-raising platform for organic fertilizer as it is already distributing for free 50 kg bags of chemical fertilizer to subsistence farmers each year. The organic fertilizer from biogas production (digestate) value chain, has potential to improve livelihoods in areas where biogas digesters are constructed.
- The Gender and Energy Network of Botswana (GENBO) at Project design was participating in the development of the Integrated Waste Management Policy that is currently being developed by DWMPC.

Banks / Financiers:

- The **Botswana Development Corporation (BDC)** is the country's main agency for commercial and industrial development. The Government of Botswana owns 100% of the issued share capital of the Corporation. The Project Document states that the BDC considered the Biogas Project to be of national importance and expressed its willingness to provide credit to bankable biogas projects. To provide a loan for the construction of a biogas plant, BDC stipulated the following criteria: (i) a commitment from the Botswana Power Corporation (BPC) to purchase power produced by a biogas/bio-methane project (i.e. a PPA); (ii) a maximum contribution of 25%; and, (iii) provision of loan interest at a competitive interest rates.
- **Barclays Bank of Botswana.** Barclays has, through Absa Bank,²⁰ funded a biogas project in South Africa. Barclays energy and infrastructure desk expressed interest in the provision of financing (loans and working capital) for biogas projects in Botswana;
- **Insight Consulting** connects local entrepreneurs with overseas financiers, and at Project design saw potential for such partnerships in the context of biogas / bio-methane. They therefore expressed an interest in connecting private companies with European or American financiers, to potentially secure loans at between 5-10% interest per annum.

3.1.5 Linkages between Project and other interventions within the sector

The activities of the other donors and the foreseen synergies and opportunities for co-operations are discussed in chapter 1 of the Project Document. During implementation, the intention was to establish communication and co-ordination mechanisms to ensure that areas of common interest were addressed in a cost-efficient way. For example, the Project was to: (i) collaborate with the UNIDO-implemented, GEF-financed project, 'Promoting organic waste-to-energy and other low-carbon technologies in small and medium and micro-scale enterprises (SMMEs): accelerating biogas market development' (PIMS 5704); (ii) build on the lessons of the Government of Botswana implemented GEF-financed project, 'Renewable Energy-Based Rural Electrification Program for Botswana'²¹ in developing a guide for the development of the PPP model; and, (iii) build on BITRI biogas project with a partner in Ghanzi District in western Botswana.

²⁰ Absa Bank Limited (Absa Bank) is a wholly-owned subsidiary of the Barclays Africa Group. Absa Bank exists in South Africa and Namibia only.

²¹ PMIS 1235.

3.1.6 Gender Responsiveness of Project Design

Section 1.8 of the Project Document notes that it is women who suffer the most from conditions of extreme poverty, and that, due to that fact that they are traditionally responsible for collecting fuel and water, women and girls would benefit the most from access to improved energy services. The Project Document states - 'It is therefore imperative that gender is mainstreamed in the GEF-financed biogas project'. In order to achieve gender equity, Project activities with specific gender equality outputs were to be undertaken such as:

- Development of gender goals and indicators.
- Equal participation in decision-making roles: e.g. in the Councils' project management teams.
- Similar numbers of women and men trained in bio-digester construction, maintenance and repair.
- Marketing of bio-digesters to agro-businesses – at least 40% women engaged in the promotion of the small-scale bio-digesters.
- Women biogas masons and entrepreneurs established – 40% of the agro-business bio-digesters reserved for women entrepreneurs and women's groups.
- Women's groups encouraged to take up biogas work.
- Gender training was to be conducted for the Project management team at BITRI.
- Gender parity sought in the employment of Project staff (50% women and 50% men, to the extent possible).

While the Project Document states that 'the project has a major focus on women, therefore gender mainstreaming will be applied at all levels of project implementation and monitoring and evaluation' (para 217), it DoEs not include a specific gender action plan for the delivery of gender activities. The Project Document DoEs not include any gender targets in its Results Framework. Gender is made explicit in one activity; Activity 3.2.2 – develop gender sensitive training materials to train male and female masons. It is not clear what gender expertise was used in the design and development of the Project.

3.1.7 Social and Environmental safeguards

A Social and Environmental Screening report (SES)²² is provided in the Project Document. The Project's overall risk categorization is Moderate. The Project has the potential for adverse social and environmental risks and impacts, related to the construction of the biogas plants – for example safety risks related to explosion of biogas during construction and operation, risks to community health and safety through transport accidents with organic waste, and risk of greenhouse gas (methane) being emitted and sludge being released in open water. These risks were all to be addressed through application of high-quality construction, applied safety standards, capacity development, best practice, mitigation measures and stakeholder engagement during Project implementation

3.2 Project Implementation

3.2.1 Overview of key achievements and challenges

As context, this sub-section set out the key achievements of the Project and the main challenges it faced - these are discussed in more detail in later sections of this report. Key achievements include:

- **Small-scale biogas plants have been successfully piloted and there is interest in their broader uptake.** The small-small-scale biogas plants have had a positive impact on people's lives reducing energy costs and the time spent collecting fuelwood by women, reducing deforestation and providing health benefits from reduced indoor air pollution.

²² UNDP's Social and Environmental Standards (SES) underpin UNDP's commitment to mainstream social and environmental sustainability in its Program and Projects to support sustainable development. The SES policy was launched in 2015 and updated in 2019 to ensure alignment with GEF's new safeguards policy.

- **Training of masons** has built technical expertise in the construction of bio-digesters, which supports the sustainability of the Project's benefits, and has created employment, especially for youth.
- **The Project has advanced the policy and regulatory framework for biogas and renewables**, notably through the development of biogas standards, biofuel guidelines, an update of the ReFIT (Renewable Energy Feed in Tariff), and support to the draft IWM Bill, Green Certificate Framework and Trade Effluent Agreement.
- **The Project adopted an integrated approach to energy generation and waste management, and engaged a broad range of stakeholders.** The Project worked closely with two ministries – MENT and MMGE.
- **The Project has successfully pushed the energy diversification agenda**, for example through the work done on ReFIT and renewable energy in general, and promoted a circular economy.
- **The Project has raised awareness and changed the perception of biogas.** A radio campaign in 2020 increased the visibility of the Project and increased public interest in small-scale biogas plants.

Key challenges facing the Project:

- **COVID-19 restrictions affected all aspects of Project implementation from its fourth year of implementation** resulting in numerous delays and adaptations, including: (i) limitations on face-to-face interactions affected engagement with project partners and beneficiaries, with many training events and meetings postponed; (ii) the Project required a considerable amount of travel to rural areas, where the small-scale biogas digester sites were located, both for construction and monitoring. COVID-19 national travel restrictions imposed for a period of two months (April – May 2020) meant that the construction of the digesters had to be halted and in general COVID-19 travel restriction made it difficult to get to sites by the masons and others resulting in construction delays. In some cases, partly constructed digesters were damaged during the hiatus in activities and farmers were unable to feed the digesters; (iii) there were disruptions in supply chains leading to delays in partners and beneficiaries receiving goods and services. For example, with border closures / restrictions it was difficult to get construction materials from South Africa leading to delays in construction of the small-scale bio-digesters²³; (iv) procurement of consultants was affected, as internationally based consultants were unable to travel to undertake the required work; (v) there were a number of in-direct financial impacts related to COVID-19. In some cases people lost their job, so could no longer finance a small-scale bio-digester and left the Project. While for medium-scale digesters, the squeeze on Government and private sector finances meant they were not financially feasible due to the high capitalization cost and low liquidity; and, (vi) some beneficiaries contracted COVID and could not continue their engagement in the Project.
- **Project management.** The Project faced significant project management issues, with a change in the Implementing Partner following the mid-term review, three Project Managers over the Project period, and a reduced PMU (from 3 to one person) over the closing year of the Project.
- **Project Design.** As discussed above, the Project design was overly ambitious and not well grounded in the realities on the ground. The four-year duration was not realistic for such a complex project, especially considering the ambition to install 3 medium-scale digesters. The upshot of this in terms of Project implementation was that Project activities were not appropriately sequenced and focused across the 4 year Project.
- **Finance and private sector engagement.** While community members (farmers and agribusinesses) showed interest in the technology they indicated a lack of funds to self-finance construction of small-scale digesters. This slowed down the roll out, with

²³ There was reportedly a period when there was no cement at all in the country.

the Project revising its approach and introducing demonstration plants and a subsidy arrangement. Access to funding for biogas digesters from banks and government also hindered implementation / uptake of the biogas plants at all scales. Engagement of the private sector and the ability to raise finance for medium-scale digesters proved very challenging, although considerable effort was put into exploring a viable medium sized digester in the first 3 years of the Project.

- **Enabling environment** for private sector engagement is still under development. While the Project developed standards, the updated Renewable Energy Feed in Tariffs and revised Integrated Waste Management Bill are still to be adopted.

3.2.2 Adaptive management

Adaptive management relates to the changes to project design and project output during implementation. The Project that has been implemented is much reduced in scope relative to its design as summarized in Table 5, and discussed further below. The Project implemented less than half of its planned outputs and 61% of its activities, many of which needed to be downscaled or revised. The reduced scope has meant that the Project did not achieve many of its outcomes, as discussed in Section 3.3. While the Project adapted in a number of ways, as set out below, these adaptations could have gone further to better focus the Project.

Table 5: Overview of Number of Outputs / Activities implemented relative to design

Outcome	Design	Implemented
1.1: Increased capacity of Government, private sector and community stakeholders to develop, finance and implement PPPs in the agro-waste sector.	7 outputs 16 activities	4 outputs 12 activities (adapted)
1.2: Increased capacity of Government authorities to properly monitor and enforce waste management regulations in the agro-industrial sector.		
1.3 Autonomous support systems in place for replication and scale-up of agro-waste technologies post-project.	3 outputs 4 Activities	3 outputs 4 activities (adapted)
2: Increased investment in clean-energy technologies and low-carbon practices in the agro-waste sector.	9 outputs 15 activities	4 outputs 11 activities (adapted)
3: Total investment (USD) in biogas technology.	6 outputs 14 activities	1 output 3 activities (adapted)
TOTAL	25 outputs 49 activities	12 outputs 30 activities

No formal changes were made to the Project's Logical Framework at the Inception phase or following the MTR, although various obstacles to the uptake of the biogas plants and the likelihood that the Project would not be able to attain many of its targets were highlighted early on in the Project (see, for example, PIR, 2018). The Regional Technical Advisor (RTA) called for substantial modifications of the indicators (some of which had become obsolete) as late as June 2021 – i.e. 6 months before project closure (PIR, 2021). However, this is too late in the process to have any impact on the Project's strategy. The Logical Framework and the Theory of Change should have been revised much earlier on in the Project's life as it became evident that a re-orientation of the Project's strategy and focus was needed to increase its efficiency and effectiveness. Such a re-evaluation may have allowed for the roll out of more small-scale digesters, a monitoring period, and a detailed synthesis of the lessons learnt. The initial timeframe was to roll out the small-scale biogas plants in Year 1 of the Project. For various reasons this did not start in earnest until 2021.

While no formal changes to the Logical Framework were agreed with the GEF, following the MTR the Project documents acknowledged the small-scale bio-digester indicator as the clear 'flagship indicator' for the Project. The revision of the target for the small-scale bio-digesters

from 1,000 to 200 was recommended by the MTR²⁴ and endorsed by the PSC following the Management Response to the MTR.

Further, the Project introduced a number of changes to how it was implemented in response to the COVID-19, the obstacles facing uptake of biogas as a new technology in Botswana and project management issues.

COVID-19 specific adaptations

- Restrictions on movement and physical meetings and workshops caused by the COVID-19 pandemic, resulted in the Project adopting digital means of disseminating public information and generating awareness and interest in the utilization of bio-methane from agro-waste (PIR, 2021). The Project developed an animation video and on-site video which were shared through television and social media platforms. However this did exclude people living in areas without internet connectivity (PIR, 2019).
- The Project developed an online application form for applicants of the small-scale biogas plants to use when strict social distancing was in place (PIR, 2020).

Adaptations to address project management issues / delays

- Following the MTR, the Implementing Partner changed from BITRI to Department of Energy.
- In an effort to accelerate construction of small-scale bio-digesters the project engaged a consultant to oversee construction of the 150 digesters in 2021.
- In response to the limited number of masons responding to the call for construction of small-scale biogas digester, the Project trained additional masons to increase the pool of qualified masons.

Adaptations to address barriers to uptake

- Ahead of the MTR, the Project realized that in order to sell the technology it needed first to demonstrate that it worked, and build understanding and interest. In July 2017, the PSC approved 30 demonstration digesters.
- Another barrier to uptake of the small-scale biogas plants was cost / finance. The need for subsidies / grants to encourage uptake was recognized by the PSC in July 2017. Following the MTR, to address this and incentivize uptake, the Project adopted a cost sharing arrangement with the beneficiaries, whereby the Project financed the labor costs and the beneficiaries were responsible for providing the building materials.

Adaptations related to change in scope

- While the Project persevered for many years to meet the target of establishing three medium sized biogas plants, as specified in the Project design, in 2020 it became apparent that it would not be possible within the Project timeframe – largely due to financial issues. Nonetheless, the Project endeavored to push forward with activities that would put the country in a better position to establish medium sized biogas plants in the future. For example, the Project supported the National Development Bank (NDB) to develop an Environment and Social Management Framework (ESMF), to strengthen their ability to assess environmental projects and attract concessional funding from International Development Banks such as the African Development Bank (AfDB) and the European Investment Bank (EiB).
- Green Certificate Framework for buildings (waste-water). Bench marking for green certification did not take place as it was not possible to do this remotely. However, the Project added energy efficiency to the framework– supporting the development of a solar - thermal road map for Botswana.

²⁴ The MTR recommended a target of 200-300, and the lower level target was adopted.

- The PSC October 2020 agreed to replace the initial activity 1.4.5 - piloting of a constructed wetland, with the piloting of a wastepaper recovery project at a government enclave, led by the DWMPD with a budget of USD 50,000.
- The development of effluent regulations was removed as an activity, as the Trade Effluent Agreement (TEA) was to play the role of enforcement. This was endorsed by PSC (2021).
- The development of a PPP framework was removed, as one already existed (PSC, 2021). The Ministry of Finance and Economic Development are the custodians of the PPP framework for Botswana. Further, a PPP waste to energy project is not feasible, given the limited quantities of organic waste produced in Botswana.

3.2.3 Actual stakeholder participation and partnership arrangements

It was anticipated that the Project would be implemented in close collaboration with key partners. The Biogas technology was not well known to farmers and institutions within the region and therefore much effort was placed at the start of the Project on convincing farmers and agricultural officers of its benefits. Biogas technology **education and awareness raising** are cited as major Project activities (although there are no specific indicators / targets monitoring and measuring these activities). From the beginning of the Project, stakeholders were engaged and sensitized at the institutional and community through presentations, workshops, trainings and social media (PIR, 2018, 2019, 2020)²⁵. According to PIR, 2020 the Project adopted a regular and proactive approach to stakeholder engagement through the media (e.g. radio shows with public Q&A sessions led by senior Government officials, press releases and a televised visit by the Minister of Energy to one of the biogas digester sites). The increased use of social media, radio and television reportedly led to an increase in the number of people interested in the Project.

The Project reportedly provided knowledge sharing and awareness raising opportunities in the Project area for district councils²⁶, farmers associations and government departments interested in the biogas technology. For example, through the Farmers Associations, the Project presented at public events like Agriculture Shows and meetings.

Training was provided for the Technical Reference Group, Government stakeholders engaged in the Project and banking officials to introduce waste to energy projects and generate interest in financing such projects. Training of trainers and masons was held on the construction, operation and maintenance of small-scale digesters.

Partnerships were acknowledged as being essential to achieving the Project objectives (PIR, 2018). At the start of Project implementation, there was a need to re-cultivate the partnerships and agreements that were made during the Project formulation stage (PIR, 2019). Extensive stakeholder engagement was needed upfront, to re-convince some partners of the benefits of the proposed biogas technology (e.g. Rural District Councils (RDCs), BMC) and to encourage participation. This resulted in constant communication with institutions and delayed Project implementation (PIR, 2018). Some institutions that had pledged financial support indicated during implementation that they did not have sufficient funding (PIR, 2019) while a number of partners cited in the Project Document left the Project in its early stages, as they no longer saw a role for themselves or lost interest. For example:

- RDCs. As specified in the Logical Framework, the intention was to have 2 RDCs using biogas. It was thought that District departments responsible for waste would consolidate organic waste and use it to feed into a large or medium-scale digester. The energy would then be used by trucks to collect waste or machines to compact waste. The RDCs were

²⁵ An overview of the number of different types of sensitisation activities and training provided, or the number of stakeholders benefiting from them was not provided and is presumed not to be available.

²⁶ The objective was for council officers to encourage district members (farmers) to uptake the technology.

keen on the Project at the design stage, but in the first year of implementation it became clear that there was not enough organic waste to establish bio-digesters, and their role fell away.

- Botswana Development Corporation, BMC, BioSys, SENN Foods
- Banks. In the first years the Project engaged with the banks, but this did not result in any concrete support for bio-digesters, with the exception of NDB (discussed further below).

The Project did however develop partnerships and is an example of integrated working across Government Ministries promoting an understanding of the synergies and opportunities around the waste and energy agenda. Government agencies engaged in the Project include:

- Botswana Institute for Technology, Research and Innovation - conducted research on biogas technology and quality of gas produced by the feedstock used.
- Department of Waste Management and Pollution Control (DWMPC) – led the review of the Waste Management Act.
- Botswana Bureau of Standards – help to develop the biogas standards.
- Water Utilities Corporation – supported the review of the Trade Effluent Agreement (TEA) and strengthened their capacity to monitor and enforce TEA.

PSC membership represents a good coverage of Government stakeholders. It was anticipated that information from the meetings would be shared with other stakeholders at district level. Agencies represented are: MENT- DWMPC (Chair), UNDP (co-Chair), BITRI, BMC, DOE, LTC, BPC, MLGRD, PMU, BDC, BERA, Ministry of Agriculture & Food Security (MoAFS), Local Enterprise Authority (LEA), JTC, GCC, SDC, SEDC. KwDC and KDC. Membership of the PSC grew through the Project to incorporate strategic partners, for example: (i) In July 2017 it was proposed to include LEA and the Ministry of Basic Education (MoBE) (to ensure technical integration into their education systems) and the Botswana Energy Regulation Authority (BERA); and, (ii) The PSC (December 2019) noted that implementation should involve the agricultural extension officers at district level, who should be capacitated to serve as an entry point for the Project and beneficiaries to combat issues of malfunctions of digesters and maintenance. The Ministry of Agriculture and Food Security was invited to join the Project Steering Committee, and 4 agricultural extension officers for each of the Project districts were engaged to work with the Project team. Private sector is not represented on the PSC.

The TE was not provided information on the **Technical Committee / Reference Group** (e.g. Terms of Reference, composition, minutes of meetings). According to the TE interviews, they intended to meet on a quarterly basis, but did not engage at the level expected due to COVID-19 (although this constraint relates to the last 2 years of the Project). The committee tried to provide strategic guidance, and have played a role in evaluating reports, and the design of small and medium-scale biogas. TC members also travelled to Uganda to visit their biogas plants.

The Project was designed to create a number of other working Groups / platforms. These include: (i) Biogas Working group; (ii) Multi-stakeholder platform to define Biogas guidelines and standards (established); (iii) Multi-stakeholder platform to update regulations and monitoring; (iv) Investment facilitation platform (not established). It is not clear if some of these were in fact established, and generally for all groups details of their composition and level of activity was not provided to the TE. It is unclear whether any of these groups will continue beyond the Project.

To encourage partnerships the Project was to reach out to development partners to seek partial investment support to bridge the financing gap and to scale up project activities. In terms of the **Private Sector**, the Project engaged with financial institutions in Botswana (NDB, Barclays Bank Botswana etc) on financing biogas digester construction and developed a relationship with NDB, who are keen to support green economy initiatives. The Project

explored how the NDB can help farmers access soft loans and has supported the NDB to develop an ESMF. The October 2020 PSC minutes report that the Project, through the DOE, signed a memorandum of agreement with National Development Bank (NDB), to support the implementation of renewable energy projects. This agreement is subject to DOE submitting a detailed Renewable Energy Concept, to guide the NDB on investment. The NDB has reportedly shared a proposed financing model for the small-scale biogas project (unseen by TE). It is hoped that the NDB will augment access to funding for small-scale digesters and accelerate the roll-out and upscale of the concept beyond the Project area and Project lifespan. A proposal to support small-scale farmers is reportedly under discussion between NDB, DOE and UNDP.

As discussed throughout this evaluation report, financing was a key challenge. PIR, 2018 recommended that the Project reach out to both the African Development Bank (AfDB) and International Finance Corporation (IFC) as both agencies have experience in supporting municipalities with integrated waste management. The RTA also suggested contacting various potential private sector partners such as - SNV who has extensive experience in domestic biogas in Africa and Asia., Hivos, and Weltec Biopower GmbH, GIZ and Nepal's AEPC (PIR 2019). The Project acted on these recommendations to a certain extent, reaching out to SNV in Zimbabwe as well as Nepal's AEPC for technical support, and approaching the National Development Bank (a partner with AfDB) to finance digester construction at both medium and small-scale.

3.2.3.1 Project finance

Based on information provided to the TE, total disbursements as of 1 March 2022 were 75%, representing an underspend of USD 663,954. The projected underspend at Project completion (taking into account commitments) is USD 416,079, which corresponds to a delivery rate of 84% (Table 6 and 7).

Table 6 shows an overspend on Component 1, and a significant underspend on Component 3 as would be expected as many of the activities related to Component 3 were contingent on the medium-scale biogas plants progressing. There is also a significant underspend for Project management, however the accounting for this is unclear as the Project Management Cost (PMCs) budget line was reportedly exhausted in 2020. UNDP therefore provided USD 7,120 from non-GEF resources, to cover PMCs up to March 10th 2022, when the Project will close, and USD 60,000 to covers its oversight role.

The slow rate of disbursements was highlighted in PSC meetings (October 2020, May 2021). For example, in October 2020 an accelerated plan was requested to spend all the resources within the remaining 2 months of the year. In June 2021, the Project was left with USD1,262,055 to spend in 6 months and reportedly developed a detailed acceleration plan for the last six months of Project implementation.

Table 6: Delivery by component / outcome (1 March 2022), USD

Component	Approved Budget as per ProDoc	Actual Expenditure	Delivery Rate (relative to ProDoc approved amount)	Balance (based on expenditure to date)	Balance (based on expenditures including commitments)
Component 1: Institutional strengthening and capacity building	458,600	683,895	149.13%	- 106,483	-225,295
Component 2: Facilitation & establishment of biogas plants	1,142,000	1,322,185	115.78%	-63,936	-180,185
Component 3: Facilitation and establishment of appropriate biogas utilization platforms	911,700	144,096	15.81%	780,417	767,603
Project management ³	120,000	8,709	7.26%	111,291	111,291
Depreciation ⁴	0.00	19,162		-19,683	-19,683
TOTAL	2,632,300	2,178,568	82.76%	701,607	453,732
Fixed assets ⁵	0.00	37,653		- 37,653	- 37,653
TOTAL ²	2,632,300	2,216,221	84.19%	663,954	416,079

Source: PMU

Notes: 1/ Figures have been rounded; 2/ Project total including fixed assets; 3/ It is not clear why there is a balance of USD 111,291 recorded in this Table, when all Project management costs were reportedly exhausted in 2020. Clarifications were sought on this but not provided to the TE; 4/ Information on depreciation not provided; 5/ Information on fixed assets in the context of the Project was not provided to the TE.

Table 7: Expenditure by category (1 March 2022), USD

Expenditure category	Approved Budget (as per ProDoc)	Actual Expenditure	Delivery Rate (relative to ProDoc approved amount)	Balance (based on Expenditures)	Balance (based on expenditures & Commitments)
Other staff (TA and SC) ¹	458,000	535,983	117.03%	-77,983	-77,983
Consultants	399,700	395,672	98.99%	132,312	4028
Travel	88,000	213,949	243.12%	-125,949	-125,949
GoEs excluding DPC accounts 2	1,658,120	1,021,266	61.59%	756,445	636,854
DPC	28,480	11,482	40.32%	16,997.93	16,997.93
UNDP Staff costs without DPC	0.00	217		-217.27	-217.27
TOTAL	2,632,300	2,216,221	84.19%	663,954	416,079

Source: PMU

Notes: 1/Temporary Assistance (TA) and Service Contract (SC); 2/ The significant overspend on travel is explained by the PMU as the (additional) travel cost to the biogas digester sites following approval by the PSC to subsidize the construction of 200 digestors; 3/ General Operating Expenses (GoEs) and Direct Project Costs (DPC).

Table 8 presents annual disbursements based on the Combined Delivery Reports. This indicates that the Project got off to a slow start, with only 24% of funds being disbursed by the end of 2018, which would have been the mid-way point prior to the 1 year extension granted to the Project. According to PIR 2018 some activities were delayed due to extensive stakeholder engagement being needed at Project start up, as discussed above. Disbursements were notable low in 2020 (7%), and this is reportedly linked to COVID-19 restrictions which meant workshops could not be held, construction of digesters faced delays and there was shortage of construction materials. Project management arrangements are also likely to have been a contributing factor (discussed further below). This ideally would have been the time to accelerate the roll out of the small-scale biogas plants at the Project site.

Table 8: Disbursements by Year, USD

Year	Disbursements	% of total Budget (USD 2,632,300)	Cumulative disbursement as (%) of total budget
2017 (from Jan 20 th)	211,634	8.0	8.0
2018	427,133	16.2	24.2
2019	315,630	12.0	36.2
2020	186,005	7.0	43.2
2021	945,190	35.9	79.1
2022 (projected)	135,225	5.1	84.2

Source: Combined Delivery Reports

Notes: % have been rounded

The disbursement process is long with many people involved. The move to payments being made through UNDP's Global Shared Service Unit (GSSU) in early 2021 has slowed down payments. Slow payment was an issue raised by a number of masons interviewed for the TE, resulting in some masons refusing to participate in the Project (Progress Report Quarter 3, 2020).

3.2.3.2 Co-finance

Co-financing at design was equal to 86% of the overall finance. However, USD 14,749,000 of committed Project co-financing from the BDC and BMC was linked to the the direct costs of constructing, financing and operating medium-scale digesters, which did not go ahead.

According to Minutes of PSC 3 July 2018 a co-financing template was shared with partners, which was to be used to account for the specific number of hours partners dedicated to the Project. Co-financing tracking tools were to be used to gather information on financing from partners on a quarterly basis (PIR, 2019). However, co-financing appears not to have been actively tracked, and only qualitative information on co-financing commitments was provided to the TE, with the exception of a break-down of UNDP contributions in terms of staff time committed to the Project (Table 9).

Table 9: Overview of Project Co-finance

Color Code:	Related to construction of medium-scale digesters	Not related to construction of medium-scale digesters
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Organization	Commitment USD	Expectation	Actual commitments Information provided to TE
UNDP	200,000	Grant to cover project management costs	It was reported to the TE that 'UNDP has not been charging the Project for cost recovery charges which was offset by the grant'. However, the meaning of this is unclear. Contributions to the

			Project in terms of staff time is estimated at USD356,936
Botswana Innovation Technology & Research Institute (BITRI)	200,000	Total of USD200,000 in-kind contribution (USD50,000 over 4 years) including at least two researchers and office space. BITRI was the executing agency up to the Mid-term	BITRI provided office space for project staff for the duration of the project. 1 Researcher and 2 Associate Researchers were availed.
Department of Waste Management and Pollution Control (DWMPC)	1,459,000	USD309,000 grant to support to IWM policy USD250,000 – in-kind support to Development of IWM policy USD750,000 IWM policy enforcement (in-kind) USD 150,000 in-kind support for development of National Environmental Fund	IWM policy was completed and approved by cabinet
Botswana Development Cooperation (BDC)	4,600,000	Loan finance, subject to presentation of commercially viable proposals to Corporation and meeting terms and conditions of BDC. BDC was expected to fund a proposal developed for BMC to set up a medium-scale digester which was around 11 million Pula.	BDC indicated that they would only fund projects above 30 million Pula so the requirements for financing were not met
Botswana Meat Commission (BMC)	10,150,000	USD 3,000,000 in capital investment USD1,000 in-kind to support development of Integrated Waste Management Policy USD2,350,000 in operating costs for feedlots and biogas digesters (over 3 years)	BMC were not able to support the Biogas initiative as planned due to financial difficulties
Ministry of Environment, Wildlife and Tourism (MEWT)	75,000	In-kind support for the Environmental Management Plans, Environment Impact Assessments, demonstration projects and knowledge management and sharing aspects of the project	MEWT supported the EMP for BMC, waiver for EIA for small-scale plants and knowledge sharing.
TOTAL	16,684,000		

3.2.4 Monitoring & Evaluation *

3.2.4.1 M&E design at entry *

Monitoring and Evaluation (M&E) design at entry is rated as **Satisfactory**. The Project Document sufficiently sets out how the Project was to be monitored, namely through an Inception Workshop, quarterly reports through the UNDP Enhanced Results Based

Management Platform, annual project implementation reports, site visits and Back to Office Reports (BTORs), an independent MTR, an independent TE (including completed GEF Climate Change Mitigation Tracking Tool), and Project Terminal Report. An indicative M&E budget of USD 122,000 is provided (excluding project team staff time and travel expenses), which is considered to be sufficient. As discussed above, many of the indicators and targets adopted are not considered to be SMART, and would have benefited from broader stakeholder engagement, including with proposed beneficiaries, to guide their development and ensure that they were realistic.

3.2.4.2 M&E at Implementation *

Monitoring and Evaluation at Implementation is rate as **Moderately Unsatisfactory**. M&E systems could have been used more effectively to steer the Project and importantly, given the reduced Project scope, clarify ongoing needs after Project closure based on a detailed synthesis of the lessons learnt.

Monitoring and Evaluation was impacted by COVID-19 restrictions, which limited site visits and other means of direct verification of progress. But even before COVID-19, the MTR had concluded that ‘improved M&E frameworks are required around demonstration units to benchmark energy consumption.’ In general, data collection and analysis has been slow hampering its ability to inform Project planning. BTORs from overseas visits were produced, which in some cases set out the lessons learnt, but it is not clear how these lesson have been consolidated and applied to the Project (or made available in a form that can be taken up by future initiatives).

An Inception workshop was held in April 2017, attended by 23 stakeholders²⁷. The Project’s targets were presented at the workshop, and concern was raised that the Project should allow for flexibility in terms of its expected targets²⁸, specifically in relation to 1,000 small-scale biogas digesters to be constructed and made operational. It was suggested that this was not realistic and that the Project could consider increasing the medium sized digesters and reducing the small-scale to reach the carbon emission target. This reinforces the position at design that the medium-scale bio-digesters were considered to be commercially viable and achievable within the Project timeframe, which proved not to be the case. Ideally, the Project’s Theory of Change warranted revision as early on as the Inception Workshop, in order to ground understanding of how the Project’s activities could realistically evolve.

In general, Project monitoring is considered not to have been sufficiently results orientated. Annual PIRs were completed on time, but often appear overly optimistic suggesting that the Project was on-track to meet its objective and outcomes, when in reality only a limited sub-set of activities and outputs were completed and most targets had not been (or were not likely to be) met. The Project needed to be re-orientated after the mid-term to set new attainable targets aligned with the stepped process to the introduction of technology, but only the ambition on the number of small-scale digesters was addressed. Detailed monitoring and reporting on the small-scale biogas plants are still needed to improve their implementation and understand their effectiveness and to meet gender and poverty targets.

The findings of the MTR and the PSC recommendations were used to adapt Project implementation. Some recommendations in the PIRs are repeated over a number of years (e.g. by the RTA) suggesting they had not been addressed (see below).

No evaluations were undertaken of the trainings organized by Project. The Project team has yet to produce a Project Terminal Report as specified in the Project Document²⁹, in which it

²⁷ Including representatives from UNDP, GCC, BMC, Department of Meteorological Services (DMS,) US Embassy, MILK Afric, BITRI, Duma FM, MLGRD, LEA, Botswana Bureau of Standards, Southern African Development Community (SADC) and, BDC

²⁸ Flexibility is not a feature of the Results Framework, which should set realistic and achievable targets.

²⁹ According to the Project Document, this comprehensive report is to be prepared by the Project team during the last three months of the Project.

will be important to draw out the lessons-learned. It is not clear to what extent the GEF OFP was kept informed of M&E activities, and the extent to which the Project Team used inclusive, innovative and participatory monitoring systems.

3.2.4.3 Overall assessment of M&E *

Overall, M&E is assessed as **Moderately Unsatisfactory**.

3.2.5 UNDP implementation / oversight *

UNDP implementation and oversight are rated as **Satisfactory**.

As a National Implementation (NIM) project, executed by the Government, the role of UNDP is to provide quality assurance and oversight, with a firewall observed between oversight and implementation. As highlighted in the MTR, up to mid-term UNDP was crossing over into implementation, with the lines between oversight and implementation blurred. For example, the PMU to a large extent was reporting to the UNDP-CO rather than the IP. This was addressed in the Management response to the MTR.

However, UNDP is considered to have played a strong oversight and support role, with the Resident Representative following issues and actively seeking solutions. The UNDP Program Specialist joined at the start of 2020 and has spent a lot of time supporting the Project (partly compensating for an under-resourced PMU).

A new RTA joined the project in late 2021. Previous to this the RTA had provided detailed comments in the PIRs recommending, among other things, more detail on how critical risks were to be mitigated, regular conversations with the UNDP Regional Service Centre to help develop an action plan to address implementation challenges, the hiring of a part-time biogas expert who could provide strategic guidance and perform quality assurance of Project deliverables, and greater use of the UNDP's Corporate Planning System (to enable the Regional Bureau for Africa and the Regional Service Centre to provide timely implementation oversight).

3.2.6 Implementing Partner execution (*)

Execution by the Implementing Agency is rated as **Moderately Unsatisfactory** overall, although is considered to have been Satisfactory under the DOE.

Project Implementation was slow in the first couple of years of the Project and it was felt that BITRI, with its research focus, was not the most suitable Implementing Partner (IP) for a project that was designed to roll out technology in the field. The Project was significantly delayed by the mid-term. In response to the MTR recommendations, the Management Response to the MTR led to a revised management structure with the Department of Energy stepping in as the Implementing Partner, and BITRI focussing on providing research and development support.

The change in IP is generally seen as a good decision and under the DoE the Project made good progress in its final year. It is also recognized that the DoE took over the Project at a very late stage, commencing mid-December 2019, and that implementation was shortly after in early 2020 affected by COVID-19. There was thus a limit to what could be achieved in terms of rolling out the small-scale biogas plants in the time left. The DoE assigned two officers to the Project, but not on a full time basis and it was felt that the Project would have benefited from greater input in terms of day to day resources. There was also a high turnover of DoE staff, which caused delays. The PMU stayed housed at BITRI due to lack of space at the DoE, although the Management Response to the MTR had recommended that it move to the DoE and this would have been good for coordination.

3.2.7 Overall project implementation/execution (*),

Overall, Project implementation and execution is rated as **Moderately Satisfactory**. See also related discussion under section 3.3.4 on Efficiency below.

3.2.8 Risk Management

The TE concurs with the MTR's finding that the approach to managing critical risks could have been strengthened. For instance, the Project should have identified additional management measures to address the critical risk of mobilizing finance from partners to help bridge the affordability gap. Financing of the bio-digesters was highlighted as the only critical risk management factor in the Project's first PIR (2018) and in all subsequent PIRs. Other risks that emerged at implementation were COVID-19 impacts and the Project delays that started to build for the start of the Project (i.e. 3 years before COVID-19) making it impossible in the end to complete most of the Project activities. A more pro-active role was needed by the PSC to address risks, that is establishing solutions to Project risks not just identifying them.

3.2.8.1 Social and Environmental Standards

No new social or environmental risks were identified during implementation, and no existing risks were escalated.

For the planned medium-scale biogas digester at the Botswana Meat Commission (BMC), the Project carried out an Environmental Management Plan to address potential environmental risks that could be brought about by the Project and the operation processes involved.

The Project did receive complaints related to social and environmental impacts. Some beneficiaries found implementation of the small-scale biogas plants challenging due to the shortage of the cow dung to use as feedstock during drought periods when there is shortage of food for their cattle. During such period, beneficiaries needed to collect cow dung from the community, which in some cases led to adverse 'social judgments' from other community members. There was also a slight increase of water usage and some beneficiaries complained of increased water bills and shortage of water in general (PIR, 2020). It is not clear if the Project had a Grievance Redress Mechanism (GRM).

3.3 Project Results

3.3.1 Progress towards objective and expected outcomes (*)

Table 10 provides a summary of the Results Matrix (see Annex 6 for detailed Results Matrix), with the text following Table 10 elaborating on the attainment of Project Objectives and Outcomes. The Project is assessed against its 8 indicators, none of which have been completely achieved; 4 have been partially achieved, 3 are not achieved and 1 is not rated due to lack of data. Of note, 7 of the 8 indicators are partly or wholly not relevant (obsolete) given the change in scope. Many of the indicators have a number of targets³⁰, resulting in 17 targets overall, only 4 of which have been achieved.

As discussed above, no formal revision of indicators or targets was undertaken following mid-term review, however Project report's acknowledge that small-scale biogas plants had become the 'flagship indicator' and following the MTR the Project worked to a target of construction 200 rather than 1,000 small-scale bio-digesters. Indicators do not align well with outputs / activities in some cases and indicators 2a and 7a / 2b and 7b are duplicates. Many of the Indicators are interlinked and depended on financing and construction of the medium-scale bio-digesters, which did not happen.

³⁰ Indicator 2 (Objective level) – 5 targets; Indicator 5 (Outcome 1) – 3 targets; Indicator 7 (Outcome 3) - 4 targets

Table 10: Summary Results Matrix

Color code	Achieved	On-track to be achieved	Not achieved
Description of Indicator	End of project target level	Achievement / rating	Justification
Objective: To facilitate low-carbon investments and public-private partnerships in the production and utilization of bio-methane from agro-waste in the districts of South-Eastern Botswana.			
1.Amount of reduced CO2 emissions as a result of investments facilitated by the project.	Installations in place and operating to achieve direct and indirect reductions of 1.9 million tonnes CO2.	Not rated	Data not available
2.Project beneficiaries	a/ Minimum of 3 medium-scale agro-industries installed and operational		This indicator became obsolete
	b/ 200 small-scale agro-businesses utilizing agro-waste streams for biogas digestion (original target 1,000)		200 digesters completed
	c/ at least 2 District Councils utilizing organic waste for biogas digestion		This indicator became obsolete
	d/ at least 2 companies constructing biogas digesters		This indicator became obsolete
	e/ 75 masons trained and employed		77 masons trained
3.Energy generation using biogas	350,000 MWh		This target would only have been possible if medium / large scale bio-digesters had been constructed.
4.Number of new development partnerships with funding for improved sustainable energy solutions	3 Public-Private Partnerships in place to facilitate biogas investment.		Partially achieved - 1 PPP is in place, namely the National Development Bank (NDB) has been engaged as a financier for development projects within Botswana.
Outcome 1 <ul style="list-style-type: none"> Increased capacity of Government, private sector and community stakeholders to develop, finance and implement PPPs in the agro-waste sector. Increased capacity of Government authorities to properly monitor and enforce waste management regulations in the agro-industrial sector. Autonomous support systems in place for replication and scale-up of agro-waste technologies post-project. 			
5.Extent to which policies and regulations for waste management in the agro-sector are adopted and enforced.	a/Specific guidelines on low-carbon alternatives and utilization technologies for agro-waste and wastewater developed and disseminated.		The Botswana Bureau of Standards (BOBS) has developed biogas standards (gas standards and digester structure standards), which have been approved by the committee of BOBS. Biofuels Guidelines have been developed to guide the production, blending, distribution and usage of locally produced biofuels.
	b/ Framework agreement for at least 3 public-private partnerships (PPPs) in the waste sector and biogas related in place and implemented.		No PPP agreements reached - attributed to the limited amount of organic waste in the Project area

b/ ~~1,000~~ 200 small-scale agro-businesses utilizing agro-waste streams for biogas digestion

The end of project target for the number of small-scale digester constructed was downsized from 1,000 to 200 digesters following the MTR. The MTR recommended a target of between 200 and 300 small-scale bio-digesters, and the Management Response for the MTR agreed on the target of 200. This has reportedly been achieved³¹.

c/ at least 2 District Councils utilizing organic waste for biogas digestion

Engagement with District Council Officers who are responsible for waste collection and management resulted in an exchange visit to a landfill in South Africa where municipal waste is being used to produce biogas through a biogas digester. This led to the understanding that municipal waste produced in the Project area was insufficient to produce biogas for electricity.

However, the Project is supporting the DWMPC to demonstrate the viability of waste separation within public offices through a pilot project, in which 7 government departments and 2 recycling companies are participating.

d/ at least 2 companies constructing biogas digesters

This indicator is obsolete due to the inability to secure interest from companies and finance organizations.

e/ 75 masons trained and employed

The Project trained 16 instructors (training of trainers) from tertiary institutions (Brigade, Construction Industry Trust Fund and Madirelo Training Testing Centre) on biogas digester construction, operations and maintenance (PIR, 2018). The training of masons on the construction, operation and maintenance of small-scale biogas digesters was undertaken at district level through the different brigades. The masons were engaged in the construction of the small-scale digester demonstration plants as part of their training. In total 77 masons have been trained (36 in 2018 and 41 in 2021). A refresher course was also held in January 2020 to develop their business development skills (e.g. how to prepare a quotation and negotiations skills)³². The training of masons in the construction of biogas digesters has provided them with an extra skill and supported youth employment in Botswana. However, only 45 of those trained have actual been employed by the Project, so it is not clear whether the target of 75 has been reached on both the training and employment criterion, or only in terms of training. An achievement rating has been given despite this uncertainty.

The Project developed a training curriculum on biogas digester construction, operation and maintenance, which was accredited by the Botswana Qualifications Authority (BQA) and accepted into the Vocational Training Syllabus (PIR, 2018).

Box 1 summarizes the feedback from the masons interviewed as part of the TE.

³¹ As of the end of November when the field work for the TE was undertaken, 155 small-scale bio-gas plants were in operation, 25 were completed but not yet commissioned, 3 were under construction and 30 were procuring materials.

³² Information on number of attendees not provided to TE.

Box 1: Overview of masons' experiences with the Biogas Project

15 masons were interviewed as part of the TE process (10 men / 5 women). They were aged between 24 and 35 years. Half of the masons had constructed 1- 5 plants, 40% 6 – 10 plants and 10% 11 to 15 plants.

The majority of masons (87%) were not affected by COVID-19 restrictions. For those that were affected, delays were caused by the beneficiaries being unable to travel to secure the required materials.

A log sheet is filled in at each stage of construction to ensure work is fully completed. While there is no written monitoring and maintenance plan beyond the construction period a hand over discussion and briefing is held the beneficiary, prior to the final assessment by the consultant supervising the work. All structural defects have been addressed although guarantees cannot be given beyond the Project period.

Masons felt that the training they received was adequate. They noted that during the field training no allowance was provided and felt that during construction more than 1 set of Personal Protective Equipment (PPE), tents and toiletry allowance should have been provided.

Key challenges facing construction of the small-scale biogas plants from the perspective of masons are: (i) In some cases there was not enough feed and masons had to wait three days at the site for feed to arrive; (ii) Some areas are very rocky and therefore difficult to dig up; (iii) Some areas are remote making it difficult for beneficiaries to find materials. Some beneficiaries provided insufficient materials causing delays and in some cases bricks bought from different suppliers were a different size, however this was corrected through plastering. Better communication on the materials required is therefore needed to avoid delays caused by insufficient materials or the wrong materials being provided; (iv) Some beneficiaries were unable to provide water when required and/or in sufficient quantity and this caused delays; and, (v) Delays caused masons to spend more on food and meant they were late moving to the next site.

Indicator 3: Energy generation using biogas

This indicator is obsolete as it assumed that electricity would be generated by the medium-scale digesters, which were not constructed under the Project.

Indicator 4: Number of new development partnerships with funding for improved sustainable energy solutions

The target of 3 PPPs in place to facilitate biogas investment has been partially met with 1 PPP in place. Namely, the National Development Bank (NDB) has been engaged as a financier for development projects within Botswana.

This indicator focuses on funding which as discussed was a key challenge facing the Project. While engaging with several institutions who expressed an interest in medium-scale biogas digesters (e.g. BMC, Kgalagadi Breweries Limited (KBL), SENN Foods), the Project also engaged financing institutions with the hope that they would be ready to finance positive business proposals. As reported in PIR, 2018, the Botswana Development Corporation in principle agreed to finance the Project once the business case showed positive investment opportunity. Other financing institutions such as Barclays Bank Botswana and Stanbic Bank also expressed interest and the Project worked with them to secure their commitment over the period 2017-2020. However, in the end they all withdrew from the Project, with the exception of the NDB (as discussed in more detail below).

Outcome 1

- **1.1: Increased capacity of Government, private sector and community stakeholders to develop, finance and implement PPPs in the agro-waste sector.**
- **1.2: Increased capacity of Government authorities to properly monitor and enforce waste management regulations in the agro-industrial sector.**

- **1.3: Autonomous support systems in place for replication and scale-up of agro-waste technologies post-project.**

Outcome 1 covers a range of regulatory and capacity-related elements in order to improve agro-waste management and regulation for centralized and decentralized, grid- and non-grid-connected power generation. Indicator 5 has been partially achieved (2 out of 4 targets met) while Indicator 6 has not been met and became obsolete.

In terms of increased capacity of Government authorities to properly monitor and enforce waste management regulations in the agro-industrial sector (Outcome 1.2), awareness and capacity within the public sector as a result of the Project has increased, but there are no indicators / targets measuring this.

Indicator 5: Extent to which policies and regulations for waste management in the agro-sector are adopted and enforced. Number of beneficiaries (owners/users of biogas).

a/Specific guidelines on low-carbon alternatives and utilization technologies for agro-waste and wastewater developed and disseminated.

This target has been achieved. In 2019 the Project engaged the **Botswana Bureau of Standards (BOBS)** to develop biogas standards (e.g. related to gas and digester structure). The **Biogas Standards** were finalized and have been shared with the Ministry of Investment and Trade for approval. A technical reference group was established for the development of standards³³. International standards were reviewed and an exchange visit undertaken to the Netherlands to support the development of best practice standards for Botswana. **Biofuels Guidelines** have also been developed to guide the production, blending, distribution and usage of locally produced biofuels.

From the start of the Project, the **Department of Waste Management and Pollution Control (DWMPC)** was engaged in the development of an Integrated Waste Management Policy. The Department engaged Ministries and other stakeholders for input into the Policy. The enactment of the new Integrated Waste Management Policy was considered to be important for the success of the Project at design, as it is intended to compel high waste producing entities such as the large scale agro-waste producers to adopt more effective / green waste management strategies (such as the production of biogas) in order to comply with the Act. The Project is currently supporting the review of the Waste Management Act, that is it has not been enacted within the Project's timeframe.

b/ Framework agreement for at least 3 public-private partnerships (PPPs) in the waste sector and biogas related in place and implemented.

A framework agreement for public-private partnerships in the waste sector was to be developed and disseminated, supported through the establishment of a multi-stakeholder platform specifically set up for this purpose. This was to provide the legal framework for greater participation of the private sector. The PPP Framework was intended to be used by institutions constructing medium-scale digesters to establish the roles of different stakeholders in the particular partnership both under the Project and beyond (PIR, 2018). TORs to work on the PPP framework were drafted in 2018 and the Project started to engage with the Ministry of Finance for the development of the PPP framework³⁴ (PIR, 2020). However, this target was considered to be obsolete as it became clear that investments in medium-scale biogas plants were not possible at this time and the work was not progressed.

³³ Information on membership and level of activity not provided to TE.

³⁴ A PPP unit within the Ministry of Finance and Economic Development (MFED) was established in 2018 and sensitization workshops for PPPs have been held, but there has been limited utilization of PPP frameworks (MTR, 2019).

c/ Up-to-date regulations developed and adopted for the successful monitoring of effluent flows.

The Project has worked with the Water Utilities Corporation (WUC) as the custodian of **Trade Effluent Agreement (TEA)**³⁵ to strengthen their capacity to monitor and enforce the TEA. Activities undertaken supported by the Project include: (i) training on sludge management and wastewater pre-treatment methods to capacitate officers at the WUC on best practices for managing wastewater and applicable international standards; (ii) harmonization of Trade Effluent Agreements (TEAs) and Council Bye Laws; (iii) a campaign on the Trade Effluent Agreement highlighting the benefits of proper management of wastewater; (iv) a pilot study of six high polluting industries to determine wastewater parameters, how to treat wastewater and what measures could be put in place to ensure consistent pre-treatment of wastewater (ongoing³⁶). The results from the study will support the advocacy on the TEA, pre-treatment of wastewater and wastewater reuse. The study will also determine the needs of the WUC laboratories and the capacity of staff to undertake sampling and testing of wastewater from the different industries (PIR, 2021); and, (v) An Action Plan to engage industries on Trade Effluent Agreements.

At the October 2020 PSC the WUC reported that 259 of the 500 TEAs agreements had been signed and inspections carried out in Francistown and Gaborone on monthly basis. Refresher workshops were held with industries to build awareness and stress why it is important to comply with the TEAs. A number of challenges were noted: (i) a lack of public awareness with regards to the trade effluent agreements; (ii) some major polluting industries are government institution and do not fully comply, creating resistance by private institutions. Political interference and lack of support from licensing and regulatory authorities to WUC also affects enforcement of TEAs; (iii) lack of human resources to undertake the activity as WUC is completing a restructuring process; and, (iv) lack of an industrial monitoring unit at WUC and staff dedicated to TEA challenges enforcement of TEAs. Furthermore, some critical parameters for waste quality monitoring such as FOGs and sludge are not analysed due to lack of equipment. There is only one machine in the whole country for analysing trace metals. This affects the frequency of sampling and analysis. WUC has been advised to seek support from other government institutions such as DWMPC which also has a lab that could be used to facilitate testing of wastewater.

Indicator 6: Financial institutions invest in at least 3 biogas plants.

This target has not been met – no biogas plants have attracted the support of financial institutions.

The Project engaged with financing institutions, increasing their knowledge and awareness of biogas technology through training (PIRs, 2018/2019/2020), and with the Bankers Association, as the umbrella body, to generate interest (PIR, 2018). However, interest was limited from the start as expressed in PIR 2018. The Botswana Development Corporation (BDC), Barclays Bank Botswana and Stanbic Bank in principle agreed to financing waste-to-energy projects if a positive business case was presented. Following the completion of the BMC feasibility study, the financing institutions reconfirmed interest but stated the need to better understand the biogas technology and modalities of financing of green projects. The Project supported knowledge generation / awareness through a financing workshop held 2018 and exchange visits with international financing institutions. These activities have helped establish the foundation for investments in biogas plants.

³⁵ The Water Utilities Corporation (WUC) as mandated by the Water Sector Reform to oversee wastewater management in the country is responsible for Trade Effluent Agreements (TEA).

³⁶ All reports have been submitted and presented, except for the final report. UNDP is supporting procurement of testing equipment based on recommendations from this consultancy.

Overview of outputs and activities

Table 11 is based on the Project Document and presents an overview of outputs and activities under Outcomes 1.1. and 1.2. Outputs and Activities removed / obsolete are in italics. Activities completed are presented in green text and on-going activities in blue text. Outcomes 1.1. and 1.2 consist of 7 outputs, 4 of which have been implemented. Overall there are 17 activities, 12 of which have been implemented.

Table 11: Outcomes 1.1 & 1.2 – overview of outputs and activities

Code	Outputs and Activities removed / obsolete in italics	Activities completed are presented in green text	On-going activities in blue text
Outputs	Activities	Comment / Progress	
1.1 Specific guidelines and standards on low-carbon alternatives and utilization technologies for agro-waste and wastewater developed and disseminated to all relevant stakeholders in the sector.	1.1.1 Establishment of a multi-stakeholder platform (MSP) to define guidelines and standards (national level); regular stakeholder meetings. 1.1.2 Organize short workshops with sector experts to introduce new approaches and technologies. 1.1.3 Study tours in Botswana and to an African country that has been successful in developing the biogas sector. 1.1.4 Key stakeholders facilitate MSP at district level.	1.1.1 Established to support development of biogas standards and biofuels guidelines 1.1.2 Workshops undertaken and resulted in completion of both standards and guidelines 1.1.3 Study tours to Uganda and Ethiopia in the first year of the Project. Study tours in Botswana undertaken on a continuous basis during monitoring of construction of digesters 1.1.4 Done	
1.2 <i>[Framework agreement for public-private partnerships (PPPs) in the waste sector adopted and disseminated]</i>	1.2.1 <i>[Workshop and follow-up meetings to identify framework agreement].</i> 1.2.2 <i>[Share experience with PPPs in other countries; experts will be invited to present latest developments/practices on waste management]</i>	PPP framework activities were removed given that the PPP framework already exists with the Ministry of Finance and the Project did not proceed with medium-scale digester. Further the amount of waste generated in Botswana (as per the Gamodubu report and Waste to Energy study reports) DoEs not warrant development of a large scale biogas digester using the PPP framework modality	
1.3 <i>[Training conducted for all relevant stakeholders on the new guidelines and PPP framework agreement (1.1. and 1.2)]</i>	1.3.1 <i>[A training institute is identified and contracted to facilitate training and capacity development].</i> 1.3.2 <i>[Development of training materials]</i>	1.4.1 Established ³⁷ 1.4.2 Done. The institution (a joint venture between a local company and South African company) is developing the green certification framework 1.4.3 Biogas conference held in December 2021	
1.4 Updated regulations developed and adopted for the successful monitoring of effluent flows and by-product waste in all abattoirs in the country, including launch of a “green certification” waste-management award for industry actors.	1.4.1 Establishment of MSP for regulations and monitoring. 1.4.2 Identification of an institution to develop the green certification protocol to be adopted by sector stakeholders. 1.4.3 Annual event organized to promote green companies.	1.5.1 Meetings organized and utilized to harmonize the TEA with District Council Bye laws in efforts to better enforce the TEA 1.5.2 Done 1.5.3 Study on-going. Status quo report submitted following sampling and testing of wastewater from 6 different industries in and around Gaborone	
1.5 Support provided to the Department of Waste Management and Pollution Control (DWMPC) and District Council authorities to improve monitoring and enforcement of Trade Effluent Agreements between industries and local authorities.	1.5.1 Support to ongoing initiatives by DWMPC to organize MSP meetings, workshops, study tour, visits by experts, training. 1.5.2 Stakeholder training workshop on the revised monitoring tool and enforcement mechanism of TEA 1.5.3 Undertake 6 months pilot study to determine extent of wastewater pollution	1.6.1: Update of integrated waste management bill completed. Pilot study to determine amounts of	
1.6 Review of enforcement practices and support towards enforcement of pollution prevention	1.6.1 External assessment and results shared with stakeholders.		

³⁷ Information on composition and level of activity not provided to TE.

laws, mainstreamed into relevant organizations' activities: e.g. Councils or DWMPV.	1.6.2 Adjustment of current practices and information published and disseminated.	wastepaper coming out selected ministries of the government enclave undertaken. 1.6.2: Ongoing
1.7 [Corrective EIA measures implemented].	1.7.1 [DWMPV and Councils to monitor the implementation of EIA through project visits].	Not done as this activity was aligned with the construction of medium-scale biogas digesters.

OUTCOME 1.3: AUTONOMOUS SUPPORT SYSTEMS IN PLACE FOR REPLICATION AND SCALE-UP OF AGRO-WASTE TECHNOLOGIES POST-PROJECT

The Project intended to establish a mechanism to make finance available for small-, medium- and large-scale biogas digesters through banking institutions.

At the national level, Government institutions, NGOs, the private sector, the mass media, microfinance institutions, community-based organizations such as cooperatives and others were to be mobilized to create general awareness on waste management and promote biogas. These promotional activities were to be coordinated by a Biogas Working Group (BWG), but there is no evidence that this was created. A detailed plan to disseminate information on biogas was to be created with stakeholders, this was to include: training for the institutions and agro-industry on the benefits of biogas, establishment of a network of organizations working in the biogas, participation in exhibitions and national school competitions; council-level promotional campaigns and biogas-awareness workshops and the use of (social) media (Project Document).

DWMPV was to play an important role to: (i) promote biogas technology; (ii) represent the interests of the supply-side in further policy dialogue; and, (iii) become a knowledge-management and eventual training centre for issues associated with further promotion of the biogas sector in Botswana.

A summary of progress at the Output level under Outcome 1.3 is provided below.

Output 1.8 Financial institutions trained on best practices in assessing and financing agro-waste projects through BITRI.

According to the Project Document, the Project was to:

- (i) support awareness-raising on waste management and the application of biogas technology. This was to include study tours to countries such as South Africa with agro-waste biogas projects, visits to industry events, such as trade shows. The objective was to create a group within Botswana that is well connected to the international waste management and biogas industry and is well aware of market developments, so that this group can exploit these developments for the benefit of Botswana. While some of the proposed activities were undertaken, it is not clear that such a group has been established. Under activity 1.8.2, NDB representative attended a biogas conference in Pretoria, South Africa and had the opportunity to visit a biogas plant to get an appreciation of such a technology;
- (ii) train stakeholders, including financial institutions, council and municipality staff and the private sector, in best practice in assessing and financing agro-waste projects, with a particular focus on biogas. Vocational-training centers were to integrate a module on waste management and biogas into their existing curricula. Under activity 1.8.1 a Financing workshop was held to raise awareness of the Project as well as what other financing institutions are doing and identify banks interested in financing green projects. NDB remains interested and the Project is supporting development of an ESMF to assist NDB review project proposals.

Output 1.9. Dedicated investment facilitation platform on low-carbon waste-utilization technologies established at BITRI, and operational with independent budget.

The Project was to explore the scope for establishing a platform or joint ventures with potential investors, financial institutions, town councils, city councils and the private sector (Project Document). Under this output, BITRI were to organize consultation meetings to identify options for the setting up of an investment-facilitation platform. However, BITRI decided they were not the right organization for this activity. Instead UNDP is supporting NDB to secure accreditation to the Green Climate Fund (GCF).

Output 1.10: Level playing field created for all energy providers and REFIT in place.

To encourage investment in biogas as a means of generating electricity and as a grid-connected power supply the Project reviewed and updated the ReFIT (Renewable Energy Feed-in Tariff), which have been shared with MMGE, but are not yet approved and operational.

The ReFIT framework is intended to incentivise larger agro-waste producers to generate electricity through biogas and other renewables and sell (excess) power, thus creating a more dynamic commercial market. REFIT can be used to improve financial viability and encourage uptake and make electricity production more cost reflective and are considered to be key to making renewables, including biogas, operational at scale.

Other incentives supported by the Project include the development of a green certification system. The Project Document envisaged the development of a database by the Department of Waste Management and Pollution Control (DWMPC), to map and monitor waste streams, which could be used as a bases for a green certification system and the award of performance-based incentives³⁸. There is no evidence that this database has been established.

Table 12 is based on the Project Document and presents an overview of outputs and activities under Outcomes 1.3. Activities removed / obsolete are in italics. Activities completed are presented in green text and on-going activities in blue text. Outcome 1.3 consists of 3 outputs, all of which have been implement (although the important activity to establish an investment-facilitation action was revised). Overall there are 4 activities, all of which have been implemented to some extent.

³⁸ This could, for example, include topping-up of the price per kWh produced through biogas and supplied to the national grid, and tax incentives for private-sector companies to invest in green waste-management technology (in particular biogas).

Table 12: Overview of Outcome 1.3: outputs and activities

Code	Activities removed / obsolete in italic text	Activities completed are presented in green text	On-going activities in blue text
Outputs	Activities	Comment / Porgress	
1.8 Financial institutions trained on best practices in assessing and financing agro-waste projects through BITRI.	1.8.1 Capacity developed to provide training for financial institutions and other relevant stakeholders. 1.8.2 Study tours/knowledge exchange facilitated between project stakeholders and other agro-waste-to-energy projects in the region, including those supported by GEF.	1.8.1 Financing workshop held to identify banks interested in financing of environment/green projects. NDB remains interested and the Project is supporting development of an ESMF to assist NDB in reviewing of project proposals. 1.8.2 NDB representative attended biogas conference in Pretoria, South Africa and had the opportunity to visit a biogas plant to gain an appreciation of the technology.	
1.9 Dedicated investment facilitation platform on low-carbon waste-utilization technologies established at BITRI, and operational with independent budget.	1.9.1 <i>[BITRI will organize consultation meetings to identify options for the setting up of an investment-facilitation platform or similar structure].</i> Support to NDB to develop an investment platform / accreditation to GCF	1.9.1 BITRI decided they are not the right organization for this activity. UNDP is supporting NDB to secure accreditation to the GCF and develop an ESMF to guide the evaluation of renewable energy projects.	
1.10 Level playing field created for all energy providers and REFIT in place.	1.10.1 Provide technical and financial support towards development and implementation of REFIT by engaging expert to share experiences from other countries	1.10.1 REFIT guidelines for Botswana updated and shared with MMGE.	

OUTCOME 2: INCREASED INVESTMENT IN CLEAN-ENERGY TECHNOLOGIES AND LOW-CARBON PRACTICES IN THE AGRO-WASTE SECTOR

Indicator 7: Increased investment in clean-energy technologies and low-carbon practices in the agro-waste sector.

a/ One thousand (1,000) small-scale biogas digesters constructed and operational.

This indicator is a duplicate of Indicator 1b (see detailed commentary on small-scale biogas plants below).

b/ Three medium-sized biogas digesters constructed and operational.

This indicator is a duplicate of Indicator 1a. The construction of medium-scale digesters was not possible under the Biogas Project (see detailed commentary on medium-scale biogas plants below).

c/ Finalized proposal to construct a centralized biogas digester of an estimated 15,000 m³ or larger with facility to upgrade to bio-methane and utilization.

The amount of organic waste produced in the Project area proved to be insufficient to support the development of a large-scale digester. This was indicated in the MTR report as well as the waste characterization report for the Gamodubu Landfill. The Biogas Project did not therefore pursue the development of a large-scale biogas digester.

d/ At least 3,000 m³ biogas per annum and 3 MW of electricity installed.

As of mid 2021, with 110 small-scale digesters installed and the majority of them operational, it was estimated that approximately 180 m³/day of biogas is produced. Assuming daily feeding and usage of all the digesters, this would translate to 7,227,000 m³ per annum (PIR, 2021).

This is a theoretical estimate requiring validation. While the amount of biogas produced per annum has been met through the small-scale digesters, no electricity has been installed, so this target is only partially achieved.

Small-scale Biogas plants

The Project was designed to: (i) create awareness of the benefits of biogas; (ii) assist with financial analysis; (iii) make USD 50 available for each small-scale biogas digester as a completion incentive for construction of quality biogas digesters; and, (iv) provide support towards the training, marketing, M&E, quality management, project coordination and utilization of bio-slurry. The Project, as intended, developed and implemented a program to promote small-scale biogas digesters, although the original design was revised in a number of ways.

- **The assumption on financing in the Project Document did not hold, and the Project had to revise its financing plan to encourage uptake.** Potential users of the small-scale biogas digesters were expected to invest in the installation of the technology. This investment was thought justified as the payback period was less than three years and it would encourage ownership and maintenance. The expected investment cost of the small-scale biogas plant was USD 800 (6 m³) to USD 50,000 (300 m³). Based on interviews for the TE the average cost of materials only for a small-scale biogas plant (10m³) promoted by the Project was UDS1,675. To overcome barriers to uptake due to high upfront investment costs, the Project was to facilitate the availability of credit through established financial institutions. As discussed, this did not materialize.
- The actual roll-out period of the small-scale biogas program was intended to be three years. For various reasons roll out did not start in earnest until 2021, making it impossible to reach the original target of 1,000 small-scale biogas digesters.
- According to the Project Document, guidance material was to be developed for small and medium-scale operators on how to safely use digester³⁹. This was to build on South African standards for the export bio-fertilizer. Such guidelines were to be adopted by the Project with Monitoring and certification undertaken by the Ministry of Agriculture as part of ongoing agricultural support activities.

The process through which the small-scale biogas plants were implemented by the Project is:

- Development of the initial design of digester including the bill of quantities (BoQ), by BITRI. Based on peer to peer learning with experienced institutions in Zimbabwe and Uganda the brick and mortar design emerged as the preferred design as it is more durable and better suited to the hot and dry climate of Botswana. The design was adopted with amendments to increase gas pressure.
- The Project Steering Committee recommended facilitation of 30 demonstration sites fully funded by the Project to encourage uptake of the technology. Criteria for the demonstration sites were developed and 30 sites (farms) were put forward by the District Agriculture Offices. The Project team visited the sites to confirm that the selection criteria were met, in particular that the sites were located in areas with good public access to facilitate awareness raising. All 30 demonstration sites were completed by mid-2019, and in use by mid-2020 for cooking and lighting. The digester size was 6m³ producing around 1.5m³ of biogas per day.
- Monitoring and Evaluation of Small-scale Biogas Plants. The PSC (December 2019) requested a Comprehensive Research Report on the 30 piloted small-scale Biogas Digesters, covering behavioural changes, challenges and opportunities and the socio-economic benefits. Research by BITRI (including a survey of the beneficiaries) was undertaken on the demonstration sites focusing on social, environmental and energy aspects.

³⁹ Management of biogas digestate will have benefits including: lower gaseous emission; less diffuse pollution from surface run off and leaching; reduced odours, improved veterinary safety, plant pathogen reduction and the reduction of weed seeds. Source: IEA Bioenergy (2010), *Utilization of Digestate from Biogas Plants as Bio-fertiliser*

- Initially the Project was not supporting the finance of small-scale biogas plants, but in December 2019, the PSC raised concerns over labour and construction costs being too high for farmers and the unprivileged and advised that alternative cheaper materials and strategies be deployed. The Project decided to partially finance the small-scale digester providing USD 700 per 6m³ plant to cover the labor costs of construction, along with one biogas stove or heater, one de-sulphuriser, one lamp holder and one biogas pressure gauge (estimated at USD 200 (MMGE, 2021). The beneficiaries provided the materials.
- In 2017, the Project engaged a consultant to undertake a feasibility study for small-scale digesters but the Technical Reference Group was not satisfied with the output and recommended that the contract was terminated and re-advertised (PIR, 2018). The feasibility study (completed in 2019) identified households interested in using biogas as well as willing to finance their own digesters.
- On follow up with the selected beneficiaries, it became apparent they had not been provided with the selection criteria by the consultant and/or had not fully understood the questioning and had assumed a lower level of investment was required. The Project therefore, through the Department of Energy, developed an online call for applications in May 2020. The criteria for application included the availability of agro-waste and water, location within the Project area and the need for energy. In total, 1,376 people applied, of which 772 were eligible. The first 200 people were selected - 59% male and 41% female. The age of beneficiaries was: 43% - 16-35 years, 56% - 35-65 years and 1% - 65-100 years. They were spread across the four Project districts - 43% in Kweneng district, 23% in Kgatleng district, 20.5% in South East District and 16% in Southern district.
- Following the MTR, 50 digesters which were part financed by the Project were completed by end of May 2021.
- To accelerate implementation a roster for masons was set up to facilitate procurement. However, responses to the calls for masons to construct small-scale biogas digester were limited and so more masons were trained to augment the pool of masons available. This activity was included in the AWP for 2021. The International Consultant who trained the first group of masons was engaged to train the second cohort of masons.
- In 2021, the Biogas Project engaged a consultant to facilitate the construction of the 150 digesters by the end of the Project.

Impact of small-scale biogas plants

It is widely felt that women and girls have benefitted from the Project in terms of not having to go out to look for firewood. With the time saved, they can engage more in social activities and devote more time to their schoolwork and / or income generation endeavors. Other benefits include an increased production of vegetables in backyard gardens through the use of organic fertilizer from the digesters, and the channeling of savings towards improve communities and local economic development (PIR, 2020). There are also health benefits in terms of reduced air pollution from the burning of fuelwood and reduced deforestation. Box 2 provides a summary of the findings of the beneficiary interviews undertaken for the TE.

Box 2: Small-scale bio-digester – impacts and challenges

Out of the 150 beneficiaries receiving support for the construction of biogas plants, 12 were interviewed by the TE across all four districts (6 female and 6 male). A stratified random sampling technique was employed, weighted by the number of beneficiaries per district. The beneficiaries interviewed are considered to be representative of the population. The majority of beneficiaries joined the Project between April and June 2021 (84%), with the others (16%) joining earlier in January or March 2021.

A number of beneficiaries interviewed (42%) noted they were already aware of the biogas concept but didn't know how to start and were therefore excited when they heard about the initiative.

Motivations for joining the program included: they were seeking an alternative to gas for cooking, typically used together with fuelwood, given the rising cost of gas (25%)⁴⁰; interest in how they could effectively use readily available cow dung; and, desire to reduce methane emissions as a greenhouse gas and reduce their use of fuelwood. Based on the TE interviews 42% of the beneficiaries heard about the program through Facebook, either directly or through a friend, 34% through the radio, 8% through TV, 8% through a newspaper and 8% via the website.

Based on the interviews undertaken as part of the TE, the small-scale bio-digesters have improved the livelihoods and lifestyle of beneficiaries. For example, 58% of the beneficiaries interviewed said they had saved money as they no longer had to buy gas to cook, and 42% said their fuelwood collection time had been reduced. Biogas is used daily, mainly for cooking and to a limited extent lighting. During times of electricity interruptions the biogas stoves are very handy. There is interest to expand their use mostly to chicken/poultry houses for heating. The small-scale bio-digester are widely considered to be a better option than solar – they are cheaper to purchase and maintain, not prone to theft and useful during the rainy season. The stigma of biogas as a 'dirty' technology is considered to be due to a lack of understanding. The number of people benefiting from a single biogas plant ranged from 1-6 daily users, with more than 1 person benefiting in 75% of cases. The small-scale biogas plants were rolled out in rural areas far from grid and are assisting the most vulnerable.

Construction challenges

- Costs. On average the amount spent on *materials* for a 10m³ bio digester was P16,750 (USD1,670)⁴¹, varying from P9,000 (USD900) to P25,000 (USD2,500). In some cases the material costs and transportation costs were higher than expected. Furthermore, additional labor needed to be paid for to complete the digging in rocky areas. Beneficiaries met their financial contributions from their salaries (42%), savings (25%), business (17%) and livestock sales (17%). Half of those interviewed said they would be in support of having access to soft loans.
- Difficulties sourcing construction materials. Materials were not easy to find and needed to be sourced from several shops. This was considered to be the main barrier to upscaling the technology. It was suggested that a few shops could become designated suppliers to make the process more efficient.
- There was a sense that everyone was learning on-the job, and that the Project lack experts to guide the process. Concern was expressed over the lack of supervision of the masons and the impact this might have on quality. Some plants were not sealed tightly enough and sand was getting inside and beneficiaries were uncertain how this would impact the functioning of the plant.
- Only 25% indicated a slight delay caused by COVID-19. These delays were related to shop closures requiring beneficiaries to travel far to look for materials, masons unable to travel to complete work and difficulties with finance due to COVID-19 impacts.

Operation challenges

- Feeding of the biogas plants is considered to be the biggest challenge.
 - Significant raw material is required to initiate operation of the plant, which can be difficult to source and labor intensive. If there were not enough cattle around, agri-waste needed to be collected from abattoirs, often located at some distance. It can take 20 days to fill the digester and for gas to be produced.
 - 58% sourced feeding material (cow dung) from their own kraals, 33% from someone else's kraal (mainly from siblings) and 8% from nearby abattoirs.
 - Biogas plants need to be fed continuously.
 - Cow dung from free feeding cows may include soil elements which are not biodegradable and will block the digester. The quality of cow dung used is therefore important.
 - However, all beneficiaries interviewed indicated that cow dung is a common commodity in the area and that abattoirs are willing to give it out for free to them as waste.
- 17% of the beneficiaries interviewed indicated their plants were not working due to a gas leak / low pressure.

⁴⁰ Prior to constructing their biogas plant, 75 % of interviewees were using a combination of fire wood and cooking gas, 17% were using wood only, and 8% were using wood and paraffin.

⁴¹ MMGE 2021 estimated the costs of construction materials to range from P4500 – P6500 (USD450 – 650) for a 6m³ digester.

- The beneficiaries are managing their digesters on their own and would have appreciated more training / information. Although 8% of beneficiaries indicated that they had a brief demonstration by facilitators (BITRI/UNDP Biogas Team) they all felt that training on the operation, maintenance and monitoring of the plant was critical to ensure that they become independent in running their plants. No maintenance plan was provided to beneficiaries, which could jeopardize sustainability of the plant beyond the Project period. A short course on how a biogas plant works and potential uses of the plant (rather than just relying on information from masons) would also have enabled them to become ambassadors of the program.

Lessons / recommendations

- It is important to be clear from the outset on the costs involved and the requirements regarding feed.
- There is need to have a support system and a monitoring program to check the efficacy of the plant beyond the Project period.
- An assessment of solar vs biogas needs to be presented and discussed with beneficiaries at the conceptualization stage.
- An orientation course on the construction of the plant, how biogas works and its uses, operation and maintenance for beneficiaries would support sustainability and advocacy.
- Local companies could be supported to provide materials, including stoves and lights which are not readily available locally to support up-scaling of the technology.

Source: TE interviews (in-person and remote)

Medium-scale digester

As specified in the Project Document, a **public-private partnership** between agro-industry (and financiers) and the District councils was to be established at three locations in South-Eastern Botswana with the aim of constructing a biogas system utilizing locally-available waste streams. Medium-sized biogas digester of approximately 300-5,000 m³ were to be constructed, with an average expected feedstock input of 100 tonnes per day. The biogas produced was to be used to generate electricity. At least one of the 3 locations were to be grid-connected to build up expertise in this sub-sector. Excess heat was to be utilized for production processes in the agro-industrial firm and additional income generated from the sale of bio-fertilizer. The financial viability of medium-scale biogas plants at the design stage was based on an assessment of the cash flows from revenue-based sales of various products produced by the plant (e.g. biogas, pelletized organic fertilizer, heat, electricity provision).

The Project engaged intensively with a number of organizations over the period 2017-2020 with the objective of securing the uptake of medium-scale digesters – in the end none of the options explored were viable, as discussed below. The main constraint was finance, the availability of which was compounded by the impact of the COVID-19 pandemic.

- Intensive and lengthy consultations with **Botswana Meat Commission** (a Government owned abattoir) were undertaken to secure their engagement, despite the fact that they had pledged to participate during the Project conceptualization stage. In October 2018 a BMC exchange visit to Italy was organized which four BMC staff participated in. The BMC did agree to proceed, writing a letter of commitment to UNDP (unseen by TE), and a team of consultants was engaged by the Project to undertake a feasibility study of a medium-scale biogas digester at the BMC for waste management and electricity production. The outcome of the study was positive⁴² and the Project went on to engage with the BMC Executive Management and Board regarding the establishment of a PPP and financing of a medium-scale digester at their facilities (PIR, 2020). An Environmental Management Plan for the BMC was also developed, which identifies the risks and mitigation measures associated with construction and implementation of the bio-digester. Despite the early

⁴² The feasibility study for BMC indicated that approximately P11M would be required to establish the medium-scale digester, and that BMC would breakeven in 6 years.

optimism, the medium-scale bio-digester did not materialize due to financial constraints, exacerbated by COVID-19. Nonetheless, the view was expressed that construction of the BMC biogas plant would have benefited both the abattoir and the country. It would have been in line with the Paris agreement and have helped BMC demonstrate that their beef, which it is already organic, was sustainably produced.

- The Project approached Kweneng District Council's business arm - **Joint Ventures** to discuss using their landfill for a medium-scale digester. However, an exchange visit by District Council Officers responsible for waste collection to a landfill in South Africa utilizing municipal waste to produce biogas through a biogas digester revealed that municipal waste produced in the Project area is insufficient to produce biogas or electricity. Furthermore, the waste is not separated at source, making it difficult to use in a biogas digester (PIR, 2019).
- The Project held discussions with **Kgatleg Beef Producers Association** on a community medium-scale digester, which did not progress.
- The Project undertook discussions with **Kgalagadi Breweries Limited (KBL)** on using their spent grain to produce biogas and generate electricity for their operations. KBL indicated an interest in biogas technology, but required approval by their parent company - American Group (Ab-Bev), to proceed with a feasibility study. The Project sampled the waste (spent grain and yeast) in order to undertake preliminary analysis of methane content. In the end KBL decided not to proceed.
- **SENN Foods** (a private cattle abattoir) indicated interest in installing a medium-scale digester. They requested an exchange visit to gain an appreciation of biogas production in an abattoir. The PIR 2019 talks of a benchmarking exercise and a site-specific feasibility study. PSC March 2019 however notes that SENN Foods were not keen on the technology and were to look for other cost effective means of managing their waste.
- The Project approached **Water Utilities Corporation (WUC)** to consider using the fecal sludge from the sewer systems as a potential substrate for a biogas digester at their treatment plant. As reported in PIR 2019 and 2020, the equipment required to produce biogas is available on the WUC site but not fully functional. The Project engaged with the WUC to encourage them to consider refurbishment of the machinery in order to produce biogas as a source of electricity to run their boilers and pumps. It is understood that WUC has been going through a human resource restructuring process which has resulted in delays in making decisions with regards to the implementation of a biogas digester.
- Through the Department of Energy Waste to Energy Project, a feasibility study was also undertaken for the Multi Species Abattoir. This indicated that approximately P6M would be required to establish the medium-scale digester.
- According to PIR, 2018 - the Project engaged all the **District Councils**⁴³ to uptake the technology but lack of funds was given as the reason why they were not able to undertake the medium-scale digesters.

Is there a future for medium-scale biogas digesters in Botswana? Despite the limited headway made by the Project, a view is still held that medium size digesters offer a 'Golden Opportunity' for industries with organic waste in Botswana, given the many potential financial and environmental benefits. Cattle production in Botswana is estimated at 2.1 million and there is a total stock of 1.9 million chickens in South-Eastern Botswana alone so there is a large volume of agro-waste available for biogas production.

But the right policy incentives and financing packages are needed for medium-scale digesters to get over the current impasse. The Project design did not allow the Project to part finance a

⁴³ According to the Project Document at least 2 District Councils, municipal waste was to be collected and organic waste separated and used as feedstock for medium-scale biogas digesters. These District Council digesters were to be implemented as Public-Private Partnerships (PPPs), with one or more district-based agro-industrial firms providing co-investment. In return, the District Council were to share revenues gained from biogas and slurry production with the firm(s).

demonstration project, but this seems to be the logical next step, coupled with the adoption of a package of policy incentives for the private sector. There are industries who have the organic waste, which could be converted into energy, but despite a positive business case, remain unwilling to carry the risk, especially given that the technology is untested in Botswana. The right incentives for business need to be put in place such as - Power Purchase Agreements so companies can sell to the national grid / adoption of REFIT, PPPs, soft loans / grants, green certification programs. These incentives need to be supported by strict regulations on waste disposal through enforcement of the Waste Management Act (still to be approved), which will compel industries to go green.

Large scale Biogas Plant

Based on the Project Document, under Output 2.4. in the third or fourth year of the Project period, it was expected that the design, planning, partnerships and investments would be in place for at least **one utility-scale biogas installation** in South-Eastern Botswana, utilizing multiple waste streams (more than 10) from agro-industry, using Compressed Biogas (CBG) as a possible replacement for diesel and Liquefied Petroleum Gas (LPG). The large scale centralized digester was particularly ambitious. Along with the right policy dynamics, it also required land, vehicles to transport waste from the districts to site and infrastructure for power transmissions. Both the Project MTR and waste characterization report, indicated that the amount of organic waste produced in the Project area was insufficient to support development of a large-scale digester, and therefore it is not viable.

Table 13 is based on the Project Document and presents an overview of outputs and activities under Outcomes 2. Outputs and activities that were removed or became obsolete are in italics. New activities introduced during Project implementation are presented in purple text. Activities completed are presented in green text, on-going activities in blue text. Outcomes 2 consist of 9 outputs, 4 of which have been implemented to some extent (3 with substantial revisions). Overall there are 15 originally activities (i.e. specified in the Project Document), only 3 of which were implemented as intended.

Table 13: Overview of outputs, activities – Component / Outcome 2

Code	Outputs / Activities removed / obsolete in italic text	New activities introduced are in purple text	Activities completed are in green text	On-going activities are in blue text
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Outputs	Activities	Comment / progress
2.1 Sensitization campaign conducted with district councils, stakeholder and community groups in targeted biogas plant sites	<p>2.1.1 <i>[A series of meetings is organized to provide information on the pros and cons of biogas, as well as opportunities for employment and agriculture and energy use].</i></p> <p>2.1.2 <i>[Community Sensitization Workshops (4) at District Level for dissemination of research results on lessons learnt and recommendation on best practices]</i></p> <p>Social media / radio / TV</p> <p>2.1.3 National Biogas Project Conference</p>	<p>2.1.1 and 2.1.2 Due to COVID-19, meetings were not possible from 2020. The Project thus used social media, radio and television to share information about biogas technology</p> <p>2.1.3 Biogas conference undertaken in December 2021 following the relaxation of travel and gathering restrictions</p>
2.2 Feasibility ⁴⁴ study undertaken for small-scale biogas digester component.	<p>2.2.1 Consultants (international and local) identified to perform market study.</p> <p>2.2.2 Program modality identified and agreed upon by stakeholders.</p>	<p>2.2.1 Consultants engaged and report produced. However, it transpired that the consultant had not used the given criteria to select beneficiaries. The Project therefore developed an online call for</p>

⁴⁴ The terms feasibility and market study are used interchangeably. Both refer to a study to determine a detailed overview of the potential for small-scale biogas and the roles and responsibilities of stakeholders and the program modalities.

		<p>applicants interested in constructing small-scale biogas digesters.</p> <p>2.2.2 The criteria for the selection of beneficiaries was clearly highlighted in the online application and 200 participants were selected to be assisted in the program.</p>
<p>2.3 [Business plan developed for the three potential medium-scale biogas sites near agro-industrial plants with potential off-take uses analyzed].</p>	<p>2.3.1 [Technology providers will be invited to submit proposals to develop business plan (3 per site). The most suitable proposal will be selected by PPPs to undertake a complete feasibility study].</p> <p>2.3.2 [Consultants (international and local) identified and contracted to develop business plan at the three sites].</p> <p>2.3.3 [Detailed business plan developed and assessed on technical and financial feasibility].</p>	<p>2.3.1 This activity was halted based on lack of finance for a medium-scale digester. However a feasibility study for BMC was developed, which demonstrated a positive business case</p>
<p>2.4 [Feasibility study undertaken on centralized large-scale biogas plant with bio-methane upgrade].</p>	<p>2.4.1 [Consultants or technology providers identified to perform feasibility study]</p>	<p>2.4.1 Activity not undertaken due to insufficient organic waste to warrant development of a large scale biogas digester</p>
<p>2.5 [Environmental impact assessment of selected biogas sites completed].</p>	<p>2.5.1 [EIAs conducted in line with Government policy].</p> <p>Revised</p>	<p>2.5.1 EMP undertaken for the Botswana Meat Commission</p>
<p>2.6 [Tender launched for operator of the medium-sized biogas plant]⁴⁵.</p>	<p>2.6.1 [Technology providers for each of the 3 sites are selected as per Government tender procedures].</p>	<p>2.6.1 Not done as no funding available for medium-scale bio-digester.</p>
<p>2.7 [Legal establishment of biogas operators based on public-private partnerships and concessional agreements with chosen agro-industrial partners (including guaranteed supply of substrate and purchase agreement for supply of biogas).]</p>	<p>2.7.1 [The project will support the establishment of PPPs and bring in resource persons when required].</p> <p>2.7.2 [Prepare and develop sample contracts and incorporate best practices from similar projects].</p>	<p>All PPP activities removed as there is no significant waste to energy project in the country</p>
<p>2.8 [Technology agreement signed on North-South or South-South cooperation with selected international biogas equipment providers].</p>	<p>2.8.1. [The project to facilitate the signing of these agreements and support negotiations where required].</p>	<p>Not done as it was not possible for the Project to implement medium or large scale digesters</p>
<p>2.9 Construction and commissioning of biogas plants.</p>	<p>2.9.1 [PPPs, with support of the project office, to facilitate and monitor construction of biogas plants, ensure commissioning and operation].</p> <p>2.9.2 Remote Monitoring + Data Analytics for Optimization of Biogas production</p> <p>2.9.3 Engage a local trainer to conduct training for small-scale digester masons</p>	<p>2.9.1. Removed from Project activities</p> <p>2.9.2. Equipment installed by BITRI for remote monitoring of 2 pilot sites</p> <p>2.9.3. Engaged. Training done.</p> <p>2.9.4. 200 completed.</p> <p>2.9.5. On-going with construction.</p>

⁴⁵ At least one company is identified to take on responsibility to operate the digester through a tender process.

	<p>2.9.4 Piloting of 200 small-scale biogas plants - construction and commissioning.</p> <p>2.9.5 Monitoring of the construction, commissioning and operation of small-scale biogas plants undertaken</p> <p>2.9.6 Data collection and compiling for SDG Indicator 7.1.2</p> <p>2.9.7 Research and Innovation in the biogas technology through Research Technical Working Group (TWG)</p>	<p>2.9.6. Consultancy on-going. Inception report approved.</p> <p>2.9.7. Research consultancy on-going. Slowed down by travel restrictions.</p>
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Output 2.1: Sensitization campaign conducted with district councils, stakeholder and community groups in targeted biogas plant sites. Based on the Project Document, to develop widespread awareness of waste management and the opportunities to utilize biogas for energy production and bio-fertilizer, **awareness and knowledge materials** were to be developed that specifically targeted existing and new market entrants and highlighted the emerging market opportunities for biogas. A series of stakeholder workshops were to be held in conjunction with the councils and investment bodies (such as BDC).

According to Project documents, Biogas technology education and awareness has been a major component of the Project. **Presentations and workshops** were undertaken with various stakeholders, in particular the District Councils within the Project area to encourage district members (farmers) to take up the technology. A National Biogas Conference took place in December 2021 to show case the Project's work. An overview of the number of workshops and presentations and attendees / beneficiaries is not available, and the effectiveness of workshops appear not to have been evaluated by the Project.

Due to COVID-19 restrictions face to face meetings were not possible from 2020 and the Project adapted to the use of social media to share information. In efforts to engage stakeholders and strengthen stakeholder outreach activities the Project developed a **knowledge dissemination video** which demonstrates the use and benefit of biogas through interviews with several beneficiaries on selected farms. It also includes interviews with UNDP and the GoB. Following the airing of the video on national television, the Department of Energy received several calls from people interested in participating in the Project. A short animation video demonstrating how agricultural waste (cow dung, waste food and leftover crops) can be converted to biogas was also produced in four local languages in an effort to reach the majority of the population. This animation was aired on UNDP social platforms, government social platforms and Botswana Television (PIR, 2021). An overview of knowledge products produced by the Project is not available.

Output 2.9 relates to the **Construction and commissioning of biogas plants**. This Output originally focused on the development of PPPs, which were not possible to progress under the Project. The revised activities relate to the Monitoring and Evaluation of the small-scale bio- digesters – an important requirement. Many of these activities were on-going at the time of the TE, namely monitoring of the construction, commissioning and operation of small-scale biogas plants, data collection and compiling for SDG Indicator 7.1.2, and research and Innovation in the biogas technology through Research Technical Working Group (TWG).

OUTCOME 3: INCREASED INVESTMENT IN LESS GHG-INTENSIVE ENERGY SYSTEMS USING BIOGAS

Component 3 was designed to focus on the operation and maintenance aspects of biogas with the aim of safeguarding the reputation of biogas technology and thereby stimulating its replication.

According to the Project Document, to coordinate the implementation and monitor the performance of the **small-scale biogas** program, a steering committee was to be established with delegates from the participating councils in South-Eastern Botswana. The steering committee at the Council Level was to delegate day-to-day management and coordination of the program to a dedicated program office in each council (Program Manager, Biogas Engineer, biogas technicians). There is no evidence that this happened.

For **medium-scale digesters** Component 3 was to build on the partnerships established between council, investor, supplier and operator under Component 2 for the investment in, and construction of, medium-scale biogas plants. It was to include detailed arrangements on the day-to-day operation and monitoring of the plants and training of the partners in biogas technologies provided.

Little progress was possible on Outcome 3 given the insufficient amount of raw material for a large-scale bio-digester, and the inability to attract finance for the medium-size digesters.

Indicator 8: Total investment (USD) in biogas technology.

At least three financial institutions have incorporated the financing of biogas technology in their national portfolios.

Financing of the biogas plants has been challenging. From the outset, in collaboration with the Bankers association, the Project held discussions with banks to try and develop financing mechanisms to support a portfolio of investments focused on financing waste-to-energy projects. This was stepped up following the positive feasibility study for BMC, in an effort to secure funding partners. Financing institutions were engaged through a workshop (2018). The Project had the intention to contact international development banks to facilitate financing of the digester construction, once the Board of BMC agreed to proceed, which did not happen.

The NDB is the only bank that showed any real interest in the biogas technology and supporting the implementation of renewable energy projects in general. They raised the possibility of developing a financing model and program for the construction of Biogas Digesters including the offer of soft loans. This agreement is subject to the DOE submitting a detailed Renewable Energy Concept to guide the NDB on the return on investment (it is not clear if this has been done). The NDB could serve to augment the lack of funding for small-scale digesters and accelerate the roll-out and upscale beyond the Project area and Project lifespan. This arrangement is supported by the MOU between the NDB and the Department of Energy (DOE) (unseen by the TE).

Should this partnership result in the incorporation of “financing of biogas technology in their national portfolio” as stipulated by the progress indicator, it will attain only 1/3 of the set target.

Key outputs / activities

Table 14 is based on the Project Document and presents an overview of outputs and activities under Outcome 3. Outputs and activities removed / obsolete are in italics. Activities completed are presented in green text. Outcome 3 consists of 7 outputs, only 1 of which has been implemented. Overall there are 15 originally activities (i.e. specified in the Project Document), only 3 of which were implemented as intended. Most of the outputs and activities under Component 3 were contingent on Component 2 and the medium and large scale bio-digesters progressing.

Table 14: Overview of Component 3: outputs and activities

Code	Outputs and Activities removed / obsolete in italics	Activities completed are presented in green text
Outputs	Activities	Comment / Progress
3.1. <i>[Partnership established between biogas plant operators and selected district councils for supply and purchase of biogas from the plant/s].</i>	3.1.1 <i>[Facilitate meetings with operators, councils and other stakeholders].</i> 3.1.2 <i>[Technical and financial advice on utilization of biogas within the partnership].</i>	Based on medium-scale digesters which did not proceed under the project
3.2 District council staff trained on the biogas-utilization technologies selected for investment, including operations and maintenance.	3.2.1 Identify training institute to conduct training in biogas. 3.2.2 Facilitate training of trainers at the training institute. 3.2.3 Develop gender-sensitive training materials to be used to train male and female masons.	3.2.1 Vocational training institutions in the project areas were identified for training of biogas masons. 3.2.2 Trainers were trained first, then masons 3.2.3 Training manual has been developed and shared with the lead institution for accreditation into training curriculum
3.3 <i>[Monitoring scheme in place to track fuel savings (from switch to biogas) and GHG-emission reductions].</i>	3.3.1 <i>[Design and develop monitoring system with stakeholder/s].</i> 3.3.2 [Exposure and introduction of proven approaches to monitor GHG-emissions; development of a database to monitor performance on actual GHG emission reduction].	Based on medium/large scale digesters
3.4 <i>[Feasibility study conducted to analyze the financial viability and best operational options for use of biogas/bio-methane produced by a large-scale biogas digester as an alternative fuel in district council waste operations].</i>	3.4.1 <i>[Identify and contract consultant/technology providers to conduct feasibility study].</i> 3.4.2 [BITRI and project office to ensure quality of feasibility study and its relevance to local context through screening of proposals].	Based on large scale digesters
3.5 <i>[Based on outcome from feasibility study, selected biogas-utilization technologies identified].</i>	3.5.1 [Select technology providers to propose biogas technology for the large-scale biogas digester]. 3.5.2 [Facilitate financing for the biogas plant (construction, operation, maintenance)]. 3.5.3 [Forge partnerships between at least two Councils, agro-waste industries and investors and technology providers].	
3.6 <i>[By end of project, at least two (2) district councils in South-Eastern Botswana have developed plans to utilize biogas technologies in their waste operations].</i>	3.6.1 [Project design and development completed and ready for financing and construction (following a similar approach as for the medium-scale biogas digesters)].	
3.7 <i>[Contracts signed on performance-based incentive, monitored and made available to biogas owners].</i>	3.7 [Biogas owners receive a performance-based incentive based on actual output in kWh or equivalent]	

3.3.2 Relevance (*)

In terms of its relevance the Project is rated as **Highly Satisfactory**. It is consistent with beneficiaries' requirements, country needs, global priorities and donors' policies.

At the national level the Project is aligned with key Government policies and strategies. For example, it contributes to the target of reaching 15% of the country's energy from renewables by 2030, as set out in the Renewable Energy Strategy, 2019. Currently 2% of energy is produced from renewables. It also contributes to creating jobs and skills (with an emphasis on youth) and helps alleviate poverty. The Project contributes to Botswana's efforts of achieving universal access to modern energy services by 2030. With rural electrification at 24% there is a clear need for the generation of affordable energy in rural areas. With gas prices expected to continue to rise, biogas offers sustained financial benefits. Biogas can also reduce the reliance on electricity imports.

Biogas is consistent with a transition to an Inclusive Green Economy / circular economy and supports the Government's objective to build back better following the shocks imposed by COVID-19. While more monitoring of the small-scale biogas plants is needed, early findings suggest that they are having a positive impact on livelihoods and lifestyle of some of Botswana's most vulnerable communities and have met the expectations of the beneficiaries.

The Project is aligned to UNDP's Country program 2022-2026 and GEF's strategic programming on climate change. It also supports Botswana's delivery of the SDGs and International Agreements such as the United Nations Framework Convention on Climate Change (UNFCCC). For example, through its Nationally Determined Contribution (NDC), the Government of Botswana (GoB) intends to achieve an overall emissions reduction of 15% by 2030. In addition to implementing a long-term low carbon strategy to achieve these reduction targets, the GoB is committed to introducing measures surrounding the livestock sector to reduce CH₄ (methane) emissions. These international commitments coupled with national priorities outlined in the [draft] National Development Plan 11 including 'Climate Change Adaptation and Mitigation', 'Implementation of the National Waste Management Policy', 'Clean Water and Sanitation Program', 'Renewable Energy Program' and 'Biofuels' point to the strategic value of the Biogas Project (MTR, 2019).

3.3.3 Effectiveness (*)

The effectiveness of the Project relates to the extent to which the Project's objectives were achieved, or are expected to be achieved. The effectiveness of the Project is rated as **Unsatisfactory**; the level of Outcomes achieved are substantially lower than expected (none were completely achieved).

The Project has not fared well in terms of making progress towards its stated objective to facilitate low-carbon investments and public-private partnerships in the production and utilization of bio-methane from agro-waste in the districts of South-Eastern Botswana. The Project intended to achieve a well-functioning enabling environment whereby waste management policies and regulations are implemented and enforced, demonstration biogas plants constructed and operational, and investment in biogas technology demonstrably increased. Progress at the objective level largely rests with the achievements of the small-scale bio-digesters which were implemented at a much lower scale than intended. PPP for medium-scale bio-digesters have not been established and the sustainability of biogas going forward at all scales is questionable (as discussed further below). Even for areas that could be considered as foundational to the development of a biogas sector in Botswana have not been given adequate attention and focus to put the sector in the best position to move forward. These include a focus on knowledge management and consolidation and dissemination of lessons learnt, detailed studies / exploration of financing options and establishment of working groups or bodies (technical, inter-disciplinary, multi-stakeholder) that could function beyond the Project to continue its work. Furthermore, the Project's actual outcomes / outputs are a long way off what was planned. As discussed in detail above, none of the Project's 8 indicators,

were fully achieved; 4 have been partially achieved, 3 are not achieved and 1 is not rated due to lack of data. Of note, 7 of the 8 indicators are partly or wholly not relevant (obsolete) given the change in scope. The Project implemented less than half of its planned outputs and 61% of its activities, many of which needed to be downscaled or adapted.

The Project's most impactful activity has been the successful roll out of the small-scale biogas plants, which although below the scale originally envisaged, has provided proof of concept and placed the technology on a potential commercialization / replication path. In terms of developing medium-scale and large scale digesters little tangible progress has been made (largely due to the difficulties defining a finance package acceptable to all parties) and more work is needed to understand if a viable source of finance to demonstrate biogas plants at this scale can be secured.

In hindsight an alternative strategy could have been more effective in progressing the Project's objective and Outcomes, based on an earlier acceptance that constructing medium-scale biogas plants within the Project timeframe without financial support (from the Government or donors) for a demonstration site, was not viable. The Project could then have focussed on accelerating the roll out of the small-scale digesters much earlier, while focussing on building the enabling environment and securing a viable financing package for a demonstration site at the medium-scale to be realised through a follow-on Project / initiative after the Project.

3.3.4 Efficiency (*)

Efficiency is a measure of how economically resources and inputs (e.g. funds, expertise, time) are converted to results. The efficiency of the project is rated as **Unsatisfactory**; the level of Outcomes achieved is substantially lower than expected and there were significant shortcomings. As discussed, the Project implemented is a long way off what was envisaged, with most outputs / activities abandoned for a variety of reasons, while there is a substantial Project underspend. The Project also faced extensive delays. While the inception workshop and MTR were undertaken on time, the limited progress on activities at mid-term resulted in the need to request a 12 month no-cost extension in December 2020. The original planned closing date of January 2021 was therefore deferred to January 2022 (with March 10th 2022 set for administrative closure).

Project delays and inefficiencies can be attributed to a range of factors including – design flaws such as insufficient attention to a market approach and unrealistic targets (discussed above), COVID-19 restrictions (discussed above), inappropriate institutional arrangement and management challenges (discussed in this section). It is hard to attribute weight to these factors, but of note: (i) significant delays were evident before COVID-19 hit and thus the Project could have achieved more if it had been more efficient in the first 3 years of operation; (ii) there is evidence that the Project (Implementing partner and UNDP) felt that all its targets could be met as late as August 2020 when the Project extension was being approved (i.e. 1,000 small-scale bio-digesters and 3 medium-scale digesters), which is difficult to align with a consensus that the Project design was ambitious, early concerns raised about it reaching its targets, and the extent to which the Project was behind in implementing its activities; and, (iii) COVID-19 exacerbated rather than caused the difficulties the Project had been facing. It is difficult to know if financing of the medium-scale bio-digester could have been secured if COVID-19 have not happened, given its crippling impact on potential private sector partner balance sheets.

Delivery was low from the start, as evidence by the fact that only 8% of the total budget was disbursed in the first year of the Project (2017) and 14.5% in the second year (2018). As PIR, 2018 states, the previous year's work plan⁴⁶ was not fully implemented mainly because the Project Team was assembled mid-year and hence had a limited time frame to complete the

⁴⁶ The Annual Workplan is developed in consultation with key stakeholders and approved by the PSC

activities. the PSC minutes July 2017 note that BITRI should not be the only IP, and that activities should be distributed to other departments to foster buy-in, and presumably also to facilitate delivery. The PSC minutes March 2019 note that delivery could be increased through IPs undertaking some of the Project's activities and easing the burden of the PMU. The 2019 work plan was not completed in the PIR 2020 reporting period, and progress since then appears to have been slowed by on-going COVID-19 restrictions and the necessity to review the approach given some of the financiers' lack of commitment and interest (PIR, 2021). A number of key activities only started in 2021 (i) REFIT Consultancy, despite being recognised in PIR 2018 to be of strategic importance to generate interest by the private sector in Biogas investments; and, (ii) ESMF Consultancy for NDB (but this was an adaptation by the Project).

The **Project management structure** has resulted in inefficiencies namely related to the need to change the IP half way through the Project from BITRI to the DOE, the fact that there have been 3 Project Managers over the course of the Project and that for the last 1.5 years of the Project, the PMU was understaffed. BITRI was not considered to be suitable to oversee the roll out of the small-scale digesters with its focus on research and development and little had been achieved by the MTR. PSC minutes June 2019 note that the responsibilities of BITRI as IP meant that it was behind with its research and development contribution. The DOE took over the Project when it was significantly behind in December 2020, and good progress has been made in the past year with the support of the PMU.

The management structure was revised following the MTR, which noted a number of shortcomings with the existing arrangement including a lack of clarity of the role of the Project Management Unit (PMU) in general and the specific roles of BITRI employees and UNDP's seconded employees. In response the following changes were proposed in the Management Response to MTR (2019), endorsed by the PSC in December 2019: (i) the Project management role was moved to the Department of Energy (DOE); (ii) the DOE became the implementing partner, while MENT remained the executing entity; (iii) BITRI took on a more supportive role through research and development activities; (iv) DWMPC was to play a supportive role through waste management activities; (v) UNDP was to play a more supportive role; (vi) DOE was to form a unit to host the Project Team (consisting of three staff and other seconded staff) and the Renewable Energy Section at the DOE committed 16 persons to work on Biogas Project; (vii) BITRI committed staff for the Research and Development (2 Associate Researchers, 1 Researcher to carry out research and development, 1 design Engineer for the design and development of bio-digesters and 1 Senior researcher for the institution coordination role; and (viii) the DWMPC committed staff to support the small-scale digesters and waste policy interventions. It is not clear if the level of staff committed by the DOE and BITRI actually materialized.

The **Project Management Unit (PMU)** consists of a Project Manager, Project Engineer and a Finance and Administration position. Over the course of the Project, there have been 3 Project Managers. The second PM was only in post for 10 months leaving in November 2020. The high turnover in Project Managers is considered to be related to the complexity of the Project and the fact that the one year contracts offered by UNDP (and uncertainty around contracts being extended) puts people off. From November 2020 - April 2021 there was no Project Manager in place, and in April 2020 the position was offered to the Project Engineer, who has been with the Project from its start. As of November 2020, the PMU has consisted of only 1.5 staff members despite the fact that funds were available and earmarked for a PMU of three people and there was a lot to be done in the Project's final year. The PM has also been engaged in another project under the Environment Portfolio over the past year. The explanations for not hiring a Project Engineer or dedicated Finance and Administrative person are: (i) It was uncertain whether the extension would be approved (this was requested and approved in December 2020); (ii) a new person would have had to spend time getting up to speed (putting pressure on the Project Engineer) and it was decided to focus on accelerating the delivering the 150 biogas plants by hiring a consultant to monitor and ensure delivery of

the biogas plants. As noted by the RTA, while acceleration of the delivery of the bio-digesters was supported this needed to be pursued as part of a larger Delivery Acceleration Plan, which would also seek to advance on the regulation front, enabling wider adoption of bio-digesters once the Project ends. Hence the PMU needed to be well resourced; (iii) It was anticipated that DOE's engineers would take on an active role in supporting the Project, but this was considered to be insufficient. The RTA in numerous PIRs noted the need for an enhanced support team, for example in PIR 2019 it was recommended to recruit a part-time Chief Technical Advisor with knowledge and experience in biogas as well as short-term international consultants to provide technical support. While the hiring of international staff was difficult from 2020 due to COVID-19, it seems that in general throughout the Project more staff resources were required to push activities.

The Finance and Administration staff member at UNDP joined in January 2021 and supports two other projects – BIOFIN and Environment and Climate Change project – under UNDP's Environment Portfolio. She is responsible for processing payments, quotations, arranging venues for meetings and liaising with the IP and masons. The Biogas Project is meant to take 50% of her time (paid for by the Biogas Project), but reportedly accounts for closer to 80% as the workload has been high in the last year. This position within the PMU use to be a full-time person and it is not clear why it was reduced to a half time position in the final year of the Project.

The PMU has thus experienced staffing gaps, operating with half the intended resources in its final year. This has resulted in staff being over-stretched and having to multi-task. Had the PMU consisted of 3 people – it is likely that a lot more progress could have been made to build the foundation for a viable biogas sector (e.g. enhanced knowledge management, lessons learnt, establishment of an exit strategy).

The PMU has stayed housed at BITRI throughout the Project. It would have been better for the PMU to have moved to the DOE, as suggested in the Management Response to the MTR, but this did not happen due to lack of space.

The **PSC** is co-chaired by MENT-DWMPC and UNDP. The PSC has met on nine occasions⁴⁷. Attendance at meetings has varied from 14 people in December 2018 to 17 people in May 2021 (which was held virtually via Microsoft Teams). According to the Project Document, membership of the PSC is supposed to be at the Private Secretary level, but was delegated to directors, who needed to consult before making decisions, slowing down the process. A common view was that the PSC had played too passive a role and that not much happened from one meeting to the next in terms of addressing issues and solving problems, with commitments made on paper but not implemented. Members were good at highlighting challenges but not necessarily at coming up with solutions, which were left to the PMU. To address this in the later stage of the Project at PSC meetings implementing partners were encouraged to present their activities, highlight associated issues and challenges that may contribute to delays, and propose solutions for endorsement by the PSC members. This strategy is reported to have contributed to strengthening ownership of the Project by the IPs. Monthly progress meetings with the IPs have also enabled critical assessment of progress and ensured that any required corrective actions are taken, and the appropriate support is provided in a timely manner (PIR, 2021).

Other factors impacting on Project efficiency discussed in other sections of this report include: (i) M&E systems could have been strengthened to ensure effective and efficient project management; (ii) many envisaged Partnerships fell away during Project implementation; and (iii) Internal and external communication were affected by COVID-19. The majority of Project

⁴⁷ July 2017, July 2018, December 2018, March 2019, June 2019, December 2019, July 2020, October 2020, May 2021

meetings and workshops were done via platforms such as Microsoft Teams, Zoom and Webex. However, most officers did not have (good) connectivity at home, when in isolation or working from home, which limited stakeholder engagement. Information on small-scale digesters were disseminated through Botswana TV programs, radio shows as well as via social media platforms.

3.3.5 Country ownership

Country ownership is evident. As discussed the Project is aligned with national development plans and is seen as important to the country. The President was reportedly kept informed of Project progress and the Project has been reflected in Government speeches. Two key ministries (MENT and MMGE) have been involved in implementation where support for the Project is strong, although this has not been backed up enough at the technical level with day to day resources. The PSC includes a wide range of representatives from Government.

Factors diluting country ownership however are: (i) it is felt that the Government is more focused on developing solar rather than biogas despite the fact that biogas cuts across the country's environment (waste management) and energy agendas; and, (ii) it has not been possible to secure funding to develop the Project's outputs when the Project closes.

3.3.6 Gender

The Project has an Atlas gender marker GEN1: some contribution to gender equality.

While there are no gender targets included in the Results Framework, gender was considered in the Project design in terms of the number of women trained as masons and targeted for household level digester ownership. The MTR concluded that 'while gender was a consideration in project design, the project itself has not made sufficient progress to determine any substantial gender impacts'. Key gender statistic at TE are: 29% of the masons trained are women, 8 of the 30 demonstration sites involved female headed households and businesses and there is equal representation of men and women among the biogas technology beneficiaries – i.e. 50% of beneficiaries / users of biogas are women.

The Project made a concerted effort to train an equal number of female and male masons and while fewer women were trained than men, this should to be viewed in the context of bricklaying and plastering being a male dominated field, and in this respect the Project has change the perception of masonry being only for men. The Project interviewed the female masons on TV and radio which resulted in an increased interest from other women. Women have become interested in participating in the Project as they see masonry as a skill that can be used to support their families and improve their standard of living. This is thus a good basis for encouraging female participation if the Project is rolled out to the rest of the country.

Building the capacity of women in biogas technology has also enhanced environmental and resilience outcomes. The introduction and acceptance of biogas technology built the resilience of communities during COVID-19 by supporting regular practices at the home, such as cooking by women and girls, cleaning and washing up with warm water and reading⁴⁸. The Biogas project has enabled women and girls to reduce the amount of time they spend collecting firewood – reducing safety risks, and freeing uptime for other activities (including attending school and income generating activities). Smoke produced from the burning of kerosene causes some health problems and with the use of biogas, improved health outcomes are expected.

⁴⁸ Most families use candles or paraffin/kerosene lanterns in the evening. The Biogas project has enabled more lighting in the evening allowing children to do their homework and read.

3.3.7 Sustainability

Sustainability is the continuation or likely continuation of positive effects from the Project after it has come to an end, and its potential for scale up and/or replication.

3.3.7.1 Financial risks to sustainability (*)

Financial sustainability is rated as **Moderately Unlikely** (i.e. there are significant risks to sustainability).

Critically, no sources of finance have been identified to roll out the small-scale digesters and build on the foundational work undertaken regarding the medium-scale digesters after the Project ends. The Government has no funds to allocate to post project work, and UNDP may at best be able to contribute with technical assistance / policy support, but not with implementation.

Some discussions on sustainability have been held by the Project, and a Concept Note has been prepared by the Department of Energy to roll out **small-scale biogas plants** to the rest of the country (MMGE, 2021). The proposal requests financial support totaling P9.8 million (USD 980,495) from the MMGE to facilitate the roll out of 750 small-scale digesters across the country, train 200 more masons and part finance efforts to invigorate the utilization of agro-waste to generate energy in Botswana. The proposal involves part-financing the construction of 750 biogas digesters as the Biogas Project has done, that is covering labor costs, and biogas stove, heater, light, de-sulphuriser and pressure gauge.

However, there is no agreed plan in place despite growing interest and demand. Discussions are on-going with the NDB on the provision of soft loans to support the uptake of the small-scale biogas plants, however it is not clear how open people will be to soft loans and consultations are needed with potential beneficiaries to better understand the likely uptake. The concept is that a borrower would be in a position to pay back the loans through savings made on their energy cost - but the late installment of the biogas plants by the Project means that there has been no time to monitor the effectiveness of the small-scale biogas plants and the actual financial savings possible. It is likely that the soft loans may only be open to people who have a salary, excluding poorer farmers. Box 3 summarizes the factors required for a successful roll out of the small-scale bio-digesters.

For **medium-scale digesters** finance (capital) is regarded to be the number one constraint. The Project was not able to progress based on the model pursued by the Project (i.e. financed through the organizations themselves with support of commercial banks) and it seems unlikely that any progress can be made without a successful demonstration project, part financed by GoB, a carbon finance fund or development bank, and preferably with a grant component. Viable options to address the deficiency in finance holding back the uptake of medium-scale digesters have not been developed by the Project.

Box 3: Small-scale Digesters – factors required for a successful roll out?

The Project has successfully demonstrated the benefits of using small-scale biogas plants for lighting and cooking, which has generated interest and demand from off-grid farming communities both inside and beyond the study area. The technology is therefore posed to be rolled out to the rest of the country after the Project. However sustainability / up-scaling is not assured; on-going support and work is needed over the short to medium term to embed the technology and capitalize on the momentum generated. Otherwise there is a risk that the initiative will peter out after the Project ends. Factors to be addressed for a successful roll out include:

- **Affordability.** The cost of a small-scale digester, in the region of USD2,325 (based on the average cost of materials of USD1,675 plus USD650 in labor cost) is considered to be too expensive for most people, and the return on the investment too long. The extent of uptake without the level of subsidy that was provided through the Project is therefore uncertain.
- **Finance.** Finance options (e.g. soft loans) may be a solution for increased uptake and discussions are on-going with the NDB on this, but no formal arrangement is in place. It is not clear how inclusive such soft-loans would be and other finance options need to be considered to engage poor farmers, who stand to benefit the most from a small-scale biogas plant.
- **Trained masons country-wide.** Trained masons located throughout the country are required (not just in the South East of Botswana) given the size of Botswana and its dispersed population.
- **On-going awareness raising and education.** Beneficiaries and financial institutions need to fully understand the benefits of biogas (financial, environmental, health). For example, some beneficiaries view the technology as 'dirty' and want solar instead, highlighting the need to continue to build awareness of the benefits of biogas relative to solar.
- **Monitoring and Evaluation to inform on-going improvements in design and technology** is key.
- **Quality assurance of design and construction.** A quality assurance system and third party regulatory body is needed. This would improve the confidence of financial institution.
- **Supply issues.** Biogas stoves / equipment are *not* available in markets so as demand increases a supply shortage is likely, which will inevitably have a price effect – increasing price and hence affordability. It is not sustainable to rely on imports. This supply gap however also represents an opportunity for local entrepreneurs to manufacture and distribute the needed equipment and parts at an affordable price to encourage adoption at scale.

3.3.7.2 Socio-economic risks to sustainability(*),

Socio-economic sustainability is rated as **Moderately Unlikely**.

While stakeholders (Government and beneficiaries) appear to appreciate the benefits of small and medium-scale bio-digesters, this is not reflected in the on-going financial support by the Government (a key indicator of country ownership). Further, while the Project has engaged in public and stakeholder awareness raising it is difficult to evaluate the effectiveness of this and there is no synthesis of lessons learnt to enable strategic decisions to be made on the next steps for developing the technology in Botswana, and to encourage support from donors and financial institutions. The gender results flowing from the Project in terms of women and children benefiting from the installation of small-scale bio-digesters and the training of female masons are seen as long-term benefits.

3.3.7.3 Institutional framework and governance risks to sustainability (*)

Institutional and governance sustainability is rated as **Moderately Likely** (i.e. there are moderate risks to sustainability).

Capacity building. The Project has built the capacity of the Government and of the private sector through the training of masons and engagement with financing institutions and agro-industries.

The Project has increased awareness and capacity among Government authorities to engage with the agro-industrial sector in order to manage agro-industrial waste (PIR, 2019), although on-going education and capacity development within Government institutions is required.

A number of overseas trips were undertaken by Project partners to build an understanding of biogas these include: (i) Ethiopia and Uganda (2017) to learn about their biogas operations. This mission included 1 persons from the DEA, DWMPC, MLGRD and BITRI and 2 from the PMU⁴⁹; (ii) Ecomondo, Italy in November 2017, undertaken by the Project Manager, to assess medium-scale bio-digester technology and visit a biogas co-generation plant; (iii) a BMC exchange visit to Italy (October 2018) include 4 members of BMC, 1 from BITRI and 2 from UNDP. The purpose of the trip was to meet with SACE Simest, and organizations which facilitate financing of renewable energy projects; (vi) Egypt – Africa Regional Ministerial Conference on Green Economy, June 2019; (v) Germany, October 2019 by the Biofuels Working Group to visit industries using biogas; and, (vi) the Netherlands in February 2020 to support development of national feasibility study on waste to energy.

Training of masons: The Project has developed both academic and vocational biogas skills. Instructors within the vocational training institutes have been trained in small-scale biogas digester construction, operation and maintenance and the Project has worked with the training centers to develop a curriculum which can be used to train masons after the Project ends. The curriculum is accredited by the Botswana Qualifications Authority, enabling trained masons to work anywhere in the country. However, the Project has only trained mason in the Project area while masons nationwide are needed if small-scale biogas plants are to be built across the country. A long term training plan and funding is required.

Enabling policy and regulatory environment. While progress has been made on the establishment of a conducive policy and regulatory environment (e.g. the approval of biogas standards and biofuels guidelines), there are a number of areas where the legislation needs to be advanced and / or strengthened to support and incentivize the uptake of biogas at the medium / large scale. These include: (i) the introduction of **REFIT (Renewable Energy Feed-in Tariff)** to encourage investment in biogas as a grid-connected power supply (allowing the sale of (extra) energy to the grid at an attractive rate); (ii) While the Renewable Energy Strategy 2019 sets the target of 15% of the country's energy to be from renewables by 2030 (currently at 2%), biogas DoEs not feature strongly in the **Integrated Resource Management Plan** for energy generation, which sets out various projects to transition from coal to renewables and has a focus on solar energy; (iii) Approval of the Integrated Waste Management Act; and, (iv) the development of PPPs.

Uptake by project partners. As discussed there are limited signs of activities being taken up by Project partners, and plans being developed to sustain them; there is no Government funding for on-going work and muted interest from the private sector.

3.3.7.4 Environmental risk to sustainability (*)

Environmental sustainability is rated as **Likely** (i.e. there is little risk to sustainability).

The bio-digesters offer numerous environmental benefits. The medium-scale bio-digesters would require a specific environmental impact assessment prior to construction. It is possible

⁴⁹ A lesson learnt from this trip was that there were benefits to keeping cattle in enclosures. To make the collection of cow dung easier, beneficiaries were therefore encouraged to keep cattle in kraals every night so that they could harvest cow dung each morning, and (if possible) to build a small slab in the corner of the kraal where cattle could sleep.

that climate change impacts could affect the viability of the small-scale bio-digesters through, for example, impacts on water availability.

3.3.7.5 Overall likelihood (*)

Overall, sustainability is rated as **Moderately Unlikely** largely due to the lack of finance to sustain the Project's activities and a post-project strategy⁵⁰.

3.4 Other Cross-cutting Issues

3.4.1 Additionality

GEF additionality is defined as the additional outcome (environmental and otherwise) that can be directly associated with the GEF supported project.

The main achievement of the Project is the installation of 200 small-scale bio-digesters. This is expected to have resulted in a reduction of CO₂ and deforestation, although this is yet to be measured by the Project. These improvements are directly associated with the GEF supported Project and are considered to be sustainable (assuming the small-scale biogas plants are well maintained). Based on the digester utilisation rate at the time of research data collection, GHG emission reductions are at a rate of 155tCO₂/annum for the 200 digesters. Should the biogas utilisation be increased, this would result in a reduction of 608tCO₂/annum

However, the impact of the Project was intended to be much broader than this with the deployment of 1,000 small-scale bio digesters and 3 medium and large scale digesters. The Project intended to create an environment where up-take of bio-digesters at all scale would be autonomous – this has not happened. Nonetheless, the Project fares reasonably well in terms of additionally, even though only partially implemented, as summarised in Table 15.

⁵⁰ As all the risk dimensions of sustainability are critical, the overall rating for sustainability cannot be higher than the lowest rated dimension (UNDP Guidance For Conducting Terminal Evaluations of UNDP-Supported, GEF-Financed Projects' (UNDP, 2020)).

Table 15: Overview of Project's achievements against Six Areas of GEF's Additionality

GEF's Additionality	Description	Project's achievement
Specific Environmental Additionality	The GEF provides a wide range of value-added interventions/services to achieve the Global Environmental Benefits (e.g. CO ₂ reduction, Reduction).	Reduction in CO ₂ of around 155t CO ₂ /annum at current rate of utilization. Impact would have been much greater had medium sized bio-digesters been constructed
Legal / Regulatory Additionality	The GEF helps stakeholders transformational change to environment sustainable legal / regulatory forms	Biogas guidelines approved. Support to Integrated Waste Management Act, which is yet to be enacted. Update of ReFIT which are yet to be adopted
Institutional / Governance additionality	The GEF provides support to the existing institution to transform into efficient/sustainable environment manner	The Project has built Government capacity through training and study tours and promoted cross-ministerial working and broad stakeholder engagement
Financial Additionality	The GEF provides an incremental cost which is associated with transforming a project with national/local benefits into one with global environmental benefits.	It is unlikely that the small-scale biogas plants would have been rolled out without the subsidy offered by the Project
Socio-Economic Additionality	The GEF helps society improve their livelihood and social benefits thorough GEF activities	The small-scale biogas beneficiaries have improved their livelihoods and lifestyles – detailed monitoring and evaluation is needed to quantify these impacts
Innovation Additionality	The GEF provides efficient/sustainable technology and knowledge to overcome the existing social norm/barrier/practice for making a bankable project.	This has been achieved, to a large extent, for the small-scale bio-digesters, but not for the medium-scale bio-digesters

3.4.2 Catalytic Role / Replication Effect

As a pilot initiative the Project was designed to catalyze independent support and uptake of the biogas technology when the Project ended – i.e. to lead to replication and scaling up⁵¹. This has not been achieved as discussed above (see section on Sustainability) as there is no concrete plan or finance available to roll out the small-scale biogas plants or train masons at the national scale, and no financial mechanisms have been agreed with the Government and Private sector to develop a medium-scale digester in country.

The Project has however played a catalytic role through the successful demonstration of 200 small-scale bio-digester, information dissemination and training.

The ability of the Project to play a catalytic role is hampered by the limited knowledge products generate by the Project, no synthesis of the lesson learned by the Project, limited M&E of small-scale digesters and lack of an exit strategy.

3.4.3 Impact

The main environmental impacts of the Project are a reduction in GHG emissions (CO₂ and methane) and deforestation. According to information provided to the TE in March 2022 based

⁵¹ Scaling up is defined as: approaches developed through the Project are taken up on a regional / national scale, becoming widely accepted, and perhaps legally required. Replication is define as – Activities, demonstrations, and/or techniques are repeated within or outside the Project, nationally or internationally. (UNDP Guidance For Conducting Terminal Evaluations of UNDP-Supported, GEF-Financed Projects' (UNDP, 2020)).

on the digester utilization rate, GHG emission reductions are at a rate of 155tCO₂/annum for the 200 digesters. If the biogas utilization increased, this would result in a reduction of 608tCO₂/annum. The work on TEAs should also reduce waste discharge and improve water quality.

The Project has built capacity and awareness: (i) The masons trained by the Project have gained a professional skill, which they can potentially make a living out of beyond the Project; (ii) The Project has trained finance institutions on waste to energy projects. This will assist them to develop products within their portfolios that are specific to financing biogas; and, (iii) The Project held several meetings and workshops with community members and farmers associations, sharing information on biogas.

The Project has also contributed to changes in socio-economic status. The small-scale biogas plants are having a tangible impact on livelihoods and lifestyle. According to the beneficiaries, the benefits include: (i) time-savings, especially for women and children responsible for the collection of fuelwood, who can spend the time saved on income generation endeavors, schoolwork or social activities. (ii) in some cases, the technology has enabled children to be provided with a warm breakfast before school and/or at bedtime, including in the rainy season when fuelwood collection is difficult; (iii) the opportunity to grow vegetables in backyards; and, (iii) a positive impact on health. Biogas DoEs not produce any disturbing odor or smoke and hence beneficiaries are less exposed to indoor air pollution related to health problems such as respiratory difficulties and eye infections. Based on TE interviews the small-scale digesters have been given to households in need, who cannot afford gas, and therefore have helped vulnerable households to reduce their energy bills – although quantitative evidence for this is not available.

4 Conclusions, Recommendations and Lessons

4.1 Main Findings and Conclusions

The Project set out to facilitate the establishment of the first workable biogas plants in Botswana. Small- and medium-scale biogas digesters were to be constructed to demonstrate that, with private investment, biogas technology is applicable and commercially viable in Botswana. The demonstration plants were also to build capacity in design, construction, operation, investment and regulation. It was also expected that by the end of the Project, local investors would have gained sufficient capacity and confidence to support biogas technologies in the commercial sector.

The Project **objective** was to facilitate low-carbon investments and public-private partnerships in the production and utilization of biogas from agro-waste in the districts of South-eastern Botswana.

The Project that was implemented is significantly reduced in scope to that set out in the Project Document, and the Project was unable to fully achieve its objective, even with the 1 year extension. The Project implemented less than half of its planned outputs and 61% of its activities, many of which needed to be downscaled or revised. None of its 8 indicators have been fully achieved; 4 have been partially achieved, 3 are not achieved and 1 is not rated due to lack of data. Of note, 7 of the 8 indicators are partly or wholly not relevant (obsolete) given the change in scope. Of the 17 Project targets only 4 have been achieved.

The Project is left with an underspend of around USD 416,000; money that could have been allocated to the roll out of more small-scale bio-digesters (especially if this activity had started on time), or to support the foundational work needed to provide a springboard for a medium-scale bio-digester through an agreed and funded follow-on initiative. As it is the Project ends with some uncertainty around the viability of medium-scale bio-digesters.

The Project has however successfully facilitated the establishment of small-scale biogas plants in the study area (albeit at a significantly reduced number than intended). Botswana did not have a single working biogas digester when the Project was formulated. At the time of the TE, 200 small-scale digesters have been installed, and there is a strong interest in their further adoption. Households are using bio-digesters to convert animal manure into biogas to meet their cooking and, to a lesser extent, lighting needs. Beneficiaries of the small-scale biogas plants have consistently reported livelihood and lifestyle benefits. The 200 small-scale biogas plants are estimated, at the current rate of utilization, to reduce CO₂ emission by 155t CO₂/annum in total.

Other notable successes include: (i) institutional advancements with the Project supporting the development of Biogas Standards, Biofuels Guidelines, an update of the Renewable Energy Feed-In Tariffs, development of the Integrated Waste Management Bill as well as a Green Certification Framework; (ii) the training of masons; (iii) building awareness of the biogas technology among stakeholders; and, (iv) the collaborative manner in which the Project was implemented building cross ministerial relationships critical to the waste-energy agenda and engaging with the private sector.

At Project closure there is still some way to go to setting the foundation for a sustainable, commercial biogas industry in Botswana. With the lack of funding for **medium-scale digesters**, electricity generation from biogas has not yet been possible. The biogas is currently being used for cooking, lighting and heating only. Medium-scale biogas plants are still at the early stages of development in Botswana and a conducive policy environment for the private sector needs to be in place for the biogas market to develop.

While the Project has had some success in creating an enabling environment for the adoption of bio-digesters, key legislation and policies are yet to be approved (ReFIT and Integrated Waste Management Act). The establishment of these and other policies and financial incentives are a prerequisite for the market development of agro-waste management and biogas technology.

A key shortcoming of the Project is that it was not able to secure the interest and finance needed to build the three medium-scale bio-digesters⁵². Despite considerable efforts over the first three years of Project, no medium-scale digesters were agreed to, largely due to the large capital outlay required and the inability to define a viable financing mechanism. It was also intended that a proposal would have been finalized for a commercial large-scale centralized biogas plant with a facility to upgrade to bio-methane and utilization; however such a facility proved not to be technical feasible due to insufficient waste at the Project site.

The shortcomings of the Project can be explained by a number of factors including an overly ambitious project design, the impacts of COVID-19 and project management challenges. The Project was hindered from the outset by an overly ambitious project design, which also did not adhere clearly enough to the sequence in which activities needed to be undertaken to introduce biogas as a new technology. The target of 1,000 small-scale bio-digesters was unrealistic and it was also unrealistic for the medium-scale bio-digesters to have been constructed in 4 years, given that Botswana was starting at the very beginning of the process and that the private sector was unlikely to cover all the costs (risks) of a new technology. In hindsight it would have been better for the Project to have focused on implementing the small-scale biogas digesters at scale while establishing the foundation needed to introduce the medium-scale bio-digesters. That is – building awareness, partnerships, viable financing mechanism / design for a demonstration site and importantly the policies incentives and standards.

⁵² The Project was designed to establish three medium-scale biogas plants with an installed capacity of 1 MW each, financed by private-sector partners, commercial banks and Government partners (BMC or BDC).

After a slow start in its first 3 years of implementation, the Project was in 2020 significantly affected by COVID-19, which exacerbated the problems it had been facing. COVID-19 restrictions frustrated implementation of the small-scale digesters in the field and the economic downturn ended interest from financiers / co-financiers in the medium-scale digesters. However delays were embedded in Project delivery before COVID-19 hit. Disbursements in the first year of the Project were 9%, reaching only 22% by mid-term. The slow delivery is explained by difficulties hiring staff and an Implementing Partner whose core expertise is in research and development not in implementation on the ground. The small-scale biogas plants were meant to have been rolled out in Year 1 of the Project. For various reasons this did not start in earnest until 2021. The Project made good progress in its final year under the DOE, but implementation could have been accelerated with a fully staffed PMU and more day to day support from Government technicians.

The Project did not pay enough attention to the documentation of lessons learnt / knowledge management. While it was not possible build medium-scale biogas plants within the Project timeframe, the Project's experiences are important in laying the groundwork for potential future market development. However, they are not clearly synthesized / documented. This is also true of the small-scale bio-digesters. One of the strategic elements set out in the Project Document was the facilitation and establishment of appropriate utilization and knowledge platforms, these knowledge platforms do not appear to have been established and would have supported the sustainability of the Project's outputs.

The Project is considered to be highly relevant. The Government is committed to transition from coal to renewables, and biogas is seen as part of this effort. The Project also supports youth employment, and access to affordable energy for all. It also clearly aligns with the UNDP Country Program 2022-2026 and International Agreements, notably the UNFCCC.

Of great concern is the sustainability of the Project's output, with no concrete plan agreed to move forward with the small-scale and medium-scale digesters and critically no funding earmarked for this. For the small-scale biogas plants, excitement and interest has been created and demand is considered to be high across the country. It is therefore critical to keep momentum and maintain the expertise that has been built. However, resources have not been secured to ensure a seamless continuation of the work. UNDP could explore a follow-up project under GEF 8 (potentially supporting renewables in general in line with COP26 and NDCs) but this would leave a 5 year gap during which time the momentum will have been lost.

Table 16 presents the evaluation ratings. Overall the Project is rated as **Moderately Unsatisfactory**.

Table 16: Evaluation Ratings

Monitoring & Evaluation (M&E)	Rating
M&E design at entry	Satisfactory
M&E Plan Implementation	Moderately Unsatisfactory
Overall Quality of M&E	Moderately Unsatisfactory
Implementation & Execution	Rating
Quality of UNDP Implementation/Oversight	Satisfactory
Quality of Implementing Partner Execution	Moderately Unsatisfactory
Overall quality of Implementation/Execution	Moderately Satisfactory
Assessment of Outcomes	Rating
Relevance	Highly Satisfactory
Effectiveness	Unsatisfactory
Efficiency	Unsatisfactory
Overall Project Outcome Rating	Moderately Unsatisfactory
Sustainability	Rating
Financial resources	Moderately Unlikely
Socio-political/economic	Moderately Unlikely
Institutional framework and governance	Moderately Likely
Environmental	Likely
Overall Likelihood of Sustainability	Moderately Unlikely

Note: Outcomes, Effectiveness, Efficiency, M&E, I&E Execution, Relevance are rated on a 6-point rating scale: 6 = Highly Satisfactory (HS), 5 = Satisfactory (S), 4 = Moderately Satisfactory (MS), 3 = Moderately Unsatisfactory (MU), 2 = Unsatisfactory (U), 1 = Highly Unsatisfactory (HU). Sustainability is rated on a 4-point scale: 4 = Likely (L), 3 = Moderately Likely (ML), 2 = Moderately Unlikely (MU), 1 = Unlikely (U)

Forward look

The development of small-scale and medium-scale digesters are distinct processes with different financing, logistical and technical characteristics. They are on a different trajectory, given that the viability has been demonstrated by the Project for small-scale bio-digesters, but not for medium or large scale digesters. The evolution of the technology at the small and medium-scale is summarized in Table 17 and discussed below.

Medium-scale bio-digesters

Is there a future for medium-scale biogas digesters in Botswana? Despite the waning interest shown by the private sector and limited headway made by the Project, it is still felt that medium-scale biogas plants at agro-industrial facilities can make an important contribution to sustainable waste management and to meeting Botswana's renewable energy targets. Institutions could benefit through reduced energy costs and there are many potential environmental benefits. The technology is considered to be technically applicable due to the abundance of raw material and as expressed by one interviewee presents a 'golden opportunity'. This raises the question what needs to be done differently to progress the technology at this scale? The key bottleneck, as the Project has demonstrated, is raising the finance to put the technology into practice. Medium-scale plants require high capital outlay which companies in Botswana do not have in the short to medium term as they recover from the impacts of COVID-19. The Project design did not allow the Project to part finance a demonstration project (through a grant), but this type of financing arrangement seems to be the logical next step, along with the adoption by the Government of policy incentives for the private sector and the development of financing packages with financial institutions. Next steps / key considerations for medium-scale bio-digesters include:

- There are reportedly industries who have organic waste, which could be converted into energy, but despite a positive business case, remain unwilling to carry the risk, especially given that the technology is untested in the Botswana. As a next step a **demonstration site** is needed, to build investor confidence and help to clarify the perceived risks. This requires the development of a proposal and an agreed financing plan with partners. The financing plan should explore options for combined grant / soft

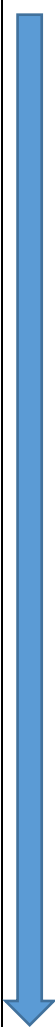
loan financing with potential contributions from Government, global climate funds (given the environmental benefits of such a plant) and other donors.

- Set up national steering group to support the development of medium-scale bio-digesters.
- The right policy incentives are needed for medium-scale digesters to get over the current impasse. As stated in the Project Document, the provision of **performance-based incentives** is an important marketing tool, needed to stimulate development of the sector. It also noted that such incentives should be linked to pre-defined quality standards to support private sector investment in biogas technology and its construction. The right incentives for business need to be put in place such as - Power Purchase Agreements so companies can sell to the national grid / adoption of REFIT, PPPs, soft loans / grants, green certification programs. These incentives need to be supported by strict regulations on waste disposal through enforcement of Waste Management Act (still to be approved), which will compel industries to go green.
- Development of National Biogas plan. If the demonstration plant is successful a study could be undertaken to determine the potential upscaling of medium-scale biogas in the country. This would include the **development of financing packages / options**, building on international experience. This should be built collaboratively with companies, financial institutions and the Government.

Small-scale bio-digesters

The DOE want to scale up the small-scale digesters to the rest of country but there are a number of challenges, in addition to finance, such as training masons nationwide and the establishment of a quality assurance mechanisms. The Government have developed an overview concept note for scaling up post Project (i.e. introducing 750 small-scale biogas plants across the country), but there are no funds secured to support this program. Finding a way forward on this in the near term is considered to be critical, so as not to lose the momentum created by the Project.

Table 17: Progressing the uptake of bio-digesters at different scales

	Stage		Small-scale digester	Medium-scale digesters
	Development	Awareness	Built by Project, but on-going awareness raisings needed if the technology is to be adopted at scale. Development of knowledge products.	On-going awareness raising needed Development of knowledge products
		Research and Development	Biogas standards developed by Project. On-going monitoring needed at the Project site to understand how well the small-scale biogas plants are performing and update technology as appropriate.	Required - building on international best practice tailored to Botswana
		Institutional Framework	Nationwide masons training program needed to upscale technology	Policy environment needs to be developed. For example, waste management policies and regulations approved, implemented and enforced, incentives developed and adopted (e.g. ReFIT).
	Demonstration		Proof of concept successfully demonstrated through Project	Demonstration biogas plants needs to be constructed and operational to generate buy-in.
	Commercial operation		It is not clear if the small-scale plants are commercially viable without a subsidy. Monitoring and evaluation of the 200 installed plants are required to better understand and quantify the financial, social and environmental benefits. This would inform suitable financing arrangements. Government support warranted if high public benefit and/or initiative helps achieve key government objectives. Development of business plans.	Undertake industry / company specific feasibility studies. Develop viable financing packages.

4.2 Lessons Learned

Poor project design affects implementation. A common problem with GEF projects is that in order to secure funding the design is often overly ambitious, requiring grounding at the mid-term review stage. The Project struggled to execute the activities related to the medium-scale digesters from the beginning, and much time was expended on this before it was accepted that it would not be possible to construct them within the Project timeframe, with the financing model being offered by the Project. The target of 1,000 small scale plants was also unrealistic. Targets should be grounded in well researched data, trends and stakeholder consultations, level of resources, enabling environment, capacity and realistic time frames. Specific design lessons from this Project include: (i) a detailed Theory of Change taking into consideration country circumstances is needed to underpin design and implementation; and, (ii) Proposals should be closely designed with stakeholders (Government, Private Sector and beneficiaries) and technical experts (national and international) to facilitate successful implementation.

The role of the private sector needs to factor strongly in project design and implementation. The private sector needs to play a central role in implementation from the

outset as major players in development. Opportunities for partnerships with private sector (with UNDP and Government) should be explored in detail at the design stage and awareness built around their potential role. A focus on state owned institutions may limit uptake of market opportunities.

The right mix of expertise and adequate core staff is needed to ensure effective and efficient delivery. The Project could have benefitted from technical support from a finance specialist, bio-digestor specialist / Chief Technical Advisor (CTA). Given the delays the Project faced and the need to accelerate delivery in its final eighteen month, the PMU should have been fully resourced, and additional resources brought on board to ensure Project outputs and lessons learnt were strongly presented.

Revision of the Theory of Change (TOC) at mid-term would have sharpened the Project's focus. Many of Project's assumptions did not hold invalidating large part of the Results Framework. The Results Framework and the Theory of Change should have been revised early on in the Project's life as it became evident that a re-orientation of the Project's strategy and focus was needed to increase its efficiency and effectiveness. Such a re-evaluation may have allowed for the roll out of more small-scale digesters along with a period of monitoring, and a detailed synthesis of the lessons learnt.

Importance of demonstrating a new technology - 'seeing is believing.' It is very hard to generate interest in a new technology that has not been tried and tested *in-situ*, especially when that technology requires significant capital outlay and incentives and mechanism to share the financial risk are not in place.

Incentives are needed to kick start new technologies. For the small-scale biogas plant beneficiaries the need for incentives relate to affordability issue and the fact that many agricultural and energy initiatives are subsidized in Botswana. For the medium-scale digesters incentives are needed to mitigate risk and encourage investments given the high capital outlay. Such Government / policy incentives are justified based on the social and environmental benefits (although more studies are needed to quantify these benefits).

An exit plan developed in final year of the project. Sustainability of the Project's outputs is a key concern and considered to be at risk. Early discussions (18 months before the Project's closure) were needed on the sustainability of the Project's outputs and the barriers to this culminating in the development of an agreed exit plan.

Knowledge should be carefully managed throughout project. Knowledge management is important for all projects, but particularly pertinent for project's introducing innovative approaches / technologies. Methodical capturing and synthesising of the knowledge generated on all aspects of introducing the biogas technology are needed.

Small-scale biogas plants

- It is important to be clear from the outset on the costs involved and the requirements regarding feed.
- There is a need to have a support system and a monitoring program to check the efficacy of the plant beyond the Project period.
- Biogas is preferred to solar by the small-scale biogas plant beneficiaries, but may not be popular with potential users who are not familiar with the technology. An assessment of solar versus biogas needs to be presented and discussed with beneficiaries at the conceptualization stage to encourage uptake.
- Training of beneficiaries of the small-scale biogas plants on the construction of the plant, how biogas works and its uses, operation and maintenance is important to enable them to become ambassadors for the technology and to independently run their plants.

- Local companies could be supported to provide materials, including stoves and lights which are not readily available locally to support up-scaling of the technology.

Engagement of women should be promoted and gender specific targets included in the Results Framework such that results can be measured and demonstrated. For the success of the small-scale biogas plants, women should be engaged from the outset in each household as they are responsible for the collection of firewood and cooking. Generally projects should develop a gender action plan for the delivery of gender activities and gender targets should feature in the Results Framework. While this was specified in the Project Document it was not adequately picked up by the Project.

4.3 Recommendations

Table 18 provides a summary of the TE's recommendations to strengthen the sustainability of the Project's outputs. Given that Project operations ended in January 2022, the recommendations largely fall to the Government.

Table 18: Recommendations Table

Ref	TE Recommendation	Entity Responsible	Timeframe
1	Category 1: Strategic planning		
1a	Develop a specific Theory of Change for small-scale and medium-scale bio-digester development to better target and plan action post project, and understand the barriers along the causal chain that require addressing.	DOE with MENT	April 2022
1b	Consider establishing a multi-stakeholder national biogas working group to develop a strategy for medium-scale digesters and small-scale digesters, within the context of Botswana's wider renewables strategy. This could consist of Government agencies, private sector (including finance sector), UNDP, donors, technical experts. A sub-group on finance / Investment facilitation platform (which was planned but not established under the Project) could be established to work on developing viable financing options (based on a review of all potential financing options – Government support, policy incentives, donor support, private sector finance).	DOE with MENT	April 2022
2	Progress development of enabling policy / legal environment		
2a	Support enactment of the Integrated Waste Management Bill.	DOE with MENT	2022
2b	REFIT- officially adopted.	DOE with MENT	2022
3	Finance		
3a	Undertake a review of financial and economic instruments that could be used to support the uptake of biogas at various scales (but with a focus on medium-scale bio-digesters) and set out agreed viable options developed with all parties (Government, donors, private sector). This should build on international practices.	DOE	2022
3b	Prepare concept notes for funding of medium-scale bio-digesters.	DOE	2022
3c	Support GCF / Adaptation Fund accreditation. Currently no institution in Botswana is accredited to the GCF and this could be used to crowd in private sector finance.	DOE	2022

Ref	TE Recommendation	Entity Responsible	Timeframe
3d	Reach out to development partners (Banks, Funds) to seek investment support based on Concept Notes prepared.	DOE, with support of UNDP	2022
4	Medium / large scale biogas plants		
	Develop national strategy and action plan on medium-scale biogas covering, for example: <ul style="list-style-type: none"> • Demonstration plant – where locate? how finance? • Private sector engagement/ PPP • Specific feasibility studies, following successful demonstration • Development of finance packages. 	DoE, and partners	2022
5	Small-scale biogas plants		
5a	Develop roll-out / scale up strategy and finance plan building on the DoE concept note and further explore funding options to ensure momentum on the small-scale bio-digester program is maintained. The finance plan should consider how to include the most vulnerable in uptake of small-scale biogas plants.	DoE	April 2022
5b	Develop monitoring plan and maintenance guide for beneficiaries to be used beyond the Project. This is needed to ensure construction standards are met and maintained and to maintain demand	BITRI	April 2020
6	UNDP Support		
6a	Consider building up staff capacity at UNDP to support transition to renewables through on-going policy support, developing project proposals and assistance to raising financing.	UNDP	April 2022
6b	Consider working with Government on GEF 8 proposal on renewable energy, including biogas	UNDP / GoB	2022
7	Private Sector		
7a	Continue the relationship building that has been started by the Project with the private sector with the objective of realizing marketable opportunities and financing options. For example, Banks still need to be convinced that the technology works, there is sufficient market demand and there are serviceable financial products	DoE, UNDP	2022
7b	To support the provision of soft loans by the NDB, the results of the small-scale biogas plants, such as ability of customers to repay loans should be monitored and share with the banks.	DoE, UNDP, NDB	2022
8	Government champion		
	DoE to champion biogas at Senior Government level. There is the capacity for biogas to play a bigger role as part for the drive on renewables and green economy, and a Government champion is needed to drive this.	DoE	On-going
9	Knowledge management and lessons learned		
	Collate and synthesize lesson learnt by the Project, by scale of technology, and present in a range of reader friendly materials (e.g. pamphlets for beneficiaries of small-scale bio-digesters, synthesis of lessons learnt by Project on development of medium-scale bio-digesters). This is in addition to awareness raising videos and operating manual developed for beneficiaries.	PMU, BITRI, DoE	March 2022
10	On-going education and awareness raising		
	Support for on-going awareness raising is important to help facilitate the uptake of small-scale biogas plants country-wide.	DoE, MENT	On-going

5 Annexes

5.1 TE ToR (excluding ToR annexes)

Terminal Evaluation Terms of Reference – Biogas Project

1. INTRODUCTION

In accordance with UNDP and GEF M&E policies and procedures, all full- and medium-sized UNDP-supported GEF-financed projects are required to undergo a Terminal Evaluation (TE) at the end of the project. This Terms of Reference (ToR) sets out the expectations for the TE of the *full-sized* project titled *Promoting Production and Utilisation of Biogas from AgroWaste in South-Eastern Botswana (PIMS #5299) – Biogas Project* initially implemented through the Botswana Institute for Technology Research and Innovation (BITRI), however following the Mid-Term Review (MTR), project implementation was shifted to the Ministry of Mineral Resources, Green Technology and Energy Security (MMGE): Department of Energy (DOE). The project started on the 20th January 2017 and is in its 5th year of implementation following a request for an extension from the MMGE in July 2020. The project has been extended up to January 2022. The TE process must follow the guidance outlined in the document ‘Guidance For Conducting Terminal Evaluations of UNDP-Supported, GEF-Financed Projects’

(http://web.undp.org/evaluation/guideline/documents/GEF/TE_GuidanceforUNDP-supportedGEF-financedProjects.pdf).

2. PROJECT BACKGROUND AND CONTEXT

The Government of Botswana (GoB) in collaboration with the United Nations Development Program (UNDP) is implementing a project called “Promoting production and utilization of Biogas from Agro-waste in South-Eastern Botswana (Biogas Project)”. The project has been funded by the Global environment Facility (GEF) to the tune of \$2,632,300 and UNDP by \$200,000. The project is being implemented in the Kgatleng, Kweneng, South-East and Southern districts of Botswana.

The project is being implemented by the *Ministry of Mineral Resources, Green Technology and Energy Security (MMGE): Department of Energy (DOE)*. Other key stakeholders in the project include the Department of Waste Management and Pollution Control (DWMPC), Ministry of Local Government and Rural Development (MLGRD), Botswana Power Corporation (BPC), Botswana Energy Regulatory Agency (BERA), District Councils, BITRI and Water Utilities Corporation (WUC).

The Biogas Project was initiated following the realization that waste has not been taken as a resource in the country. The reuse of waste to generate energy is an opportunity that Botswana must tap into for future use. Several waste streams are available at several agro-industrial facilities which can be utilized for generation of energy. Some of the agro-waste for consideration in biogas production include chicken manure, cow dung and goat/sheep droppings. Despite this immense potential presented by the abundance of livestock manure, agricultural/animal waste and other forms of biomass in the country, generation of energy from this waste remains a challenge.

The Biogas Project, as an initiative that cuts across the energy sector as well as the waste management sector offers a solution to the objectives of government to provide equitable access to energy for all, reduction of green house gas emissions by the country as a whole, increasing the contribution of renewable energy in the energy mix, reduction of the importation of carbon based electricity, reduction of deforestation, preservation of the environment through better management of waste, and valorization of waste.

The Biogas project seeks to facilitate low-carbon investments and public-private partnerships in the production and utilization of biogas from agro-waste and aims to assist the government through the following three components:

1. Institutional strengthening and capacity development;
2. Facilitation and establishment of biogas plants; and
3. Setting up of utilization and knowledge platforms.

The outcomes of the project will include the implementation of effective waste-management policies and guidelines with operational regulations; capacity to design and develop biogas projects in South-Eastern Botswana; the first best-practice public-private partnership established; reduction in greenhouse gas emissions (direct and indirect) of 1.65 million tCO₂e; and increased incomes through the use of small-scale biogas and bio-fertilizer, especially for women.

Research and development, in the form of data collection from the different small-scale digester sites and installation of a remote monitoring system at 2 of the digester sites will provide lessons learnt throughout the project. These lessons will be the basis upon which the project will then be rolled out to the rest of the country beyond the scope of this UNDP funded project and to ensure sustainability of the UNDP initiative.

As of 24 June 2021, Botswana has a total of 67,492 COVID-19 cases, with 31,341 and 1,095 recorded recoveries and deaths, respectively. Botswana implemented its first nationwide lockdown from 2 April 2020–22 May 2020, which included the suspension of all international and inter-zonal travel, and imposition of curfews for movement within the country, with the exception of essential services. In 2021, Botswana has not implemented a nationwide lockdown. While international and inter-zonal travel is currently permitted in Botswana, the Government of Botswana continues to implement restrictions on movements and gatherings as necessary such as limiting the number of interzonal movement permits and application of curfews. These restrictions have resulted in numerous delays in project implementation and processes, including: i) limitations on interactions and engagements with project partners and beneficiaries, and disruptions in the supply chain leading to partners and beneficiaries receiving goods and services; ii) procurement of consultants, as internationally based consultants were unable to travel to undertake the required work; and iii) postponement of trainings and meetings to ensure compliance with the recommended health protocols. Additionally, the anticipated increase in COVID-19 cases poses a considerable risk to the implementation of the project being evaluated, particularly with regards to travel to project sites, and consultations with project stakeholders.

3. TE PURPOSE

The Terminal Evaluation (TE) report is done at the final stages of the project, within 6 months of operational closure of the project. It is utilized to

- assess the achievement of project results against what was expected to be achieved;
- draw lessons that can both improve the sustainability of benefits from this project;
- aid in the overall enhancement of UNDP programming.

The TE will also assist the Government of Botswana in its efforts to rollout the project and/or technology to the rest of the country. The TE report promotes accountability and transparency and assesses the extent of project accomplishments.

The impacts of Covid19 on the attainment of project goals will also form part of the terminal evaluation.

4. TE APPROACH & METHODOLOGY

The TE report must provide evidence-based information that is credible, reliable and useful. The TE team will review all relevant sources of information including documents prepared during the preparation phase (i.e. PIF, UNDP Initiation Plan, UNDP Social and Environmental Screening Procedure/SESP) the Project Document, project reports including annual PIRs, project budget revisions, lesson learned reports, national strategic and legal documents, and any other materials that the team considers useful for this evidence-based evaluation. The TE team will review the baseline and midterm GEF focal area Core Indicators/Tracking Tools submitted to the GEF at the CEO endorsement and midterm stages and the terminal Core Indicators/Tracking Tools that must be completed before the TE field mission begins.

The TE team is expected to follow a participatory and consultative approach ensuring close engagement with the Project Team, government counterparts (the GEF Operational Focal Point), Implementing Partners, the UNDP Country Office(s), the Regional Technical Advisor, direct beneficiaries and other stakeholders.

Engagement of stakeholders is vital to a successful TE. Stakeholder involvement should include interviews with stakeholders who have project responsibilities, including but not limited to MMGE, DOE, MENT, BITRI, DWMP, BPC, BERA, MLGRD, District Councils, WUC; executing agencies, senior officials and task team/component leaders, key experts and consultants in the subject area, Project Board, project beneficiaries, academia, local government and CSOs, etc. Additionally, the TE team is expected to conduct field missions to the various small-scale digester sites within the project area.

The specific design and methodology for the TE should emerge from consultations between the TE team and the above-mentioned parties regarding what is appropriate and feasible for meeting the TE

purpose and objectives and answering the evaluation questions, given limitations of budget, time and data. The TE team must use gender-responsive methodologies and tools and ensure that gender equality and women's empowerment, as well as other cross-cutting issues and SDGs are incorporated into the TE report.

The final methodological approach including interview schedule, field visits and data to be used in the evaluation must be clearly outlined in the TE Inception Report and be fully discussed and agreed between UNDP, stakeholders and the TE team.

The final report must describe the full TE approach taken and the rationale for the approach making explicit the underlying assumptions, challenges, strengths and weaknesses about the methods and approach of the evaluation.

As of 11 March 2020, the World Health Organization (WHO) declared COVID-19 a global pandemic as the new coronavirus rapidly spread to all regions of the world. As travel to Botswana is not guaranteed to be open during the TE period, the TE team should develop a methodology that takes this into account. This includes the need to conduct the TE virtually and remotely, including the use of remote interview methods and extended desk reviews, data analysis, surveys and evaluation questionnaires. This should be detailed in the Inception Report and agreed with the Commissioning Unit.

The International Consultant (Team Lead) will be home-based and will work closely with the National Consultant in engaging stakeholders digitally via telephone or platforms such as Zoom or Skype. During the planning of virtual stakeholder consultations, careful consideration should be given to the coverage of mobile telephone networks, particularly in remote areas. Where possible, the appropriate technical and ICT arrangements should be made in advance to support a successful consultation process — support on this will be provided by the PMU. Should virtual consultations not be possible, the National Consultant will be required to travel to project sites to conduct face-to-face interviews — in compliance with the relevant Government of Botswana COVID-19 regulations. Field missions to project sites will be conducted by the National Consultant and findings shared with the International Consultant. Furthermore, all stakeholder engagement will be strongly supported by the Project Team.

Consideration should be taken for stakeholder availability, ability, and willingness to be interviewed remotely and the constraints this may place on the TE. These limitations must be reflected in the final TE report. No stakeholders, consultants or UNDP staff should be put in harm's way and safety is the key priority — this will be ensured by complying with all of the Government of Botswana's COVID-19 regulations.

5. DETAILED SCOPE OF THE TE

The TE will assess project performance against expectations set out in the project's Logical Framework/Results Framework (see ToR Annex A). The TE will assess results according to the criteria outlined in the Guidance for TEs of UNDP-supported GEF-financed Projects (http://web.undp.org/evaluation/guideline/documents/GEF/TE_GuidanceforUNDP-supportedGEF-financedProjects.pdf).

The Findings section of the TE report will cover the topics listed below. A full outline of the TE report's content is provided in ToR Annex C. The asterisk “(*)” indicates criteria for which a rating is required.

Findings

i. Project Design/Formulation

- National priorities and country driven-ness
- Theory of Change
- Gender equality and women's empowerment
- Social and Environmental Safeguards
- Analysis of Results Framework: project logic and strategy, indicators
- Assumptions and Risks
- Lessons from other relevant projects (e.g. same focal area) incorporated into project design
- Planned stakeholder participation
- Linkages between project and other interventions within the sector
- Management arrangements

ii. Project Implementation

- Adaptive management (changes to the project design and project outputs during implementation)
- Actual stakeholder participation and partnership arrangements
- Project Finance and Co-finance
- Monitoring & Evaluation: design at entry (*), implementation (*), and overall assessment of M&E (*)
- Implementing Agency (UNDP) (*) and Executing Agency (*), overall project oversight/implementation and execution (*)
- Risk Management, including Social and Environmental Standards

iii. Project Results

- Assess the achievement of outcomes against indicators by reporting on the level of progress for each objective and outcome indicator at the time of the TE and noting final achievements
- Relevance (*), Effectiveness (*), Efficiency (*) and overall project outcome (*)
- Sustainability: financial (*), socio-political (*), institutional framework and governance (*), environmental (*), overall likelihood of sustainability (*)
- Country ownership
- Gender equality and women's empowerment
- Cross-cutting issues (poverty alleviation, improved governance, climate change mitigation and adaptation, disaster prevention and recovery, human rights, capacity development, South-South cooperation, knowledge management, volunteerism, etc., as relevant)
- GEF Additionality
- Catalytic Role / Replication Effect
- Progress to impact

Main Findings, Conclusions, Recommendations and Lessons Learned

- The TE team will include a summary of the main findings of the TE report. Findings should be presented as statements of fact that are based on analysis of the data.
- The section on conclusions will be written in light of the findings. Conclusions should be comprehensive and balanced statements that are well substantiated by evidence and logically connected to the TE findings. They should highlight the strengths, weaknesses and results of the project, respond to key evaluation questions and provide insights into the identification of and/or solutions to important problems or issues pertinent to project beneficiaries, UNDP and the GEF, including issues in relation to gender equality and women's empowerment.
- Recommendations should provide concrete, practical, feasible and targeted recommendations directed to the intended users of the evaluation about what actions to take and decisions to make. The recommendations should be specifically supported by the evidence and linked to the findings and conclusions around key questions addressed by the evaluation.
- The TE report should also include lessons that can be taken from the evaluation, including best and worst practices in addressing issues relating to relevance, performance and success that can provide knowledge gained from the particular circumstance (programmatic and evaluation methods used, partnerships, financial leveraging, etc.) that are applicable to other GEF and UNDP interventions. When possible, the TE team should include examples of good practices in project design and implementation.
- It is important for the conclusions, recommendations and lessons learned of the TE report to include results related to gender equality and empowerment of women.

The TE report will include an Evaluation Ratings Table, as shown below:

ToR Table 1: Evaluation Ratings Table for *Promoting Production and Utilisation of Biogas from AgroWaste in South-Eastern Botswana*

Monitoring & Evaluation (M&E)	Rating ⁵³
M&E design at entry	
M&E Plan Implementation	
Overall Quality of M&E	
Implementation & Execution	Rating
Quality of UNDP Implementation/Oversight	
Quality of Implementing Partner Execution	
Overall quality of Implementation/Execution	
Assessment of Outcomes	Rating
Relevance	
Effectiveness	
Efficiency	
Overall Project Outcome Rating	
Sustainability	Rating
Financial resources	
Socio-political/economic	
Institutional framework and governance	
Environmental	
Overall Likelihood of Sustainability	

6. TIMEFRAME

The total duration of the TE will be approximately (*average 25-35 working days*) over a time period of (*12 weeks*) starting on 19th July 2021. The tentative TE timeframe is as follows:

Timeframe	Activity
9 th July 2021	Application closes
14 th July 2021	Selection of TE team
19 th – 21 st July 2021	Preparation period for TE team (handover of documentation)
(22 nd – 27 th July 2021) 4 days	Document review and preparation of TE Inception Report
(28 th July – 3 rd August 2021) 5 days	Finalization and Validation of TE Inception Report; latest start of TE mission
(4 th - 24 th August 2021) 15 days	TE mission: stakeholder meetings, interviews, field visits, etc.
(27 th August 2021)	Mission wrap-up meeting & presentation of initial findings; earliest end of TE mission
(30 th August - 10 th September 2021) 10 days	Preparation of draft TE report
(10 th September 2021)	Circulation of draft TE report for comments
(20 th September 2021)	Incorporation of comments on draft TE report into Audit Trail & finalization of TE report
(27 th September 2021)	Preparation and Issuance of Management Response
(28 th September 2021)	Concluding Stakeholder Workshop (optional)
(29 th September 2021)	Expected date of full TE completion

Options for site visits should be provided in the TE Inception Report.

⁵³ Outcomes, Effectiveness, Efficiency, M&E, I&E Execution, Relevance are rated on a 6-point rating scale: 6 = Highly Satisfactory (HS), 5 = Satisfactory (S), 4 = Moderately Satisfactory (MS), 3 = Moderately Unsatisfactory (MU), 2 = Unsatisfactory (U), 1 = Highly Unsatisfactory (HU). Sustainability is rated on a 4-point scale: 4 = Likely (L), 3 = Moderately Likely (ML), 2 = Moderately Unlikely (MU), 1 = Unlikely (U)

7. TE DELIVERABLES

#	Deliverable	Description	Timing	Responsibilities
1	TE Inception Report	TE team clarifies objectives, methodology and timing of the TE	No later than 2 weeks before the TE mission:	TE team submits Inception Report to Commissioning Unit and project management
2	Presentation	Initial Findings	End of TE mission: (24 th August 2021)	TE team presents to Commissioning Unit and project management
3	Draft TE Report	Full draft report (using guidelines on report content in ToR Annex C) with annexes	Within 3 weeks of end of TE mission: (10 th September 2021)	TE team submits to Commissioning Unit; reviewed by RTA, Project Coordinating Unit, GEF OFP
5	Final TE Report* + Audit Trail	Revised final report and TE Audit trail in which the TE details how all received comments have (and have not) been addressed in the final TE report (See template in ToR Annex H)	Within 1 week of receiving comments on draft report: (20 th September 2021)	TE team submits both documents to the Commissioning Unit

*All final TE reports will be quality assessed by the UNDP Independent Evaluation Office (IEO). Details of the IEO's quality assessment of decentralized evaluations can be found in Section 6 of the UNDP Evaluation Guidelines.⁵⁴

8. TE ARRANGEMENTS

The principal responsibility for managing the TE resides with the Commissioning Unit. The Commissioning Unit for this project's TE is UNDP Botswana Country Office.

The Commissioning Unit will contract the evaluators and ensure the timely provision of per diems and travel arrangements within the country for the TE team. The Project Team will be responsible for liaising with the TE team to provide all relevant documents, set up stakeholder interviews, and arrange field visits.

9. TE TEAM COMPOSITION

A team of two independent evaluators will conduct the TE – one team leader (with experience and exposure to projects and evaluations in other regions) and one team expert, from Botswana. The team leader will be responsible for the overall design and writing of the TE report. The team expert will undertake stakeholder consultations, collect and analyse data on the ground and undertake relevant site visits.

The evaluator(s) cannot have participated in the project preparation, formulation and/or implementation (including the writing of the project document), must not have conducted this project's Mid-Term Review and should not have a conflict of interest with the project's related activities.

The selection of evaluators will be aimed at maximizing the overall "team" qualities and the Team Expert will be evaluated in the following areas:

Education

- Masters degree in Renewable Energy, Natural Sciences, Environmental Management or related fields with focus on Monitoring and Evaluation or Project Management.

Experience

- Relevant experience with results-based management evaluation methodologies;
- Experience in undertaking stakeholder consultations;
- Experience in various data collection and analysis methods;
- Experience working in Botswana;

⁵⁴ Access at: <http://web.undp.org/evaluation/guideline/section-6.shtml>

- Experience in relevant technical areas for at least 5 years;
- Demonstrated understanding of issues related to gender and climate change;
- Excellent communication skills;
- Demonstrable analytical skills;

Language

- Fluency in written and spoken English and Setswana.

10. EVALUATOR ETHICS

The TE team will be held to the highest ethical standards and is required to sign a code of conduct upon acceptance of the assignment. This evaluation will be conducted in accordance with the principles outlined in the UNEG 'Ethical Guidelines for Evaluation'. The evaluator must safeguard the rights and confidentiality of information providers, interviewees and stakeholders through measures to ensure compliance with legal and other relevant codes governing collection of data and reporting on data. The evaluator must also ensure security of collected information before and after the evaluation and protocols to ensure anonymity and confidentiality of sources of information where that is expected. The information knowledge and data gathered in the evaluation process must also be solely used for the evaluation and not for other uses without the express authorization of UNDP and partners.

11. PAYMENT SCHEDULE

- 20% payment upon satisfactory delivery of the final TE Inception Report and approval by the Commissioning Unit
- 40% payment upon satisfactory delivery of the draft TE report to the Commissioning Unit
- 40% payment upon satisfactory delivery of the final TE report and approval by the Commissioning Unit and RTA (via signatures on the TE Report Clearance Form) and delivery of completed TE Audit Trail

Criteria for issuing the final payment of 40%⁵⁵:

- The final TE report includes all requirements outlined in the TE TOR and is in accordance with the TE guidance.
- The final TE report is clearly written, logically organized, and is specific for this project (i.e. text has not been cut & pasted from other TE reports).
- The Audit Trail includes responses to and justification for each comment listed.
- In line with the UNDP's financial regulations, when determined by the Commissioning Unit and/or the consultant that a deliverable or service cannot be satisfactorily completed due to the impact of COVID-19 and limitations to the TE, that deliverable or service will not be paid.
- Due to the current COVID-19 situation and its implications, a partial payment may be considered if the consultant invested time towards the deliverable but was unable to complete due to circumstances beyond his/her control.

12. APPLICATION PROCESS⁵⁶

Recommended Presentation of Proposal:

- a) Letter of Confirmation of Interest and Availability using the template provided by UNDP;
- b) CV and a Personal History Form (P11 form);
- c) Brief description of approach to work/technical proposal of why the individual considers him/herself as the most suitable for the assignment, and a proposed methodology on how they will approach and complete the assignment; (max 1 page)

⁵⁵ The Commissioning Unit is obligated to issue payments to the TE team as soon as the terms under the ToR are fulfilled. If there is an ongoing discussion regarding the quality and completeness of the final deliverables that cannot be resolved between the Commissioning Unit and the TE team, the Regional M&E Advisor and Vertical Fund Directorate will be consulted. If needed, the Commissioning Unit's senior management, Procurement Services Unit and Legal Support Office will be notified as well so that a decision can be made about whether or not to withhold payment of any amounts that may be due to the evaluator(s), suspend or terminate the contract and/or remove the individual contractor from any applicable rosters. See the UNDP Individual Contract Policy for further details:

https://popp.undp.org/layouts/15/WopiFrame.aspx?sourcedoc=/UNDP_POPP_DOCUMENT_LIBRARY/Public/PSU_Individual%20Contract_Individual%20Contract%20Policy.docx&action=default

⁵⁶ Engagement of evaluators should be done in line with guidelines for hiring consultants in the POPP <https://popp.undp.org/SitePages/POPPRoot.aspx>

d) Financial Proposal that indicates the all-inclusive fixed total contract price and all other travel related costs (such as flight ticket, per diem, etc), supported by a breakdown of costs, as per template attached to the Letter of Confirmation of Interest template. If an applicant is employed by an organization/company/institution, and he/she expects his/her employer to charge a management fee in the process of releasing him/her to UNDP under Reimbursable Loan Agreement (RLA), the applicant must indicate at this point, and ensure that all such costs are duly incorporated in the financial proposal submitted to UNDP.

All application materials should be sent to the email address procurement.bw@undp.org with the following reference "Consultant for Terminal Evaluation of Biogas Project" by 9th July 2021 at 12noon Botswana time. Incomplete applications will be excluded from further consideration.

Criteria for Evaluation of Proposal: Only those applications which are responsive and compliant will be evaluated. Offers will be evaluated according to the Combined Scoring method – where the educational background and experience on similar assignments will be weighted at 70% and the price proposal will weigh as 30% of the total scoring. The applicant receiving the Highest Combined Score that has also accepted UNDP's General Terms and Conditions will be awarded the contract.

5.2 List of persons interviewed

Organization	Name	Position	Gender
Beneficiaries of Small Scale Biogas plants	Bamphitlhetse Rabogadi		M
	Barati Monare		F
	Batisane Reuben		M
	Boikie Mabone		M
	Esther Seleke		F
	Kegopotswe Phiri		M
	Keorapetse Machola		F
	Magdeline Ditlele		F
	Maipelo Connie Mothobi		F
	Moathudi Mathuba		M
	Radikgong Botie Matala.		M
	Seitebaleng Ramakgwa		F
BITRI	Edward Rakgati	Research Co-ordinator	M
Consultants	Themba Gift Modise		M
DOE	Midas Sekgabo	Director of Energy	M
Masons	Calvin Ramolapong		M
	Deliwe Matshameko		F
	Ellen Chienda		F
	Gofaone Mfetane		M
	Kefilwe Matala		M
	Keletso Maribe		M
	Ontiretse Ntshole		M
	Ontiretse Ramontshonyana		M
	Oratile Maseko		F
	Oteng Phenyio Suping		M
	Thabiso Molapisi		M
	Thabiso Rantleru		M
	Tracy Rukero		F
	Trevor Sandla		M
	Tshephang Koobotswe		F
NDB	Bosa Gaofiwe	Resource Mobilization Manager	M
MLGRD	Mmoloki Masole		M
UNDP	Baboloki Autlwetse	First Project Manager for Biogas Project	M
	Bame Mannathoko	Monitoring and Environment Analyst	M
	Chimbdzanii Bratonozia	Programme Specialist – environment and Climate Change	F
	Ludo Moroka	Project Manager - Biogas Project	F

	Margunn Indreboe Alshaikh	Deputy Resident Representative	F
	Thuso Mogae	Project Finance and Admin Associate	M
WUC	Tshegofatso Bakgaleng	Environment Officer	F

5.3 List of documents reviewed

Project reporting / M&E

- Project Document plus Appendix
- PIMS 5299 UNDP-GEF revised DOA Communication
- PIMS 5299 Biogas LPAC Minutes
- GEF Executive Coordinator endorsement letter
- PIMS 5299 BIO signed Letter of Agreement for DOC 2017
- PIMS 5299 - Botswana biogas - LoE - updated, June 2015
- Project Inception Report, 2017
- Project Implementation Reports – 2018, 2019, 2020 and 2021
- Project Steering Group Meetings Minutes – July 2017, July 2018, December 2018, **xx** 2019, June 2019, December 2019, October 2020, July 2020, May 2021
- UNDP management response template midterm evaluation of biogas project
- Annual Work Plans (AWP) - 2018, 2019, 2020
- Biogas Progress Report, July 2020
- Outcome 3 Action Plan
- List of Project Stakeholders
- Vertical Fund COVID Survey, April 2020
- Various procurement notices / TORs
- Budget Revisions, 2018
- BTOR
 - Ethiopia and Uganda, July 2017
 - Landfill to Energy Exchange Visit, South Africa, October 2017
 - Ecomondo Italy, November 2017
 - BMC Exchange visit Italy, November 2018
 - Egypt Green Economy Conference, June 2019
 - Germany, October 2019
 - Netherlands, February 2020

Project outputs

- Update of 2021 renewable energy feed-in tariff ReFIT guidelines for Botswana ReFIT guidelines for Botswana – first draft
- Ministry of Mineral Resources, Green Technology and Energy Security, 2021. Biofuels Guidelines for Botswana
- Botswana Bureau of Standards, 2021. Agricultural Structures – Biogas Plants (Finalized Draft)
- Botswana Bureau of Standards, 2020. Biogas – Biogas production, Conditioning, Upgrading and Utilization – Terms, Definitions and Classification Scheme. (Finalized Draft)
- Feasibility Study for Production and Utilization of Biogas at Botswana Meat Commission in Lobatse, Botswana
- Botswana Waste to Energy Feasibility Study. Phase 2: Biogas Plants Feasibility at Abattoirs, January 202. Prepared by Worley Utilization of Biogas at Botswana Meat Commission in Lobatse, Botswana
- Environmental Management Plan (EMP) for the Botswana Meat Commission (BMC) Medium Sized Digester Plant at Lobatse Abattoir. Prepared by TRENDS Environmental Consultancy (Pty) Ltd.
- Small-scale Digester BOQ
- 6 cbm approved plan
- 20 cbm approved plan

- 30 cbm approved plan
- Request for Quotation - Digester Construction
- Phase 2: Biogas Plants Feasibility at Abattoirs
- Gamodubu Regional landfill – fact Sheet. Prepared by Kweneng District Ventures
- Mason engagement letter final
- Development of an Environmental and Social Management Framework Inception Report, May 2021. Prepared by Environmental Solutions Africa
- Links to biogas technology knowledge dissemination videos
- Ministry of Mineral Resources, Green Technology and Energy Security, Concept Note. Roll Out of a Small-scale Bio-digester Program (*undated*)

5.4 Evaluation Question Matrix

Evaluative Questions	Indicators	Sources	Methodology
Relevance: How DoEs the project relate to the main objectives of the GEF Focal area, and to the environmental and development priorities at the local, regional and national level			
How well DoEs the project align with evolving GEF focal area priorities?	Extent to which GEF priorities and areas of work incorporated	Project documents National policies and strategies Project partners Project beneficiaries	Document review, interviews with project staff and stakeholders
Is the project aligned with other donor and Government programs and projects? Is the project country driven?	Degree of coherence between the project and national priorities, policies and strategies		
DoEs the project adequately take into account the national realities, both in terms of institutional and policy frameworks in its design and implementation?	Adequacy of project design and implementation to national realities and existing capacities		
Have implementation strategies been appropriate (is the logframe logical and complete)?	Degree to which the project supports objectives of Government.		
Did the project address the needs of target beneficiaries and other stakeholders? Is the approach inclusive? Are beneficiaries and other stakeholders effectively engaged in implementation?	Degree to which the project supports local aspirations Degree to which the project meets stakeholder expectations		
Effectiveness: To what extent have the expected outcomes and objectives of the project been achieved ?			
How well has the project performed against its expected objectives and outcomes, and its indicators and targets?	Extent to which milestones and targets are achieved, as laid out in the logframe and monitoring plan	Project quarterly progress reports and PIR Minutes of Project Steering Committee Meetings Local partners and beneficial Project reports	Interviews with project staff and stakeholders Review of legislative developments within project period
Which have been the key factors leading to project achievements?	Achievement of milestones and targets as laid out in the logframe and monitoring plan		
To what extent can observed results be attributed to the project or not? In this respect have there been notable changes in the enabling environment for the project?	Extent of change to the enabling environment, particularly changes affecting operations		
Has the project failed in any respect? What changes could have been made (if any) to the design or implementation of the project in order to improve the achievement of the expected results?	Evidence of adaptive management and/or early application of lessons learned		
How has the project contributed to raising capacity of local stakeholders to address aims of the project or of Government?	Extent of support from local stakeholders		

Evaluative Questions	Indicators	Sources	Methodology
What are the views of stakeholders on the implementation and activities of the project? Are there activities missing from the implementation?	Extent to which stakeholders are actively participating in the implementation and monitoring of the project		
Efficiency: Was the project implemented efficiently, in line with international norms and standards?			
<p>Has the project been implemented efficiently, cost-effectively, and been able to adapt to changing conditions? To what extent are project-level monitoring and evaluation systems, reporting, and project communications supporting the project's implementation?</p> <p>Implementation efficiency (including monitoring):</p> <ul style="list-style-type: none"> Was the project implemented as planned, including the proportion of activities in work plans implemented? Have monitoring trips been conducted to project sites as per the M&E plan? [<i>Periodic Monitoring through site visit?</i>] Has monitoring data been collected as planned, analyzed and used to inform project planning? Has project implementation been responsive to issues arising (e.g. from monitoring or from interactions with stakeholders)? What learning processes have been put in place and who has benefitted (e.g. training, exchanges with related projects, overseas study visits) and how has this influenced project outcomes? Were progress reports produced accurately and timely, and did they respond to reporting requirements including adaptive management changes? Did the project experience any capacity gaps (e.g. staffing gaps)? [Difficulties hiring contractors?] Has internal and external communication been effective and efficient? How efficiently have resources and back-up been provided by donors, including quality assurance by UNDP? 	<p>Extent to which project activities were conducted on time</p> <p>Extent to which project delivery matched the expectation of the ProDoc and the expectations of partners</p> <p>Level of satisfaction expressed by partners in the responsiveness (adaptive management) of the project</p>	<p>Project work plans and reports</p> <p>Local partners</p>	<p>Document review, interviews with project staff and stakeholders</p>
<p>Financial efficiency:</p> <ul style="list-style-type: none"> Are the accounting and financial systems in place adequate for project management and producing accurate and timely financial information? 	<p>Extent to which funds have been converted into outcomes as per the expectations of the ProDoc</p> <p>Level of transparency in the use of funds</p> <p>Level of satisfaction of partners and beneficiaries in the use of funds</p>	<p>Project financial records</p> <p>Project audit reports</p> <p>Project work plans and reports</p>	<p>Document review and discussions with stakeholders</p> <p>Interview with financial officers for the project</p>

Evaluative Questions	Indicators	Sources	Methodology
<ul style="list-style-type: none"> Have funds been available and transferred efficiently (from donor to project to contractors) to address the project purpose, outputs and planned activities? Are funds being used correctly? Are financial resources being utilized efficiently (converted into outcomes)? Could financial resources be used more efficiently? Have any issues been raised in audit reports and if so, how efficiently were they addressed? Was project implementation as cost effective as originally proposed (planned vs. actual) Has the leveraging of funds (co-financing) proceeded as planned? 	<p>Timely delivery of funds, mitigation of bottlenecks</p> <p>Coordination and synergies of project funds and co-financing</p>		
<p>Efficiency of partnership arrangements for the project</p> <ul style="list-style-type: none"> To what extent were partnerships/linkages between institutions/organizations/private sector realized as planned? Which partnerships/linkages were facilitated? Which ones can be considered sustainable? What was the level of efficiency of cooperation and collaboration arrangements? 	<p>Extent to which project partners committed time and resources to the project</p> <p>Extent of communication and collaboration between partners</p> <p>Extent of commitment of partners to take over project activities</p>	<p>Project work plans and reports</p> <p>Reports of local partners</p>	<p>Document review, interviews with project staff and stakeholders</p>
Is the project responsive to threats and opportunities emerging during the course of the project?	Level of adaptive management related to emerging trends	Project work plans and reports	Document review, interviews with project staff and stakeholders
How well were risks, assumptions and impact drivers managed? What was the quality of risk mitigation strategies developed? Were these sufficient? Are there clear strategies for risk mitigation related to long-term sustainability of the project?	<p>Extent to which project has responded to identified and emerging risks</p> <p>Level of attention paid to up-dating risks log</p>	Risks log	Document review, interviews with project staff and stakeholders
Is a communications strategy in place? How well is it implemented and how successful has it been in reaching intended audiences?	<p>Extent to which project information has been disseminated</p> <p>Level of awareness of beneficiaries and the general public</p>	<p>Communications documents</p> <p>Press articles</p>	<p>Review of communications documents</p> <p>Interviews with stakeholders</p>
Sustainability: To what extent are there financial, institutional, socio-economic, and/or environmental risks to sustaining long-term project results?			
Is the social, legal and political environment conducive to sustainability?	Extent of supportive policies and strategies	Policy documents	Document review, interviews with project staff and stakeholders
Are there early signs of activities being taken up by project partners, and plans being developed to sustain them?	Extent to which partners are considering post-project actions	Steering Committee minutes	As above

Evaluative Questions	Indicators	Sources	Methodology
Have partners and stakeholders successfully enhanced their capacities and do they have the required resources to make use of these capacities?	Extent to which partners and stakeholders are applying new ideas outside of the immediate project context	Local partners and beneficiaries	As above
Gender equality and women's empowerment: How did the project contribute to gender equality and women's empowerment?			
Gender was considered in the project design in terms of the number of women trained as masons as well as targeting women in terms of household level digester ownership. Has this been achieved?	Number of female beneficiaries and trained masons	Results matrix	Document review, interviews with project staff and stakeholders
Are gender targets included in the Logical Framework and have they been tracked?	Number of women trained, receiving small-scale bio-digesters, attending workshops, experiencing improvements in livelihoods	Results matrix Project reports	
Impact: Are there indications that the project has contributed to, or enabled progress toward reduced environmental stress and/or improved ecological status?			
What impact has the project had on CO2 and methane emissions?	Reductions in CO2 and methane that can be attributed to the project	Results matrix and project reports	Document review, interviews with project staff and stakeholders
What impact has the project had on water and air pollution, land degradation ?	Improvements in waste management contributing to reduced pollution / land degradation / deforestation		

5.5 TE Rating scales

Ratings for Outcomes, Effectiveness, Efficiency, M&E, Implementation/Oversight, Execution, Relevance	Sustainability ratings:
<p>6 = Highly Satisfactory (HS): exceeds expectations and/or no shortcomings</p> <p>5 = Satisfactory (S): meets expectations and/or no or minor shortcomings</p> <p>4 = Moderately Satisfactory (MS): more or less meets expectations and/or some shortcomings</p> <p>3 = Moderately Unsatisfactory (MU): somewhat below expectations and/or significant shortcomings</p> <p>2 = Unsatisfactory (U): substantially below expectations and/or major shortcomings</p> <p>1 = Highly Unsatisfactory (HU): severe shortcomings</p> <p>Unable to Assess (U/A): available information DoEs not allow an assessment</p>	<p>4 = Likely (L): negligible risks to sustainability</p> <p>3 = Moderately Likely (ML): moderate risks to sustainability</p> <p>2 = Moderately Unlikely (MU): significant risks to sustainability</p> <p>1 = Unlikely (U): severe risks to sustainability</p> <p>Unable to Assess (U/A): Unable to assess the expected incidence and magnitude of risks to sustainability</p>

5.6 Results Matrix

Color code	Achieved	On-track to be achieved	Not achieved
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Description of Indicator	Baseline Level	Mid-term level and Assessment	End of project target	TE rating	Justification for rating
Objective: To facilitate low-carbon investments and public-private partnerships in the production and utilization of bio-methane from agro-waste in the districts of South-Eastern Botswana.					
Amount of reduced CO ₂ emissions as a result of investments facilitated by the project.	0		Installations in place and operating to achieve direct and indirect reductions of 1.9 million tonnes CO ₂ .	Not rated	Data not available
Project beneficiaries	0	No medium-scale digestors commissioned. The only vaguely realistic medium scale digester is the one proposed by BMC, but there is not guarantee that this will happen within the project period.	a/ Minimum of 3 medium-scale agro-industries installed and operational;		a/ This target became obsolete
	0	Only 20 digesters built and 8 under construction. The target is unachievable. Not a single digester has been purchased commercially. All the ones currently being built or commissioned are project funded. If 700 were to be achieved in 2020, the Project would be completing 2 digesters a day.	b/ 1,000 200 small-scale agro-businesses utilizing agro-waste streams for biogas digestion;		b/ 200 digesters completed
	0		c/ at least 2 District Councils utilizing organic waste for biogas digestion.		c/ This target became obsolete
	0		d/ at least 2 companies constructing biogas digesters		d/ This target became obsolete
	0	Curriculum developed. A number of trainers trained (16) and masons (20) trained. Curriculum not yet submitted to BQA for accreditation	e/ 75 masons trained and employed.		e/ 77 masons trained

Description of Indicator	Baseline Level	Mid-term level and Assessment	End of project target	TE rating	Justification for rating
Energy generation using biogas	0		350,000 MWh		This indicator became obsolete This target would only have been possible if medium / large scale bio-digestors had been constructed. Requires gas to be cleaned and is only viable for large quantities of biogas. With the lack of funding for medium scale digesters , electricity generation from biogas has not been possible yet. The biogas is currently being used for cooking, lighting and heating only
Number of new development partnerships with funding for improved sustainable energy solutions	0		3 Public-Private Partnerships in place to facilitate biogas investment.		Partially achieved - 1 PPP is in place. The National Development Bank (NDB) has been engaged as a financier for development projects within Botswana.
Outcome 1 <ul style="list-style-type: none"> Increased capacity of Government, private sector and community stakeholders to develop, finance and implement PPPs in the agro-waste sector. Increased capacity of Government authorities to properly monitor and enforce waste management regulations in the agro-industrial sector. Autonomous support systems in place for replication and scale-up of agro-waste technologies post-project. 					
Extent to which policies and regulations for waste management in the agro-sector are adopted and enforced.	Poor infrastructure maintenance and weak monitoring and enforcement capacity of waste treatment regulations.	a/ BOBS assisted with standards. Draft guidelines developed for review and discussion	a/Specific guidelines on low-carbon alternatives and utilization technologies for agro-waste and wastewater developed and disseminated.		a/ The Botswana Bureau of Standards (BOBS) has developed biogas standards (gas standards and digester structure standards), which have been approved by the committee of BOBS. Biofuels Guidelines have been developed to guide the production, blending, distribution and usage of locally produced biofuels.
Number of beneficiaries (owners/users of biogas).	Lack of specific guidelines or policies on biogas resources and absence of an appropriate legal and regulatory framework on the utilization of biogas from agro-waste and wastewater. Insufficient capacity of relevant financial institutions and stakeholders (including				

Description of Indicator	Baseline Level	Mid-term level and Assessment	End of project target	TE rating	Justification for rating
	banks) to assess the technical risks and benefits of investing in biogas technologies.				
		b/ This output appears in both the 2018/2019 AWP. Progress Report (Q4, 2018) suggest activity moved to 2019. TORs for PPPs under review (Q1, 2019). There does not appear to be sufficient time to ensure three operational PPPs by 2020	b/ Framework agreement for at least 3 public-private partnerships (PPPs) in the waste sector and biogas related in place and implemented		b/ There are no PPP framework within the Ministry of Finance. The Project requested the PSC to remove the activity from the work plan. The lack of agreements developed with public or private institutions in form of PPP agreements is attributed to the limited amount of organic waste being produced in the country, and specifically in the project area
		c/ Contract signed with consultant to undertake sludge management and wastewater treatment methods. Final reports produced. But levels of regulation not yet in place. Concept of green certification discussed but no approval / adoptions as yet. Appeared in both 2018 & 2019 AWP. No evidence of Green Certification Protocol	c/ Up-to-date regulations developed and adopted for the successful monitoring of effluent flows.		c/ Trade Effluent Agreement with Water Utility harmonized with city bye-laws
		Preliminary financing workshop held. No progress on Investment Facilitation Platform (with own budget). Consultant engaged to work on REFT tariff guidelines. A research agenda on biogas technology has been developed. First paper has not been released / published (target of 5 research papers)	d/ Financial institutions invest in at least 3 biogas plants.		d/ This target became obsolete
Outcome 2: Increased investment in clean-energy technologies and low-carbon practices in the agro-waste sector.					

Description of Indicator	Baseline Level	Mid-term level and Assessment	End of project target	TE rating	Justification for rating
Increased investment in clean-energy technologies and low-carbon practices in the agro-waste sector.	0	Only 20 digesters built and 8 under construction. The target is unachievable. Not a single digester has been purchased commercially. All the ones currently being built or commissioned are project funded. If 700 were to be achieved in 2020, the Project would be completing 2 digesters a day.	a/ Two hundred (200) small-scale biogas digesters constructed and operational. (revised at MT) [original target: One thousand (1,000) small-scale biogas digesters constructed and operational].		a/ 200 small-scale biogas digesters constructed.
	0	No medium-scale digesters commissioned. The only vaguely realistic medium scale digester is the one proposed by BMC, but there is not guarantee that this will happen within the project period.	b/ Three medium-sized biogas digesters constructed and operational.		b/ This target became obsolete
	0		c/ Finalized proposal to construct a centralized biogas digester of an estimated 15,000 m3 or larger with facility to upgrade to bio-methane and utilization.		c/ The amount of organic waste produced in the project area is not sufficient enough to warrant the development of a large-scale digester. This was indicated in the MTR report as well as the waste characterization report for the Gamodubu Landfill. The Biogas Project therefore could not pursue the development of a large-scale biogas digester.
	0		d/ At least 3,000 m3 biogas per annum and 3 MW of electricity installed.		d/ With 110 small scale digesters having been installed and the majority of which are operational, an approximate amount of 180m3/day is produced. Assuming daily feeding and usage of all the digesters, this would translate to 7,227,000m ³ per annum. This is a theoretical estimate. requiring validation. No electricity installed so this target is only partially met.
Outcome 3: Increased investment in less GHG-intensive energy systems using biogas.					
Total investment (US\$) in biogas technology.	0		At least three financial institutions have incorporated the		

Description of Indicator	Baseline Level	Mid-term level and Assessment	End of project target	TE rating	Justification for rating
			financing of biogas technology in their national portfolios.		Partially met – the Project has signed a MoU with the NDB to support the financing of bio-gas.

Note: 1/ The MTR undertakes assessment at output level, which have been mapped to objective / outcome level

5.7 Signed UNEG Code of Conduct form

Evaluators/Consultants:

1. Must present information that is complete and fair in its assessment of strengths and weaknesses so that decisions or actions taken are well founded.
2. Must disclose the full set of evaluation findings along with information on their limitations and have this accessible to all affected by the evaluation with expressed legal rights to receive results.
3. Should protect the anonymity and confidentiality of individual informants. They should provide maximum notice, minimize demands on time, and respect people's right not to engage. Evaluators must respect people's right to provide information in confidence, and must ensure that sensitive information cannot be traced to its source. Evaluators are not expected to evaluate individuals, and must balance an evaluation of management functions with this general principle.
4. Sometimes uncover evidence of wrongdoing while conducting evaluations. Such cases must be reported discreetly to the appropriate investigative body. Evaluators should consult with other relevant oversight entities when there is any doubt about if and how issues should be reported.
5. Should be sensitive to beliefs, manners and customs and act with integrity and honesty in their relations with all stakeholders. In line with the UN Universal Declaration of Human Rights, evaluators must be sensitive to and address issues of discrimination and gender equality. They should avoid offending the dignity and self-respect of those persons with whom they come in contact in the course of the evaluation. Knowing that evaluation might negatively affect the interests of some stakeholders, evaluators should conduct the evaluation and communicate its purpose and results in a way that clearly respects the stakeholders' dignity and self-worth.
6. Are responsible for their performance and their product(s). They are responsible for the clear, accurate and fair written and/or oral presentation of study imitations, findings and recommendations.
7. Should reflect sound accounting procedures and be prudent in using the resources of the evaluation.
8. Must ensure that independence of judgement is maintained, and that evaluation findings and recommendations are independently presented.
9. Must confirm that they have not been involved in designing, executing or advising on the project being evaluated and did not carry out the project's Mid-Term Review.

Evaluation Consultant Agreement Form

Agreement to abide by the Code of Conduct for Evaluation in the UN System:

Name of Evaluator: Camille Bann

Name of Consultancy Organization (where relevant): _____

I confirm that I have received and understood and will abide by the United Nations Code of Conduct for Evaluation.

Signed at: London on 11 February 2020

Signature:



Evaluators/Consultants:

1. Must present information that is complete and fair in its assessment of strengths and weaknesses so that decisions or actions taken are well founded.
2. Must disclose the full set of evaluation findings along with information on their limitations and have this accessible to all affected by the evaluation with expressed legal rights to receive results.
3. Should protect the anonymity and confidentiality of individual informants. They should provide maximum notice, minimize demands on time, and respect people's right not to engage. Evaluators must respect people's right to provide information in confidence, and must ensure that sensitive information cannot be traced to its source. Evaluators are not expected to evaluate individuals, and must balance an evaluation of management functions with this general principle.
4. Sometimes uncover evidence of wrongdoing while conducting evaluations. Such cases must be reported discreetly to the appropriate investigative body. Evaluators should consult with other relevant oversight entities when there is any doubt about if and how issues should be reported.
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6. Are responsible for their performance and their product(s). They are responsible for the clear, accurate and fair written and/or oral presentation of study limitations, findings and recommendations.
7. Should reflect sound accounting procedures and be prudent in using the resources of the evaluation.
8. Must ensure that independence of judgement is maintained, and that evaluation findings and recommendations are independently presented.
9. Must confirm that they have not been involved in designing, executing or advising on the project being evaluated and did not carry out the project's Mid-Term Review.

Evaluation Consultant Agreement Form

Agreement to abide by the Code of Conduct for Evaluation in the UN System:

Name of Evaluator: MOTSHEREGANYI VIRAT KOOTSOSITSE

Name of Consultancy Organization (where relevant): N/A

I confirm that I have received and understood and will abide by the United Nations Code of Conduct for Evaluation.

Signed at GABORONE, BOTSWANA (Place) on 31st January 2022 (Date)

Signature:  _____

5.8 Signed TE Report Clearance form

to be provided by UNDP

5.9 Annexed in a separate file: TE Audit Trail