Promoting production and utilization of biogas from Agro-waste in South Eastern Botswana

UNDP PIMS: 5299 / GEF project ID: 00098758

Mid-Term Review

Mid-Term Review (MTR) time frame:

Date of MTR Report:

Project Country: Botswana

GEF Operational Focal Area/Strategic Program: Climate Change CCM Objective 3: Promote investment in renewable energy technologies

Executing Agency/Implementing Partner and other project partners: Executing Entity; Ministry of Environment Natural Resources and Tourism (MENT), Implementing Partner: Botswana Institute for Technology, Research and Innovation (BITRI)

MTR consultant: Robert Aitken

Acknowledgements: The consultant would like to extend his gratitude to all those stakeholders that gave of their time during the Midterm Review. A special thank-you to the Project Management Unit at BRITI as well as UNDP seconded team (Project manager, engineer and finance officer) who were immensely helpful and supportive of the review process.

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Acronyms and Abbreviations

AEPC	Alternative Energy Promotion Centre
AWP	Annual Work Plans
BDB	Botswana Development Bank
BDC	Botswana Development Corporation
BITRI	Botswana Institute for Technology, Research and Innovation
BMC	Botswana Meat Commission
BOBS	Botswana Bureau of Standards
CTA	Chief Technical Advisor
DC	District Councils
DoE	Department of Energy
DWMPC	Department of Waste Management and Pollution Control
GoB	Government of Botswana
IRR	Internal Rate of Return
MENT	Ministry of Environment Natural Resources and Tourism
MTR	Midterm Review
NDC	Nationally Determined Contribution
NIM	National Implementation Modality
PPA	Power Purchasing Agreement
PPP	Public Private Partnerships
ProDoc	Project Document
PSC	Project Steering Committee
R&D	Research and Development
REFIT	Renewable Energy Feed-in-Tariff
SWM	Solid Waste Management
ToC	Theory of Change
UNCDF	United Nations Capital Development Fund

Executive summary

Table 1: Project Information Table

Project Title:	Promoting production and utilization of bio-methane from agro-waste in South-Eastern Botswana		
UNDP Project ID (PIMS #):	**5299**	**PIF Approval Date:**	
GEF Project ID (PMIS #):	**5628**	**CEO Endorsement Date:**	
Award ID:	**00098758**	**Project Document (ProDoc) Signature Date (date project began):**	**8 April 2016**
Country(ies):	**Botswana**	**Date project manager hired:**	**May 2017**
Region:	Africa	**Inception Workshop date:**	**20 April 2017**
Focal Area:	Climate Change	**Mid-term Review date:**	**May 2019**
GEF-5 Focal Area Objective:	CCM-3	**Planned closing date:**	**April 2021**
Trust Fund:	GEF TF	**If revised, proposed closing date:**	**April 2022**
Implementing Partner:	**Botswana Institute for Technology, Research and Innovation (BITRI)**		
Other execution partners:	**Ministry of Environment, Natural Resources, Conservation and Tourism (MENT)**		
Project Financing:	**at CEO endorsement (USD)**	**at Mid-term Review (USD)**	
[1] GEF financing (excl. PPG):	**$2,632,300**	$734,284	
UNDP contribution:			
Government:	**$16,684,000**	$867,000[1]	
Other partners:			
[5] Total co-financing:	**$16,684,000**		
TOTAL PROJECT COSTS [1 + 5]	**$19,316,300**	$1,601,284	

[1] Figure derived from estimated contributions from the following government entities: DWMPC (cash) $154,500, BITRI (in-kind) $100,000, MENT (in-kind) $37,500, DWMPC (in-kind) $575,000

Project Description

The objective of the 'Promoting the production and utilization of biogas from agro-waste in South Eastern Botswana' Project is to facilitate low-carbon investments and public-private partnerships in the production of biogas from agro-waste with a long term view of both a sustainable biogas industry and a sustainable means of managing agricultural waste. Botswana's beef or cattle industry is not only an important economic sector in terms of export revenue and domestic livelihoods it is also an important socio-cultural practice which is interwoven into the fabric of the cultural life of the Batswana people. While the sector represents an important economic and cultural hallmark, it also produces a vast amount of agro-waste in the form of animal faeces, blood, fat, animal trimmings, stomach contents and urine. This agro-waste needs to be effectively managed to limit both Green House Gas (GHG) emissions from these effluents and the contamination of local aquifers through waste water entering the environment.

The Government of Botswana (GoB), through its various environmental and developmental commitments, regards the development of a sustainable and commercial biogas sector as a key mechanism for reducing GHG emissions, more effectively managing agricultural waste, improving access to modern energy services, enhancing local livelihoods prospects and various other socio-economic dividends. These strategic development considerations and agro-waste realities lay the foundation for the 'Promoting Production and Utilization of biogas from Agro-waste in South Eastern Botswana' programme

The programme is designed to address the broad requirements of establishing a sustainable biogas sector in the country. The project has three strategic elements (incorporating a number of sub-components or 'outcomes') which are designed to work collectively to support the creation of a sustainable biogas sector in Botswana;

- Increased capacity of government, private sector and community stakeholders to develop, and finance, PPPs in the agro-waste sector
- Increased investment in clean energy technologies and low-carbon practices in the agro-waste sector.
- Increased investment in less GHG-intensive energy systems using biogas.

The locus of the programme is in the South Eastern Region of Botswana. Once successfully implemented, it is the intention to support similar initiatives in other regions of the country.

Project progress summary

The project's implementation design includes two key strategic considerations; a pragmatic focus on improving access to biogas digesters and a broader commitment to ensuring the requisite enabling framework is in place to develop and support a sustainable biogas sector going forward. The Midterm Review (MTR) reveals both the successes and challenges that the project has faced. While these achievements and challenges are detailed in the MTR that follows, they may be summarized as follows;

Project achievements;

- The project has mobilised the market through effective engagements with a cross section of stakeholders in Botswana including various government ministries, parastatals, local government, and private sector organizations amongst others. Importantly, both rural communities that represent the future market for household level biogas digesters and larger agro-waste producing commercial entities that represent the future market for medium scale 'commercial' biogas digesters have been effectively engaged

- There is clear and widespread interest in biogas from government which is a fundamental requirement for success. With biogas having very little history or traction in Botswana, explicit government support will be pre-requisite for success.
- Responding to the high entry costs and early market inertia, the Project Management Unit (PMU) has installed a number of demonstration units (around 25 x 6m3 units) which has enabled the household market to witness and interact with the technology more effectively. This development is important to entice and agitate the market.
- A number of masons have been trained in the construction of small-scale digesters which will ensure sufficient capacity in the market to construct digesters. The training of masons is based on a curriculum developed specifically for the project and involved local 'Brigades' which are vocational training institutions in Botswana.
- A technical and financial feasibility study for a medium-scale biogas digester for the Botswana Meat Commission (BMC) has been concluded and provides important reassurances around technical design issues, financial performance and energy/power inputs and outputs.

Project challenges;

- The project design, particularly in terms of assumed levels of interest in the technology, is somewhat ambitious. With the cheaper of the small-scale biogas digesters priced around P20,000, levels of interest will be somewhat muted. Other than the important demonstration units, there is no subsidies of any kind currently available. The market assumptions built into the project design do not suggest a clear understanding of how technologies mature over time. There needs to be greater support, financial or otherwise, upfront (avoiding long-term price distortions) to *push* the technology as opposed to relying on market *pull* at these early stages of a technology's development.
- The medium scale commercial digesters have experienced some caution from the market. While engagements with BMC have been positive, these encouraging sentiments have not translated into active investments. While there are a range of reasons for this, at the forefront is the issue of the technology's relative immaturity in Botswana as well as a level of uncertainty around MBC's current management and public sector status. With regard to the other potential medium-scale digester investors, there are currently no policy frameworks or legal instruments obligating high producing agro-waste businesses (in this project context referring to SENN Foods and Kalagadi Brewery) to manage waste production in a specific manner. The uncertainty associated with the technology's emergent status and the lack of any legal coercion does at least in part account for the challenges noted within the medium-sized digester components.
- The project is somewhat over reliant on policy which may or may not materialize within the project's implementation period. For instance, an Integrated Waste Management Policy which would, amongst other things, provide the legal obligation to manage agro-waste in a specific manner has not been implemented. While it has been developed it has not been adopted as yet. The project is also somewhat reliant on the promotion and support of Public Private Partnerships (PPP) which would provide the legal framework for greater private sector involvement. While the GoB has expressed support for PPPs, there is still very little concrete evidence that these frameworks are actively supported. The same can be said for Power Purchasing Agreements (PPAs) and Renewable Energy Feed-in Tariffs (REFIT) both of which offer legal and commercial platforms for greater private sector investment and involvement in the industry.
- The Project Management Unit (PMU) is too vaguely constituted. The specific role of BITRI employees and UNDP's seconded employees is not sufficiently clear. Greater role clarity is the basis for accountability the absence of which can and will undermine the management of the project.

MTR Ratings & Achievement Summary Table

Table 2: MTR Ratings & Achievement Summary for Promoting production and utilisation of biogas from Agro-Waste in South Eastern Botswana

Measure	MTR Rating	Achievement Description
Project Strategy	N/A	
Progress Towards Results	Objective Achievement Rating: (rate 6 pt. scale)	4. Moderately Satisfactory
	Outcome 1: **: Institutional strengthening and capacity building for biogas investment and improved agro-waste management and regulation**	MS – Moderately Satisfactory
	Outcome 2: Facilitation and establishment of the first biogas plants in Botswana	MU – Moderately Unsatisfactory
	Outcome 3: : Facilitation and establishment of appropriate biogas utilization platforms in at least two districts in South-Eastern Botswana	MU – Moderately Unsatisfactory
Project Implementation & Adaptive Management	4	Implementation of some of the three components is leading to efficient and effective project implementation and adaptive management, with some components requiring remedial action.
Sustainability	3	Moderately likely. The project is not without its challenges but there is considerable potential for a successful outcome

Concise summary of conclusions

- Fundamental question: can such a biogas programme succeed where so many others have failed? The overall assessment suggested 'Yes'
- Improved understanding of how technologies mature is required
- Project management unit requires more clearly defined roles and responsibilities
- The cost of small-scale digesters is too high
- The project is too policy dependent
- Medium-sized digesters will not be constructed and operational by project close
- Lack of research is evident at various levels
- Current marketing and/or sensitization initiatives are inadequate

Recommendation Summary Table

Table 3: Recommendations summary table

No.	Recommendation
Project management and Institutional issues	
1	The following PMU arrangement is proposed; ➢ The project is co-managed by BITRI and DWMPC/MENT; ➢ BITRI remains the Implementing Partner and MENT the Executing Entity. ➢ The Depart of Energy (DoE) plays a supporting role. ➢ UNDP will also play a more supportive role and not assume specific responsibility for any project activities or outcomes.
2	With regard to specific leadership roles within the PMU, it is proposed that BITRI retain the overall project coordinator role but that the participating DWMPC/MENT staff are accorded clear management responsibilities not only for their area of responsibility but for the overall strategic direction of the project.
3	Each active output and activity must be assigned to a named staff-member from either BITRI or DWMPC/MENT. In terms of project accountability, staff responsibilities should be specifically allocated and progress should be monitored
4	A Gantt chart needs to be developed which will include the full range of activities and outputs under each component, include anticipated time of conclusion as well as progress over time.
5	Establish more meaningful partnerships with entities that have significant experience in biogas; this would include SNV, GIZ and Nepal's AEPC.
Small-scale digesters	
6	Target of 1,000 units needs to be adjusted. A realistic target needs to be based on consensus between stakeholders. The MTR would suggest in the region of 200 – 300 units within the remaining project implementation period.
7	Small-scale units will be sold with a declining amount of financial support
8	The project is advised to consider a number of possible sales scenarios. The scenarios differ in the rate of sales including a 'slow, moderate and high' sales scenario. This will assist in determining a reasonable sales figure within the remaining project timeframe.
9	Working with Banks; the current approach to familiarizing banks such as the Botswana Development Corporation (BDC) and the National Development Bank (NDB) with the biogas technology is too passive. A more interactive 'partnership' approach has been recommended.
10	Improved market awareness and mobilization; a range of activities have been proposed including establishing baselines to measure impacts, the use of energy diaries, demonstration days, placement of signage, demonstrate range of digesters. Etc. which will strengthen levels of market awareness and community mobilization.
11	Research and demonstration; the MTR has made a number of recommended on the range of alternative construction materials, digester designs, co-payment options, knowledge platforms, market intelligence, developing business plan packages, which are required to enhance the contribution of R&D to the project's success.
Medium-scale digesters	
12	The PMU works closely with BMC on advancing the prospects of the entity investing in the proposed biogas digester. Some form of commitment, in writing would be positive in this regard.

13	It has been recommended that the financial and technical feasibility study produced for BMC should provide the template for analyzing digester options for both SENN Foods and Kalagadi Breweries as well. This is a key outcome for the medium-scale digester component.
14	The MTR recommended that the three EIAs are to be undertaken based on the 3 technical/financial feasibility studies as proposed in the recommendation outlined above (#13)
15	The MTR underlined the important of uncoupling the project's success from the adoption of future policies. The project's success should not be dependent on the development, ratification and adoption of national policy as the timeframes associated with such policy developments are unpredictable while the project timeframes are fixed.
16	The MTR recommended that the Public sector takes greater pioneering responsibility in developing medium-scale biogas digesters. Example proposed was school-based amongst others.
17	The MTR recommended that the project work more closely with a private sector organisation such as Kgatleng Beef Producers Association who have expressed an interest in the technology on 'own-consumption' power generation options. These private sector, 'own-consumption' options present additional important outcomes for the medium-scale digester component.
Closing comments	
18	While prospects of success are reasonable there are a number of critical issues to be addressed moving forward
	➢ The Project Document overstated the up-front potential of biogas in the country
	➢ The implementation approach from the mid-term point onwards needs to better internalize the manner in which technologies mature
	➢ Better use needs to be made of international expertise
	➢ The Promoting production and utilization of biogas from Agro-waste in South Eastern Botswana' will require an extension of at least one year if it is to lay the necessary foundations for a sustainable, commercial biogas industry in Botswana.

Introduction

Project introduction

The objective of the project is 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.

While the benefits of establishing a sustainable biogas sector are many, at its centre is the reality of Botswana's emerging agro-waste challenge. 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. However, there are more cattle than people in Botswana[2]. The slaughtering of cattle primarily through the abattoirs under the control of the Botswana Meat Commission (BMC) produce 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 significantly adverse environmental impacts including the pollution of local aquifers through waste-water entering the environment, as well as Green House Gases (GHG) emitted from these effluents.

Through its Nationally Determined Contribution (NDC), the Government of Botswana (GoB) intends achieving an overall emissions reduction of 15% by 2030[3]. In addition to implementing a long-term low carbon strategy to achieve these reduction targets, the GoB further 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[4] including 'Climate Change Adaptation and Mitigation', 'Implementation of the National Waste Management Policy', 'Clean Water and Sanitation Programme', Renewable Energy Programme' and 'Biofuels' point to the strategic value of this biogas initiative. This confluence of national and international commitments, reinforced by political and socio-economic pledges, lay the foundation for the 'Promoting Production and Utilization of biogas from Agro-waste in South Eastern Botswana' programme.

The programme is designed to address the broad requirements of establishing a sustainable biogas sector in the country. The project has three strategic elements (incorporating a number of sub-components or 'outcomes') which are designed to work collectively to support the creation of a sustainable biogas sector in Botswana;

- Increased capacity of government, private sector and community stakeholders to develop, and finance, PPPs in the agro-waste sector
    - Developing guidelines and standards on low-carbon alternative technologies
    - Develop a framework agreement on PPPs in the waste sector (waste to energy)
    - Training of relevant stakeholders on [new] technology guidelines and PPP framework
- Increased investment in clean energy technologies and low-carbon practices in the agro-waste sector.
    - Training masons and 'training the trainers'
    - Robust research undertaken on biogas technology
    - Updated regulations for monitoring of effluent flows in abattoirs (green certification)
    - Support emergence of trade effluence agreements between industry and local authorities
    - EIAs around medium sized digesters

[2] https://www.drovers.com/article/world-cattle-inventory-ranking-countries-fao
[3] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Botswana%20First/BOTSWANA.pdf
[4] https://www.finance.gov.bw/images/NDP_11_2017-2023.pdf

- Dedicated investment facilitation platform located within BITRI
- REFIT in place
- Sensitization campaigns conducted with District Councils (DC), stakeholders et al
- Feasibility study for small-scale digesters undertaken
- Business plans developed for 3 potential medium scale digesters – with potential off-taker uses analysed
- Legal framework for PPPs
- Construction and commissioning of biogas plants (small – 1000, medium - 3)

- Increased investment in less GHG-intensive energy systems using biogas.
  - Partnerships between biogas operators and DCs for supply/purchase of biogas
  - District Council staff trained on bio-gas utilization technology

The locus of the programme is in the South Eastern Region of Botswana. Once successfully implemented, it is the intention to support similar initiatives in other regions of the country.

Purpose of the Midterm Review and Objectives

The Mid-term Review (MTR) will assess operational aspects such as project management and the implementation of activities across the three components and the extent to which the objectives of the project are being fulfilled. A comparison shall be made between the expected achievements of the project as described in the Project Document and Annual Work Plans (AWPs) and the actual achievements on the ground. Further, the review will propose measures to ensure the project is recalibrated/realigned, where necessary, so as to move in the direction of achieving the impacts and outcomes as originally envisaged.

The fact that this is a mid-term review as opposed to a terminal evaluation means that methodology must be developed around the need to influence the program's success as opposed to simply providing a post-program evaluation. What is required is not merely a high-level assessment that focuses on the correspondence between project achievements and the objectives contained in the results framework, but rather a method of assessment that engages with the project managers, implementers and beneficiaries to determine ways in which goals can be more effectively achieved. At its centre, the methodology needs to *Review* and *Adapt*. A Terminal Evaluation may get away with a simple review but a mid-term review needs to be more proactive, understanding the challenges, failures and successes and working with the client to overcome them and ensure the project adapts to these lessons.

The objectives of the MTR reflect on the purpose of the MTR; to evaluate and understand project progress, identify the challenges, bottle-necks and risks and to then assist, through a series of recommendations, in overcoming these obstacles and ensuring meaningful, practical and value-for-money outcomes.

Scope and methodology

The scope of the MTR was broad and inclusive, looking at all the project components and associated activities and outcomes, over-arching issues such as project management and stakeholder buy-in as well as 'meta' issues examining the programme's overall relevance and strategic value. The starting point with the MTR is the Project Document (ProDoc), the basis on which the programme was designed, motivated and funded. This document defines the overall programme, activities, outcomes and targets. While foundational, the ProDoc is very often in reality only lightly tested, with contributing authors/consultants having limited time to conceive of and design a detailed programme that is both enticing and innovative yet pragmatic and achievable. Having to compete for funding with numerous other worthy sector initiatives, the inducement is ever there to overstate what is achievable, presented in outwardly plausible implementation frameworks, exploiting the blind spot between what the sector has committed to achieve and what is indeed practically achievable.

Nonetheless, the ProDoc remains foundational and the starting point in terms of understanding the programme and the anticipated activities and outcomes. These early insights are complemented by other programme management and evaluation tools and resources including the Inception Report, Annual Workplan, Quarterly Progress Reports, minutes from the Project Steering Committee, Project Implementation Reviews, and reports commissioned from Consultants, amongst others.

The research approach or technique for this particular MTR is essentially qualitative. There are no significant data sets that will assist with appraising and interpreting the progress of the programme thus far. Instead, there are a range of different stakeholders that need to be engaged with principally on a 'one-on-one' basis. The only statistical component are the outcomes; 1,000 small-scale digesters installed, 5 research papers published, 3 medium scale digesters, etc. but these are programme records or achievements rather than the basis for quantitative evaluation. The key research technique utilized within this MTR was the open-ended interview.

While gender was a consideration in the project design, the project itself has not made sufficient progress to determine any substantive gender impacts.

A key principle of the review was that it was independent; the consultant is not a staff member of UNDP or GEF and was not involved in the programme design and/or implementation.

The review makes use of the standard evaluation ratings used in UNDP projects (See Annex A).

Structure of the MTR report

While the report is structured to provide context to the review, including background to the programme, targets, outcomes, etc. the focus of the review is on performance, results, conclusions and recommendations. The opening section of the report presents a high level overview of the programme, the objectives and the approach of the MTR. This is followed by a more detailed section looking at the project design and context, addressing issues such as the development context, the problems and opportunities the programme was designed to address as well as the overall project strategy; the specific approach adopted in order to achieve the intended outcomes.

The MTR then presents the findings; offering a more critical appraisal of the project strategy, progress towards results, project implementation and adaptive management as well as longer term sustainability issues. Once the findings are presented, the report then focuses on the conclusions and recommendations which are designed to ensure more effective outcomes in terms of programme results.

Project design, objectives and background context

Development context: environmental, socio-economic, institutional, and policy factors relevant to the project objective and scope

The *Promoting production and utilization of biogas from Agro-waste in South Eastern Botswana* programme is designed in a particular development context. The programme has been designed and implemented to address challenges identified by key national stakeholders. Not surprisingly, the extent to which the programme is able to address these challenges and mitigate their impacts will be an important measure of the programme's success. It is a useful exercise to unpack the 'development context' within which the programme is conceived in order to inform and guide expectations regarding the programme's design, performance and achievements.

Environmental

There are a number of important environmental issues which the programme is designed to address. Principal amongst these concerns is agro-waste. Abattoir agro-waste can be defined as[5] waste or wastewater from an abattoir, which can consist of pollutants such as animal faeces, blood, fat, animal trimmings, stomach contents and urine. Proper waste treatment and methane capture of agro-waste presents opportunities, not only for reducing GHG emissions but also for addressing the country's energy needs and limiting groundwater contamination. Even where abattoirs are managed according to export standards, as is the case in Botswana Meat Commission's (BMC) Lobatse abattoir, the treatment of effluents is unsustainably managed[6]. There is also evidence that Agro-waste is making its way into the country's landfill sites[7]. A significant amount of money is spent on waste management activities within the project locations (South Eastern region[8]), estimated in the region of P21 million a year[9]. Significant quantities of poultry waste is also an issue, producing offensive odours and 'promoting fly and rodent breeding' environments. Yet despite an obvious level of awareness of both the scale and consequences of the waste challenges the country faces, the issue is not being effectively managed, a reality that provides an important backdrop to the programme's conceptualisation and design.

A second important environmental issue that provides programme context is the unsustainable consumption of woodfuel. Wood fuel, in the form of firewood, remains a major source (80%) of energy for rural and low-income urban communities. It is mainly used for cooking, space heating and lighting. The consequences of unsustainable woodfuel use (deforestation) are significant and of great concern to a semi-arid country such as Botswana[10]. Impacts include soil erosion and flooding, habitat destruction, increased Greenhouse Gases (GHG) as well as water-cycle disruption. In a

[5] From Project Document.
[6] Project Document. This observation was supported by an Environmental Impact Assessment undertaken in 2009 which confirmed that polluted waste from the abattoir was entering the environment. *Retrospective EIA of the Lobatse Abattoir – Botswana*, Ecosurv, Client: Botswana Meat Corporation, 2009.
[7] Project document
[8] District Councils (Gaborone City Council, South-East District Council, Lobatse Town Council, Southern District Council, Jwaneng Town Council, Kweneng District Council, Kgatleng District Council).
[9] As of the date of this report, the official UN exchange rate is 1US dollar = 10.71 Botswana Pula.
[10] See, for instance, https://www.pachamama.org/effects-of-deforestation

relatively water scarce, traditionally agricultural, highly eco-tourist dependent country, these are the types of impacts that a country like Botswana can least afford to deal with.

In addition to the environmental threats, there are a range of other adverse sociological issues associated with unsustainable woodfuel gathering and consumption, including the long hours spent by women and girls collecting fuelwood, safety issues associated with vulnerability of women/children to criminal elements and, in certain locations, wild animals while collecting wood. Indoor air pollution[11] resulting from the widespread use of open-fires within households, presents a significant health risk. Indoor air pollution contains a range of health-damaging pollutants, for instance, small particles and carbon monoxide, and particulate pollution levels may be 20 times higher than accepted guideline values[12].

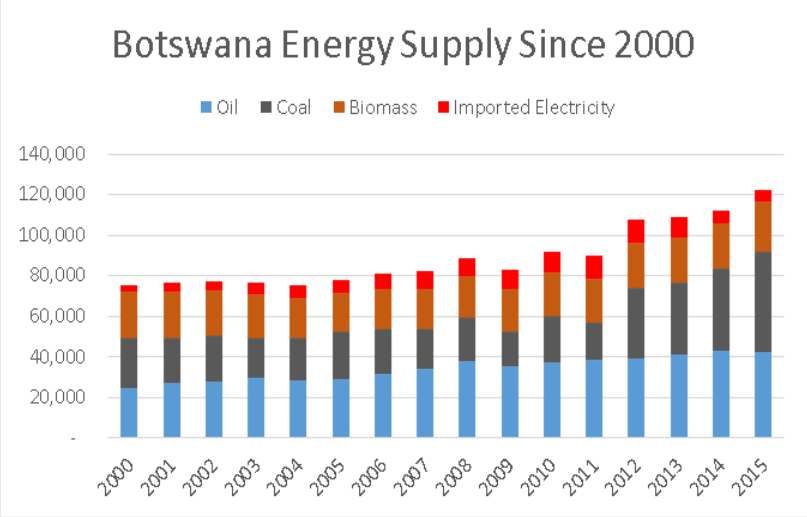


Figure 1: Botswana energy supply from 2000 to 2015

As evident in Figure 1, the consumption of biomass has not been reducing over time. It may account for an increasingly lower portion of the energy supply but in absolute terms, the consumption of woodfuel has been quite consistent over the recent 15 year period captured in the figure presented.

Socio-economic

While Botswana's economy has been one of the World's fastest growing economies, averaging around 5% p.a. for the last decade[13], the persistence of certain socio-economic challenges remains a national concern. Significant mineral wealth, good governance and effective management of the economy have ensured that Botswana has developed from one of the World's poorest countries at independence to an upper middle-income country[14]. However, these recognized achievements have not entirely addressed the notable levels of poverty and income inequality. This is particularly true in

[11] See, for instance, http://www.scielo.org.za/pdf/caj/v28n1/11.pdf
[12] https://www.who.int/phe/air/en/
[13] https://www.worldbank.org/en/country/botswana/overview
[14] https://www.worldbank.org/en/country/botswana/overview

rural areas where the number of people living below poverty has marginally increased from 2009/10 to 2015/16[15] as has the Gini Coefficient (measurement of inequality) based on consumption data[16].

The country's draft National Development Plan 11 places significant emphasis on three key areas; tackling poverty, inclusive growth and job creation. There is an important geography to national inequality with the most pronounced of this development challenge occurring within more remote, rural, areas. Some of the key approaches to addressing poverty include 'broad-based labour absorbing economic growth' as well as intensifying development of remote settlements, promoting production-orientated income and employment generating activities[17]. These policy goals and associated strategies are well aligned to the provision of biogas which is labour intensive, requires a consistently available supply of an appropriate substrate[18] includes a yield of fertilizer as well as provides access to sustainable energy resources.

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. The ProDoc notes the prominence of women in wood collection and cooking both of which would be alleviated/modernized by enhanced access to modern energy services.

Institutional stakeholders

Key institutional partners include the following Ministries and entities;

- Ministry of Environment, Natural Resources, Conservation and Tourism (MENT)

The Department of Waste Management and Pollution Control (DWMPC) under the Ministry of Environment, Natural Resources, Conservation and Tourism[19]. DWMPC is mandated to prevent and control pollution of the environment through the formulation of waste management policies and the regulation and monitoring of the waste sector. DWMPC is a strategic programme partner, responsible for developing national waste management policy and ensuring compliance. These are important mandates if effective agro-waste management policies are going to provide policy incentives and frameworks for the development of biogas digesters. The Department is currently working on an Integrated Waste Management Policy, with the aim of holistically addressing issues of waste management and enforcement of these policies in the country. Work on this policy started in 2014 and was expected to be concluded by 2016 but at the time of his review, the policy had not been completed.

- Ministry of Local Government and Rural Development (MLG&RD), and District Councils

The importance of this ministry is that they support local authorities in fulfilling their legislative requirements. The legislative requirements that are of specific interest to the programme include the responsibilities of Local Authorities in terms of the Waste Management Act 1999. While such responsibilities are various, those most aligned with the programme include: preparation of waste management plans; waste recycling plans and litter plans; waste collection; ensuring the provision of waste storage receptacles; disposal of waste; serving notices for depositing litter; waste recycling;

[15] http://www.statsbots.org.bw/sites/default/files/publications/BMTHS%20POVERTY%20STATS%20BRIEF%202018.pdf – Pg. 9

[16] Ibid, Pg. 10

[17] http://www.orangesenqurak.com/people/socioeconomics/Portraits/Botswana.aspx

[18] There are over 38,000 registered traditional cattle farmers with an average herd of approximately 50 head of cattle http://www.statsbots.org.bw/sites/default/files/Agric%20Stats%20Brief%202015.pdf

[19] http://www.mewt.gov.bw/DWMPC/index.php

prohibition of litter and abatement of litter. In short, they have the mandate and authority to support the development of biogas digesters in so far as such interventions address the waste management responsibilities of Local Authorities.

A further point of policy interest involves the District Councils' mandate to invest in Public Private Partnerships (PPPs) to enhance development. While no such PPPs have been established as yet, this co-operative framework does open up opportunities for agro-industries and councils to jointly develop initiatives to better utilize agro-waste for commercial purposes.

- Ministry of Minerals, Energy and Water Resources: Department of Energy and BPC

The Energy Affairs Division (EAD) formulates national energy policy, with the aim of creating an environment in which Government, development partners and the private sector can provide affordable, environmentally-friendly and sustainable energy services in the country[20]. The ability of the biogas programme to integrate within the Division's renewable energy and/or off-grid initiatives will be important for mainstreaming the technology and ensuring broader policy/programmatic support.

The Botswana Power Corporation (BPC) is a parastatal utility established in 1970 by an Act of Parliament. The Corporation is responsible for the generation, transmission and distribution of electricity within Botswana. BPC, with support from the Government, commenced implementation of the Rural Electrification Programme in 1975[21] with the objective of extending the national grid across the country over time. The programme continues to date. The importance of the BPC within the context of a biogas initiative are the electricity grid tied opportunities that may be considered which would contribute to the development of the biogas market and the achievement of the benefits associated with such developments[22]. This would obviously refer to larger biogas options which would support gas to electricity power generating technologies. Grid connect options and frameworks would include Power Purchasing Agreements (PPAs), Renewable Energy Feed-in-Tariffs and Net Metering.

- Ministry of Tertiary Education, Research, Science and Technology, BITRI

The Botswana Institute of Technology Research and Innovation (BITRI) is a publicly-funded research and development institution, a parastatal under the Ministry of Tertiary Education, Research, Science and Technology. BITRI was established as a limited company by guarantee (non-profit) in 2012. BITRI's energy mandate focuses on needs-based research, and the development and adoption of energy technologies for Botswana. BITRI is the Implementing Partner for the Promoting production and utilization of biogas from Agro-waste in South Eastern Botswana programme.

[20] From Project Document
[21] http://www.bpc.bw/Pages/home.aspx
[22] Importantly, this would include more effective agro-waste management.

Policy Factors

The Project Document lists a number of Policies and Legislation that remain relevant to the biogas programme. The key issues/considerations are italicised. These include[23]:

Instrument	Year	Objective	Potential Impact of the Act on Biogas/Bio-Methane Demonstration Plants
Environment Assessment Act	2005 2011	Provision of an EIA for activities that have a negative impact on the environment.	A biogas/bio-methane plant *owner must invest in an EIA.*
Waste Management Act (To be reviewed as part of the Integrated Waste Management Policy[24])	1999	Management of controlled and hazardous waste.	The Act requires biogas/bio-methane plants to be included in District Council Waste Management Plans. The Act supports information-sharing and transparency – biogas/bio-methane production information should be deposited with the Department of Waste Management and Pollution Control (DWMPC) to be included in the Public Records and the Public Register. *The Act is supportive of abattoirs and poultry farms supplying substrates to biogas/bio-methane plants.*
Waterworks Act	1962	Prevention of the misuse and pollution of water.	This Act calls for the efficient use of water at future biogas/bio-methane plants, as well as care to be taken so as not to cause any pollution to underground aquifers and other public water works.
Public Health Act	1981	Prevention of pollution of underground water and other pollution that could affect public health.	Protects the quality of water used by the public by controlling the disposal of polluted water. *Prohibition of 'nuisance' or smells which could come from, for example, garbage or manure heaps supports biogas/bio-methane production* as penalties can be imposed on organic waste owners who do not comply, indirectly encouraging them to use their manure/garbage for biogas production.
Electricity Supply Act	1973 Amended in 2007	Amended 'to authorize the creation and licensing of independent producers and suppliers of electricity…'.	The Amendment Act of 2007 allows applications for a license to generate, supply, transmit, distribute, export or import electricity. It supports the Government's plans to attract the private sector (*i.e. independent power producers, IPPs)* to contribute in the

[23] From the Project Document. Certain more peripheral policies have been omitted.

[24] The Department of Waste Management and Pollution Control (DWMPC) is currently in the process of reviewing the Waste Management Policy.

Instrument	Year	Objective	Potential Impact of the Act on Biogas/Bio-Methane Demonstration Plants
			development of the country's energy infrastructure and service delivery. However, the lack of *feed-in tariffs* or any clear renewable energy guidelines represents a barrier for potential investors.
Local Government Act	2012		This Act allows councils to generate revenue through business operations. The Kgatleng District Council has already established a business arm which could be used to create a *Public-Private Partnership (PPP)* to establish and operate a biogas/bio-methane plant.

Problems that the project sought to address: threats and barriers targeted

The overarching objective of the programme is to establish and support a biogas industry within Botswana that will contribute towards addressing a number of environmental and socio-economic outcomes. These include:

- Better waste management. Particularly of agro-waste streams
- Improved access to clean and sustainable energy sources for rural households
- Reduced reliance on woodfuel
- Improved and enabling environment including; mason training, research and development on biogas, access to finance, supportive waste management and energy policies, etc.

Key threats & barriers[25]

- The lack of suitable demonstration projects to facilitate learning and understanding of biogas. This was true at both the household as well as the institutional levels.
- Insufficient knowledge amongst stakeholders (Government, private companies, farmers, communities, women, consumers) about the benefits of biogas and the available technologies.
- In addition, there is, across the board, a very low level of knowledge among stakeholders about the major benefits of biogas technologies, including: the production of green energy – both electricity and heat;
- No existing PPPs in the sector (and lack of established framework) to encourage private sector involvement within the waste and energy sectors
- There is a lack of specific guidelines or policies on biogas resources and the absence of an appropriate legal and regulatory framework for the utilisation of biogas from agro-waste and waste water
- There is poor infrastructure maintenance and weak monitoring and enforcement of waste treatment regulations.

[25] These threats and barriers are taken from the Project Document.

- Banks and financial institutions in Botswana (including the Botswana Development Corporation) have insufficient capacity to assess the technical risks and benefits of investing in biogas technologies.
- Lack of a level playing field: the Botswana Power Cooperation supplies electricity at BWP 0.77/kWh[26] and is subsidised. For a biogas digester to produce electricity on cost-recovery terms, a minimum price of BWP/1.4 kWh is required. To stimulate investment in biogas technology, a level playing field has to be created.
- Currently there is only one successful Public-Private Partnership (PPP) in Botswana[27], namely the Debswana/Botswana Government PPP (a 50:50 diamond mining joint venture). This is a large scale and highly profitable PPP that presents something of a strategic case which may not lend itself to simple replication.

Project Description and Strategy

The programme's objective is '*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'.* In order to achieve this objective, the biogas programme has adopted a project design that is intended to lay the foundations and create a sufficiently enabling environment to support the establishment and continued growth of the biogas sector. The design is based on three key Project Components with a number of activities and outcomes associated with the successful implementation of each of these components.

Project component 1: ***Institutional strengthening and capacity building for biogas investment and improved agro-waste management and regulation***

This component specifically focuses on increased capacity of Government, the private sector and stakeholders to develop, finance and implement Public-Private-Partnerships (PPPs) in the agro-waste sector. The component will also focus on increasing capacity of Government authorities to monitor and assess the effectiveness of incentives, ensure quality, and enforce guidelines and standards, related to waste management, in the agro-industrial sector. Outcomes include;

- 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 replication and scale-up of agro-waste technologies post project

Project component 1 Outputs include the following:

Table 4: Project component 1: Outputs

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.

[26] BPC 2018 rates. https://www.bpc.bw/media-site/news/Pages/2018-New-tarifs.aspx
[27] PPP, BOCCIM Business Conference, Public Private Partnership, October 14-17, 2012

1.2 Framework agreement for public-private partnerships (PPPs) in the waste sector adopted and disseminated.
1.3 Training conducted for all relevant stakeholders on the new guidelines and PPP framework agreement (1.1. and 1.2)
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.
1.5 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
1.6 Review of enforcement practices and support towards enforcement of pollution prevention laws, mainstreamed into relevant organizations' activities: e.g. Councils or DWMPC.
1.7 Corrective EIA measures implemented
1.8 Financial institutions trained on best practice in assessing and financing agro-waste projects through BITRI
1.9 Dedicated investment facilitation platform on low-carbon waste-utilization technologies established at BITRI, and operational with independent budget
1.10 Level playing field created for all energy providers and REFIT in place
1.11 Robust research undertaken for the biogas technology
1.12 Training conducted for training institution facilitators and masons for small scale digester construction

Project Component 2: ***Increasing Investment in clean-energy technologies and low-carbon practices in the Agro-waste sector/Facilitation and establishment of the first biogas plants in Botswana.***

This component focuses on increased investment in biogas technologies and low-carbon practices in the agro-waste, small-scale farming and institutional (e.g. schools) sectors. This component is about operational biogas plants, ensuring that the value of this technology is effectively demonstrated and that it provides a positive stimulus for future market development and growth. The key component outcome:

- Outcome 2.1: Increased investment in biogas technologies and low-carbon practices in the agro-waste, small farming and institutional sector (e.g. schools)

Project component 2 Outputs include the following[28]:

Table 5: Project component 2 outputs

2.1 Sensitization campaign conducted with district councils, stakeholder and community groups in targeted biogas plant sites
2.2 Feasibility study undertaken for small-scale biogas digester component
2.3 Business plan developed for the three potential medium-scale biogas sites near agro-industrial plants with potential off-take uses analyzed.

[28] The 'strike through' outputs no longer appear in the Workplan

~~2.4 Feasibility study undertaken on centralized large-scale biogas plant with bio-methane upgrade.~~
2.5 Environmental impact assessment of selected biogas sites completed
~~2.6 Tender launched for operator of the medium-sized biogas plant.~~
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).
2.8 Technology agreement signed on North-South or South-South cooperation with selected international biogas equipment providers
2.9 Construction and commissioning of small scale biogas plants
(2.9) Construction and commissioning of medium scale biogas plants

Project Component 3: ***Facilitation and establishment of appropriate biogas utilisation platforms in at least two districts of South-Eastern Botswana***

This component will facilitate increased investment in less GHG-intensive energy systems using biogas. Financing Institutions like Botswana Development Corporation and Barclays Bank were encouraged to finance partnerships that could arise from the biogas utilization.

- Outcome 3.1: Increased investment in less GHG-intensive energy systems using biogas

Project component 3 Outputs include the following:

Table 6: Project component 3 - outputs

3.1 Partnership established between biogas plant operators and selected district councils for supply and purchase of biogas from the plants.
3.2 District council staff trained on the biogas-utilization technologies selected for investment, including operations and maintenance.
3.3 Monitoring scheme in place to track fuel savings (from switch to biogas) and GHG-emission reductions.
3.4 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.
3.5 Based on outcome from feasibility study, selected biogas-utilization technologies identified.
3.6 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
3.7 Contracts signed on performance-based incentive, monitored and made available to biogas owners.

Theory of change

As with most UNDP supported initiative, the Botswana biogas programme is premised on a theory of change. The Theory of Change (ToC) is a method used for designing and monitoring development interventions. The theory as it appears in the Project Document is presented in Figure 2

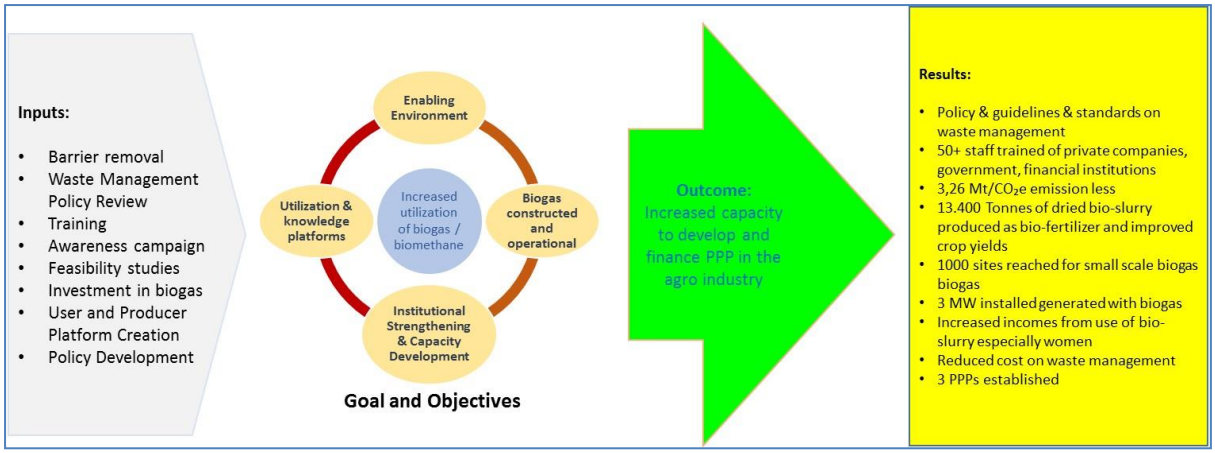


Figure 2: Biogas programme's Theory of Change

A ToC is designed to capture the causal links between different actions. For a programme to succeed, it needs to clearly articulate the short and long-term programme objectives and the series of interventions required to achieve these objectives. It generally starts by identifying the intended impacts, for instance a commercial market for biogas in Botswana, and then works backwards in identifying the kinds of interventions required to make this happen. The ToC applied to the Botswana biogas programme is rather high-level and not sufficiently disaggregated to understand the causal relationships between proposed actions. There are no causal linkages made between specific inputs, objectives and outcomes. The lack of detail displayed in the ToC and its potential impacts will be discussed in greater detail under the Findings section. Suffice it to say here that that the ToC as presented is far too simplistic to guide specific project interventions and to make the necessary causal linkages between specific challenges and appropriate interventions.

Findings

Project strategy

Project design

At first glance, the overall project design appears sound. It has a purposeful pose, acknowledging the need to establish an enabling environment that can support the integration of biogas into a range of policy initiatives including both waste and energy. But it is not just policy, the design acknowledges the activities and stakeholders required to ensure a longer and more successful future for biogas in Botswana. Important references to increasing capacity of the government as well as the private sector. Encouraging references to multi-stakeholder forums, workshops, information sharing, best practice, involvement of local government, training of masons, engaging with financial institutions, etc. Purely from a project design point of view, most of the key elements are there.

However, on close inspection, there are a number of design issues that need to be flagged and appraised. These include:

- Project purpose

While it is quite acceptable even strategically desirable for projects to have multiple positive impacts and outcomes, it is nevertheless important to define and even prioritise these outcomes. What is not clear is the overarching purpose of the programme. Is it an agro-waste management initiative? Is it an energy access initiative? Is it a pilot or commercial project? Is it pro-poor or market related? Is it pitched more at domestic users as opposed to larger scale commercial options? When project objectives are uncertain, this can negatively impact on issues such as project ownership[29] as well as expectations and interpretations around outcomes, particularly in terms of what outcomes are to be prioritised.

Staying with outcomes, uncertainty of purpose can undermine project accountability. If the purpose and associated objectives are not clear and/or unanimously acknowledged, then it becomes more difficult to measure the success and hold project stakeholders accountable. For instance, the [lack of] financial sustainability of biogas installations may be downplayed where agro-waste is being sustainably managed and/or the amount of Greenhouse Gases (GHG) emitted is reduced. In this case, the challenges associated with generating energy on a financially sustainable basis are obscured by the positive environmental impacts. The point is, where we place the emphasis creates different expectations. If the project is considered a critical waste management intervention then expectations surrounding the urgency about establishing a commercial market may be softened. If the project is essentially a pilot, then the early stage focus will be on demonstrations, proof of concept, R&D, M&E, etc as opposed to the role of banks, the regulator, national policy, etc. The issue of clarity of purpose is taken up again later in the review; suffice it to say here that the multiple project outcomes that characterize this initiative should be used to leverage greater value rather than diluting expectations.

[29] For instance, who are the public sector owners? Ministry of Environment Natural Resources and Tourism (MENT) or the Department of Energy?

- Policy dependency

A further project design issue is the dependency on policy. The project's success (or otherwise) hinges to a great extent on the Government of Botswana (GoB) devising and/or enacting various pieces of legislation and policy. To be fair, it would be negligent from a project design point of view not to ensure a substantive alignment with national government policy. However, there is an important distinction between alignment with *existing* government policy and banking on *future* government policy development. The development of policy is as fluid and unpredictable as politics itself. While it may have been more reasonable during the development of the Project Document – some time before the launch of the project – to indicate important and supportive policy developments, the continued reliance on these *possible* future developments places significant risks on the project's ability to achieve the intended outcomes. Key policies in this regard include;

Integrated Waste Management Policy; the enactment of the new 'Integrated Waste Management Policy' was considered an important development for the success of the project. The Project Document indicated that 'the Department[30] is currently working on an Integrated Waste Management Policy, with the aim of holistically addressing issues of waste management and enforcement of these policies in the country. Work on this policy started in 2014 and is expected to be concluded in 2016'[31]. At the time of the MTR (2019) this policy while having been developed, has not been approved or adopted.

The significance of this policy development was not only that it would place various waste management requirements in the spot light but that it would simultaneously compel high waste producing entities to adopt more effective waste management strategies which may have included the production of biogas. This was particularly true for a number of large scale agro-waste producers such as the BMC, Kgalagadi Breweries and SENN foods. It was the view that the enactment of the Integrated Waste Management Act Policy would have compelled high agro-waste producing companies to invest in green technologies in order to comply with the provisions of the act. This scenario and the anticipated reactions were strategically key to ensuring the achievement of the medium-scale digester targets, including the digesters themselves as well as any attendant arrangements for electricity sales through the proposed PPA or REFIT frameworks.

Renewable Energy Feed-in Tariff (REFIT); as noted in the Project Document, 'Adoption of the renewable energy feed-in tariff (REFIT) policy' is also stated among the Draft Policy's electricity strategies. It is envisaged that the Policy will be passed by the legislature in 2015[32]. Again, at the time of review, the REFIT tariff is no longer on the agenda[33]. This is important because the REFIT framework may have presented an opportunity for larger agro-waste producers to generate electricity through biogas and on-sell the power to the BPC. While the existence of a REFIT framework is not a pre-requisite for such companies to generate electricity (they could so do for their own consumption as well) it would have created a more dynamic commercial market and arguably a greater inducement for larger companies to pursue electricity producing options.

These are the two key policies that have not been promulgated and adopted by the time of the MTR and yet which are of strategic value to the ability of the project to achieve its stated results. There are others such as the Public Private Partnerships (PPP) framework which was intended to provide

[30] Department of Waste Management and Pollution Control (DWMPC)
[31] Project Document p17
[32] Project Document p19
[33] Personal communication with BPC official.

the legal framework for greater participation of the private sector in waste management which - with one notable exception (Debswana/Botswana) – is not really a realistic prospect at present[34]. While GoB policy is open to greater participation by the private sector in the economy[35], the utilization of PPP frameworks has very little track record in the country. Indeed, a PPP unit within the Ministry of Finance and Economic Development (MFED) was only established in 2018 and was until recently conducting sensitization workshops for PPPs[36]. While the Project Document reasonably identified these future policy developments as important to the achievement of project outcomes, they have not been implemented and adopted and cannot any longer play the role envisaged. This now becomes a question of adaptive management.

- Commercial overreach

The earlier conceptualisation of the project, as reflected in the Project Document, had a stronger commercial intent about it. Reference to the conversion of diesel vehicles to biogas, discussions on investment costs for compressed biogas, reference to replacing government funded/distributed chemical fertilizer with bio-fertilizer produced from biogas, a 'Biosys Energy Park' based around the construction of a proposed 7MW bio-methane production facility[37], etc. These expectations are no longer part of the project results framework. Indeed, the overall project intent is far less commercial than these earlier Project Document comments suggest. While the project remains committed to medium-scale digesters of a commercial nature and is committed to overall financial sustainability more generally: the focus is on less high visibility, capital intensive initiatives and more pragmatic considerations around household level initiatives, knowledge platforms, research papers and so forth. This shift has resulted in reduced interest from Financial Institutions[38] and other key stakeholders which will account for reduced co-financing commitments. While the contributions of commercial financial institutions such as Barclays Bank were never factored into the Project Document co-financing or resource allocation assumptions, the drift away from explicitly commercial activities will also impact on the contributions of development finance institutions (such as Botswana Development Corporation).

- General project design observations

As suggested, the overall design is persuasive, combining practical actions on the ground with efforts aimed at creating an enabling framework to support growth and investment in the technology moving forward. However, the project needs to ensure it gets the timing and sequencing right, displaying a more strategic understanding of how technologies develop and mature. As indicated in Figure 3, there are different stages to the maturation of a technology, biogas being no different. This is an important concept and one which needs to inform the project's approach. For instance, the development of PPP frameworks should not precede effective demonstrations of the technology. This is equally true for the anticipated commercial involvement of the private sector in Solid Waste

[34] This position was communicated by various public sector stakeholders – including the BPC.
[35] See, for instance, http://en.rfi.fr/africa/20180414-botswanas-new-30-year-old-minister-unlocking-private-sector-growth-and-investment
[36] http://www.thepatriot.co.bw/business/item/5406-ppps-new-cost-effective-way.html
[37] Project Document, p37
[38] Dr Oduetse Koboto noted that 'once the businessman withdrew, district councils became less interested and the banks [reference to Barclays] withdrew resulting in less co-funding being committed'. Personal communication.

Management (SWM) as it is for households investing in biogas. The technology needs to be effectively demonstrated; in the parlance of the figure below; technologies need to be pushed before the market can be expected to pull them.

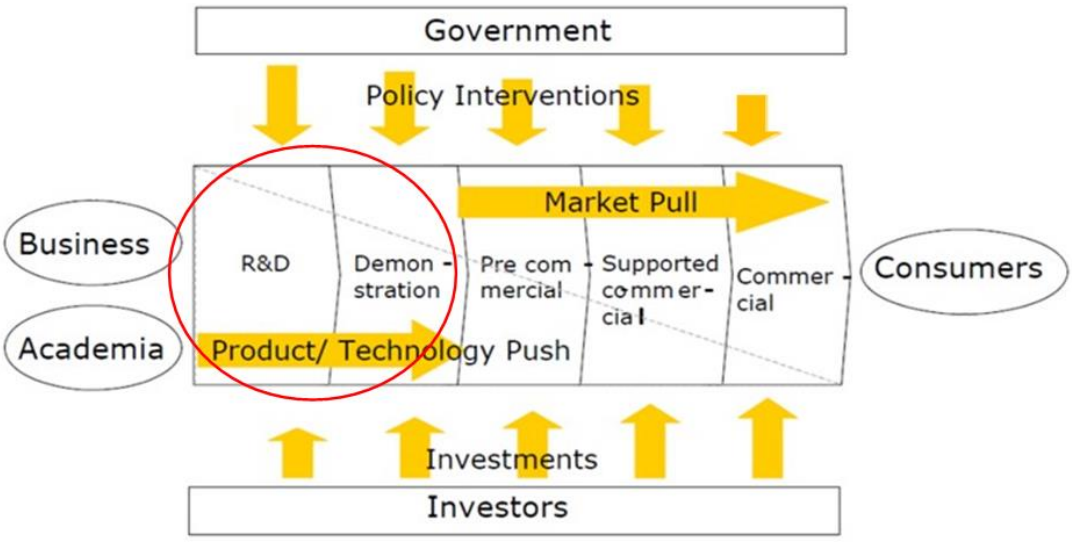


Figure 3: Understanding how technologies mature

The review will return to the technology maturation model with specific reference to project components as the discussion progresses. Suffice it to say here that such a model or approach needs to provide an organizational blueprint for project design.

Results Framework

The results framework includes both qualitative and quantitative outcomes. There are a number of targets that are smart (Specific, Measurable, Achievable, Relevant, Time-bound) while others remain less subject to measure. For the most part there were no mid-term targets set.

Smart targets include;

- One thousand (1,000) small-scale biogas digesters constructed and operational.
- Three medium-sized biogas digesters constructed and operational.
- Finalised proposal to construct a centralised biogas digester of an estimated 15,000 m3 or larger with facility to upgrade to bio-methane and utilisation.
- At least 3,000 m3 biogas per annum and 3 MW of electricity installed.
- At least three financial institutions have incorporated the financing of biogas technology in their national portfolios.
- At least 60 people trained on the developed PPP guidelines
- 5 research articles produced
- Train 75 masons on the construction, operation and maintenance of small-scale biogas digesters
- Gender is targeted to some extent around the training of masons as well as being considered beneficiaries of biogas being the primary energy agent within households but no absolute numbers are evident

- Note on targets

The targets for small-scale digesters are extremely optimistic at 1,000 units within the project implementation period. This observation was put forward by many stakeholders who pointed out that the figure was *arbitrary*[39], *unobtainable*[40] and the *costs too high*[41]. A key issue with the target is that in the original Project Document and subsequent Project Inception Report[42] and the Annual Workplan (2017)[43] the 1st small-scale biogas digester is assumed to be installed on the same terms as the 1,000th small-scale digester. There is no staggered approach to sales starting, for instance, with subsidized options and becoming increasingly commercial. There is no contouring of expectations which would anticipate a tougher market in the earlier stages of the project which would become increasingly commercial over time. While the project is certainly a pilot project given the lack or even absence of biogas technology in-country experience, this reality is not reflected in how the sales of small-scale biogas digesters are anticipated. Again, this speaks to a misconception of how technologies mature in new markets, which is more of a phased or stepped process as presented in Figure 3. While the targets for medium-sized digesters are markedly more modest, they too will face challenges which are discussed in greater detail below.

[39] Dr Oduetse Koboto (MENT)
[40] Dr Edward Rakgati – BITRI PSC Member
[41] Ms Dorcus Mpedi and Ms Tuduetso Ramokate – MLGRD PSC Member
[42] Project Inception Report 2017.
[43] Annual Workplan 2017 Approved (AWP)

Progress Towards Results

Progress Towards Outcomes Analysis:

Table 7: Progress towards results matrix

Outputs[44]	Indicator	Base-line Level	Midterm Target[45]	End-of-project Target	Midterm Level & Assessment[46]	Achievement Rating[47]	Justification for Rating
Project Component 1: Institutional strengthening and capacity building for biogas investment and improved agro-waste management and regulation							
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.	Draft guidelines and standards Approved. Guidelines and standards approved	None	None indicated	Guidelines and standards developed and approved	BOBS assisted with standards. Draft guidelines developed for review and discussion	S	There is sufficient time to complete the task.
1.2 Framework agreement for public-private partnerships (PPPs) in the waste sector adopted and disseminated.	T(2019): draft Framework Agreement T(2020): Approved Framework Agreement	None	None Indicated	Approved Framework Agreement	This output appears in both the 2018/19 AWP. Progress Report (Q4 2018) suggests activity moved to 2019. TORs for PPPs under review (Q1; 2019)	MS	According to AWP 2018 the task should have already been completed. Little precedent for PPPs in Botswana.

[44] Outputs indicated and their sequence is based on the approved project Annual Work Plans
[45] None set in ProDoc
[46] Colour code this column only
[47] Progress Towards Results Rating Scale: Highly Satisfactory (HS), Satisfactory (S), Moderately Satisfactory (MS), Moderately Unsatisfactory (MU), Unsatisfactory (U), or Highly Unsatisfactory (HU)

1.3 Training conducted for all relevant stakeholders on the new guidelines and PPP framework agreement (1.1. and 1.2)	Output indicator 1: No. of people trained (public & private) T(2019): 20 T(2020): 40 Output indicator 3: No. of stakeholders benefiting from PPP framework T(2019): 1 T(2020): 3	None	None Indicated	40 people trained and 3 PPPs operational	Training may be completed on time if the PPP framework agreement is completed	S	The first indicator relating to training should be achieved. The second indicator referring to number of stakeholders benefitting from PPPs is unlikely to be achieved. Much work has to be done getting PPPs set up in the SWM sector. With no timeframe for the implementation of the Integrated Waste Management Act this seems unrealistic.
					There does not appear to be sufficient time to ensure three operational PPPs by 2020	U	

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.	Output indicator 1: Effluent regulations BL: draft Regulations T(2020): Approved Regulations Output indicator 2: Level of monitoring and enforcement of regulations BL: unsatisfactory T(2020): satisfactory NB: scorecard to be developed to measure the level of satisfaction Output indicator 3: Green certification framework in place BL: No T(2020): Yes	Unsatisfactory	None Indicated	Effluent regulations BL: draft Regulations T(2020): Approved Regulations Satisfactory level of monitoring and enforcement of TEAs	Contract signed with consultant to undertake sludge management and waste water pre-treatment methods. Final reports produced. But levels of regulation not yet in place. Concept of green certification discussed but no approval/ adoption as yet. Appeared in both 2018 & 2019 AWP No evidence of Green Certification Protocol	S	The difficult part is convincing [local] government to adopt new regulation – even more difficult in the absence of the Integrated Waste Management Act.
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	Level of monitoring and enforcement of TEAs BL: unsatisfactory T(2020): satisfactory NB: scorecard to be developed to measure the extent of monitoring and enforcement	Unsatisfactory	None Indicated	Satisfactory level of monitoring and enforcement of TEAs	Training on sludge management and waste water pre-treatment methods undertaken No evidence that level of monitoring and enforcement of TEAs is taking place or is 'satisfactory'	S	As above.

1.6 Review of enforcement practices and support towards enforcement of pollution prevention laws, mainstreamed into relevant organizations' activities: e.g. Councils or DWMPC.	This activity is supportive of Outputs 1.4 and 1.5. No progress made as yet.						
1.7 Corrective EIA measures implemented	Level of compliance to EIA measures during construction of bio-digesters BL: None (dependent on construction of bio- digesters) T(2020): full compliance	None	None Indicated	Full compliance to EIA measures during construction of digesters	The EIA is associated with medium-scale digesters and none of these have been commissioned/built as yet	MU	There is no guarantee that a medium-scale digester will be commissioned during the remainder of the project. That reality remains a threat to this activity.
1.8 Financial institutions trained on best practice in assessing and financing agro-waste projects through BITRI	Linked to Investment facilitation platform	None	None Indicated	FIs trained with developed biogas products (1) Bench marking exercise undertaken. Financing workshop undertaken	Preliminary financing workshop held	MS	There is still time to achieve these outcomes but the level of active interest of D/FIs is questionable at this point. Will require more meaningful intervention than a workshop

1.9 Dedicated investment facilitation platform on low-carbon waste-utilization technologies established at BITRI, and operational with independent budget	Existence of Investment Facilitation Platform	None	None Indicated	Investment Facilitation Platform with own Budget	Other than the workshop mentioned above – no further progress	MU	There is still sufficient time to engage and strategize around the nature, scope and functions of such a platform. Best Practice frameworks would be a start; financial instruments used in Nepal? South Africa has a dedicated 'National Biogas Platform'? Where would funding come from, what would be the institutional mandate? So many questions so few answers?
1.10 Level playing field created for all energy providers and REFIT in place	REFIT tariffs BL: draft REFIT tariff guidelines (2020): approved tariff guidelines	Draft REFIT Tariff	Non Indicated	Approved REFIT tariff guidelines	A consultant has been engaged to work on the tariff guidelines	MS	According to the BPC, the REFIT framework has been shelved for now. Unlikely to have an operational framework within project life.
1.11 Robust research undertaken for the biogas technology	5 research papers on Biogas	None	Not Indicated	5 research papers	A research agenda on biogas technology has been developed. First paper has not been released/published	MU	The target is still achievable but will require better M&E, data collection and analysis

1.12 Training conducted for training institution facilitators and masons for small scale digester construction	Output indicator 1: Existence of mason training curriculum T(2019): Draft curriculum T(2020): Approved curriculum Output indicators 2: Number of masons trained 2019 (40), 2020 (75)	None	Not indicated	Training curriculum and masons trained (75)	Curriculum has been developed. A number of trainers have been trained (16) and 20 masons have been successful trained Curriculum not yet submitted to BQA for accreditation	HS	The trainers appear competent and committed as do the masons that have been trained thus far. There is sufficient time to achieve the total number of masons & trainers to be trained. Question; will the number of masons significantly exceed the number of bio-digesters to be built? (Capacity exceeding demand)?

Outputs[48]	Indicator	Base-line Level	Midterm Target[49]	End-of-project Target	Midterm Level & Assessment[50]	Achievement Rating[51]	Justification for Rating
Project Component 2: Facilitation and establishment of the first biogas plants in Botswana							
2.1 Sensitisation campaign conducted with district councils, stakeholder and community groups in targeted biogas plant sites	Output indicator 1: No sensitisation campaigns BL: 0 T(2019): 15 T(2020): 30 (2 per sub-district) Output indicator 2: Level of awareness BL: low T(2019): medium T(2020): high	None	None Indicated	30 sensitisation campaigns conducted and level of awareness *high*	Q1: 2019 states project 'planned to have biogas workshop…', 'media tour planned…'	MU	No evidence of such campaigns being undertaken or the strategic fit/purpose of such campaigns.
2.2 Feasibility study undertaken for small-scale biogas digester component	BL: pre-feasibility study report T(2020): feasibility study report	None	None Indicated	Feasibility study report for 1,000 digesters	The feasibility study is complete although the methodology and, related, results are questionable[52]	S	The draft feasibility study has been submitted as required – the results/findings are still to be considered

[48] Outputs indicated and their sequence is based on the approved project Annual Work Plans
[49] None set in ProDoc
[50] Colour code this column only
[51] Progress Towards Results Rating Scale: Highly Satisfactory (HS), Satisfactory (S), Moderately Satisfactory (MS), Moderately Unsatisfactory (MU), Unsatisfactory (U), or Highly Unsatisfactory (HU)
[52] More details of the report are provided in the narrative discussion on the results matrix that follows.

2.3 Business plan developed for the three potential medium-scale biogas sites near agro-industrial plants with potential off-take uses analyzed.	Output indicator: No. business plans for medium-scale biogas sites BL: 0 T(2019): 1 T(2020): 3	None	None Indicated	3 business plans developed for 3 medium scale biogas sites (with potential off-taker options analysed)	The first feasibility study has been completed for BMC at Lobatse. It is a detailed study from a technical and financial point of view	S	It is a credible and encouraging study on paper – the challenge will be getting BMC to commit. The same could be said of the additional 2 sites required. Although this (commitment) is not a requirement for this output
2.5 Environmental impact assessment of selected biogas sites completed	No of EIA for Medium Scale biogas sites BL: 0 T(2019): 1 T(2020): 3	None	None Indicated	3 EIAs undertaken for medium scale digesters (2020)	The Terms of Reference have been drafted for an EIA on the Lobatse plant based on the Business plan developed	S	Business plan completion (Jan, 2019) would dictate the speed with which an EIA could be undertaken.
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).	Output indicator: No of legally registered Biogas Operators BL: 0 T(2019): 1 T(2020): 2	None	None Indicated	2 Legally registered biogas operators based on PPPs	These have been officially delayed. No PPP framework has been developed and BPC has not indicated interest in a PPA	MU	This would require a level of maturity in the market (including biogas technology, Waste to energy, PPP frameworks and PPAs) which is simply not there at present. And supportive policy/legal frameworks (such as Integrated Waste Management Act) are not in place.

2.8 Technology agreement signed on North-South (NS) or South-South cooperation (SSC) with selected international biogas equipment providers	Output indicator: No of (Mid-scale) Technology Agreements BL: NS - 0 SSC – 0 T(2020): NS - 2 SSC-1	None	None Indicated	By 2020, facilitate signing of medium sized biogas construction agreements NS – 2 SSC - 1	This output is premised on the construction of medium-scale digesters. This has not happened	MU	The only realistic medium scale digester to be constructed – and which would require technology agreements – would be BMC and that is by no means guaranteed within the project implementation period. A target including three such agreements is unrealistic
Construction and commissioning of small scale biogas plants	Baseline: 0 Indicator: Number of biogas digesters constructed and in use. Target: 1000 T (2019) – 300 T (2020) - 700	None	None Indicated	1,000 small-scale biogas digesters constructed	Only 20 digesters built and 8 under construction	MU	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 wold be completing 2 digesters/day.
2.9 Construction and commissioning of medium scale biogas plants	Baseline: 0 Indicator: Number of biogas digesters constructed and in use. Target: 3	None	None Indicated	3 medium scale digesters constructed	No medium-scale digesters commissioned,	MU	The only vaguely realistic medium scaled digester is the one proposed for BMC. But there is no guarantee that this will happen within the project period.

Project Component 3: Facilitation and establishment of appropriate biogas utilization platforms in at least two districts in South-Eastern Botswana							
3.1 Partnership established between biogas plant operators and selected district councils for supply and purchase of biogas from the plants	No. of partnership on biogas sales BL: 0 T(2019): 1 T(2020): 3	None	None Indicated	3 partnerships between district councils and biogas plant operators (supply/purchase biogas)	Real success (impact) will be based on acceptance of REFIT/PPAs as well as the PPP framework. BPC seems a long way off supporting such.	MU	No district councils indicated they were interested in such partnerships. PPA must be solicited from BPC and must be competitive (not unsolicited)
3.2 District council staff trained on the biogas-utilisation technologies selected for investment, including operations and maintenance	No. stakeholders trained BL: 0 T(2019): 10 (BMC) T(2020): 30 (inclusive of other stakeholders to be identified)	None	None Indicated	30 stakeholders trained on biogas technology (from District Councils)	Q1: 2019 – indicated that 'training is on-going and workshops planned'. Not sure how this activity is integrated into and supportive of overall project progress	MS	This is an achievable target but not much movement as yet. Should be linked to development of PPPs etc which is static at this point.

Green= Achieved	Yellow= On target to be achieved	Red= Not on target to be achieved

Table 8: Overall project component rating

Project component	Overall rating
Project Component 1: Institutional strengthening and capacity building for biogas investment and improved agro-waste management and regulation	MS – Moderately Satisfactory
Project Component 2: Facilitation and establishment of the first biogas plants in Botswana	MU – Moderately Unsatisfactory
Project Component 3: Facilitation and establishment of appropriate biogas utilization platforms in at least two districts in South-Eastern Botswana	MU – Moderately Unsatisfactory

Notes on the results matrix

- Delays until 2019

Many of the scheduled outputs have been 'delayed until 2019'. For instance, Outputs 1.1[53] (Guidelines/standards on low-carbon alternatives) and 1.2 (PPP framework agreement) are both signalled to be progressing 'by June 2019'. Output 1.4 (Monitoring of effluent flows) will have Green Certification in place 'by August 2019'. For Output 1.8 (Financial Institutions involvement), benchmarking will be undertaken 'in May 2019'. In the case of Output 1.9 (Investment Platform), a benchmarking exercise on similar investment platforms 'will be undertaken before June'. Output 1.10 (REFIT) to 'be completed by July'. There appears to be a constant pushing out of activities many of which are completely uncoupled from or independent to the achievement of other outcomes.

For instance, Output 1.1 *'Specific guidelines and standards on low-carbon alternatives and utilisation technologies for agro-waste and wastewater developed and disseminated to all relevant stakeholders in the sector'.* There is a considerable body of literature which is very relevant to this output. It is not necessary to rely on the Botswana Bureau of Standards (BOBS) to determine the progress of this output. A few engagements with relevant sector experts from Nepal[54], relevant GIZ[55] representatives, similar municipal waste management initiatives in South Africa[56], etc. would have established a clearer terms of reference for this output, would have informed the project (and BOBS) of best practice in this regard, what technical standards already exist, etc. Agro-waste and waste water usage options and technologies is a well-researched field[57], why wait for the BOBS? BITRI is a research institute with the capacity to advance this output without the direct and constant support of BOBS.

In the case of Output 1.9: *Dedicated investment facilitation platform on low-carbon waste-utilisation technologies established at BITRI, and operational with independent budget*. Why has no benchmarking exercise already taken place? Progress on this outcome was expected, according to the approved Annual Work Plan 2018, in 2018. Why would there have been no progress made 18 months later? South Africa has a 'Biogas platform[58]' which is supported by GIZ. The Nepalese biogas programme is arguably the most successful in the world[59] and the work of the Alternative Energy

[53] All of these references can be found in the SPC Progress Report Q1: 2019
[54] For instance, engaging with the Alternative Energy Promotion Center (AEPC) www.aepc.gov.np
[55] They have been undertaking allied initiatives in South Africa http://cityenergy.org.za/uploads/resource_327.pdf
[56] https://www.sustainable.org.za/userfiles/wastewater%20biogas(1).pdf
[57] See, for instance, https://www.researchgate.net/publication/301745422_Advances_in_Recycling_and_Utilization_of_Agricultural_Wastes_in_China_Based_on_Environmental_Risk_Crucial_Pathways_Influencing_Factors_Policy_Mechanism, https://www.ajol.info/index.php/njt/article/viewFile/145674/135199, http://www.uncrd.or.jp/content/documents/Session2_Agamuthu.pdf
[58] http://www.energy.gov.za/files/biogas/nationalBiogasPlatform.html
[59] See, for instance, https://sswm.info/sites/default/files/reference_attachments/NEWAR%20ny%20Making%20Exonomic%20Sense.pdf

Promotion Centre (AEPC) is at the heart of this success[60]. What financing facility does the AEPC have? What can we learn from the work of Horn of Africa Regional Environment Centre and Network (HoA-REC&N)[61] in Ethiopia where a branch office has been established to provide information, advice and project services? A significant amount of work has been undertaken on establishing appropriate institutions within the energy sector, developing suitable mandates, etc. All this under a range of *institutional strengthening* initiatives[62]. It would be reasonable to assume that by now, a draft outline of the mandate and role of such an institution could have been established. This could have detailed the vision/mission of the entity, staffing requirements, funding options, what kinds of financial services may be available, etc.

The point has been made that certain components, activities and outcomes are being unnecessarily delayed. And while there may be sufficient time to conclude these outcomes in the remaining two years, there is little strategically sensible about back-loading a project. This is a reflection not just of overall project management but strategic management as well; correctly sequencing activities, determining individual(s) responsibility for the outcome, not waiting unnecessarily on the contributions of outside entities and individuals, etc. These management issues will be addressed in greater detail under the Management Arrangements: section that follows. But before the MTR proceeds to address management issues, it is necessary to discuss those outcomes that have been highlighted in red and deemed 'Not on target to be achieved'.

- Commercial access and commercial frameworks

The outcomes considered 'Not on target to be achieved' broadly fall into one of two [inter-related] categories. They either refer to the actual construction of small and medium scale digesters or they are associated with the construction and/or effective commercial operation of these plants. In the case of the former, the target of 1,000 small-scale digesters is an unreasonable target and in all likelihood will not be achieved within the project timeframe. To date, two years into the project, not a single small-scale digester has been purchased by a private household. At an average cost of P20,000 ($1,860) these small-scale digesters are not widely affordable and, in many cases, do not present a commercial proposition[6364]. While the project is attempting to address this through the installation of demonstration units, more effort will have to be made in understanding, targeting and supporting the market. However, regardless of the improved success that might be anticipated through adaptive management, more 'technology push' based strategies, etc. the target of 1,000 units will not be achieved. Recommendations to this end are made in the

[60] https://www.aepc.gov.np/
[61] http://www.aau.edu.et/hoarecn/major-projects/biogas/
[62] https://open.enabel.be/en/RWA/2007/p/institutional-strengthening-and-capacity-development-energy-sector.html
[63] For instance, many households use fuelwood for cooking and heating which is very often collected free of charge. The introduction of biogas for cooking and heating would not displace significant (or any) energy costs for such households.
[64] A further consideration on commercial competitiveness is offered by the following. P20,000 is the equivalent value of 1,000kgs of LPG. The average household uses 5kgs/month for cooking. 1,000kgs of LPG could provide a household with enough gas to cook on for 200 months or over 16 years. https://static1.squarespace.com/static/52246331e4b0a46e5f1b8ce5/t/5b8cd4a71ae6cf1d7df58593/1535956147393/4B_Bagopi_An+inquiry+into.pdf

Conclusions and recommendations section.

The construction of medium-scale biogas digesters has been stalled by a number of strategic considerations. For instance, based on the BMC feasibility study[65], the estimated capital costs of P10.5m, even with a very encouraging 5.7 year payback and Internal Rate of Return (IRR) of 14% is still a significant ask for a public sector entity. The feasibility study was only concluded in 2019 which, coupled with change in management at the BMC[66], the potential presentation of the Botswana Meat Commission (BMC) Act which is intended to end BMC's beef export monopoly[67], creates an environment of uncertainty within which capital decisions of this magnitude are unlikely to be made in a hurry. The two other potential medium-scale biogas investors are private sector companies SENN Foods and Kgalagadi Breweries Limited. In neither case have the companies expressed a strong interest in biogas. It appears unlikely that the two private sector entities will commit to biogas within the current project timeframe. In the case of the BMC, while engagements were positive and there certainly is a level of interest in the technology, there is at the same time a level of uncertainty and transition within BMC in terms of its potential privatization or corporatization. Uncertainty is a time to defer risks that are under ones control. Taking a $1 million investment decision in a time of change (and uncertain change at that) seems improbable. The overall expectations within the medium-scale digester component of the project need to be subject to the same *realism assessment* as the small-scale digesters.

Why does the project design, in the case of both small and medium-scale digesters, assume that the market is ready to engage the technology on a commercial basis? There is no real market preparation, mobilization, no slow introduction. No strategic considerations around the technology adoption life cycles, how technologies mature and become mainstreamed, etc. Instead, the approach implies that there is significant latent demand that can be harnessed without much effort. The same is true for small-scale digesters. The expectations are somewhat misplaced; the private sector, again with reference to Figure 3, plays a rather belated role in mainstreaming new technologies. The key upfront partner in this regard is the public sector.

The remaining outputs that are considered 'Not on target to be achieved' include the more framework agreements that potentially make private sector investment in waste to energy more attractive and secure. These include Public Private Partnerships (PPPs), Renewable Energy Feed in Tariffs (REFIT) and more generally, Power Purchasing Agreements (PPAs). As indicated in the Project Document, PPPs are not widespread in Botswana[68] and that successfully achieving outputs associated with or relying on PPPs would require that 'The proposed legal and regulatory improvements pass swiftly through the Government approval process'. In short, this has not occurred and the role of PPPs in facilitating private sector entry into the waste to energy sector is questionable in the short term. Similarly reference to the REFIT approval was negative; 'REFIT was on the table around 2012 but then abandoned, do not try to rely on this option' was the sentiment expressed by a BPC representative[69]. With regard to PPAs, the government does not accept 'unsolicited bids' was the assessment offered which means that any PPA entered into would be

[65] Feasibility Study for Production and Utilization of Biogas at Botswana Meat Commission in Lobatse, Botswana, January 2019.
[66] Personal communications
[67] http://www.sundaystandard.info/still-loadingbmc-amendment-bill
[68] See, for instance, the Project Document p57 where the document notes that 'PPPs are not yet widely established in Botswana…project could face protracted bureaucratic challenges'.
[69] Person communication with Mr Kenneth Syanjibu, BPC

based on competitive bidding[70]. The only PPA on the table at present is for a 100MW solar installation, nothing else. Further, BPC has never entered into a PPA with the exception of a single occasion which came about through an 'emergency situation' that required immediate resolution[71]. Generally the prospects of a PPA being entered into within the project timeframe are negligible due to the following additional reasons; BPC has spare capacity[72], biogas to electricity is a new technology and at 200kW output, as is the potential indicated for the BMC digester analysis, the power utility would not be interested.

Project Implementation and Adaptive Management

Management Arrangements:

The Promoting production and utilisation of biogas from agro-waste in South-Eastern Botswana project is implemented under the National Implementation Modality (NIM) with the Executing Entity being the Ministry of Environment Natural Resources and Tourism (MENT) and the Implementing Partner being the Botswana Institute for Technology, Research and Innovation (BITRI). Figure 4 presents the project implementation arrangement between the different parties.

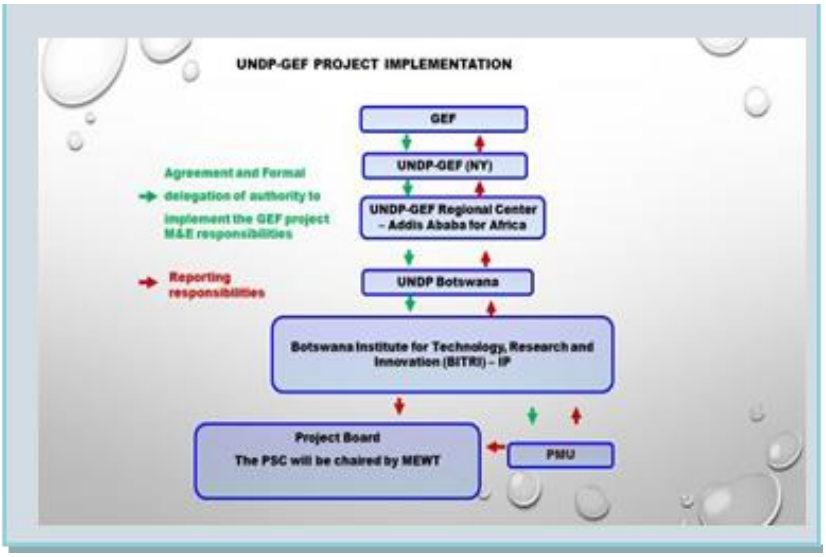


Figure 4: Management arrangement for the biogas programme

[70] This would have to be in response to a 'Call for Proposals' and not as a result of independent initiatives by BMC, SENN Foods, etc.

[71] Person communication with Mr Kenneth Syanjibu, BPC

[72] Peak demand is around 500MW and the government has 732MW of installed capacity plus 160MW of peaking plants. Further it has committed to 100MW of solar based more on international commitments than absolute demand. In addition, demand has decreased by around 100MW due to the closure of Bamangwato Concessions Ltd. (BCL) mines. While some generation units have been closed for maintenance, this is a performance issue rather than a supply problem.

There are a number of important leadership and management issues that need to be addressed, the resolution of which will enhance the leadership and performance of the project.

- The parties involved

The key parties involved are BITRI, MENT, UNDP and DoE. However, while the role of the BITRI and UNDP are prominent if somewhat imprecisely defined[73], the roles of DoE and MENT are less clear. The DoE is the custodian of energy policy in Botswana and should be acknowledged for that. If biogas, at both the household and commercial level, is to be mainstreamed through policy agitation and development, the DoE then needs to be more clearly on board. MENT is the Executing Entity and speaks to all the environmental and waste issues that underpin the assumptions supporting this project. It is also a very practical ministry, being involved in a range of engineering tasks, with trained technical staff, access to suitable vehicles, a range of rural mandates including conservation, mineral resource management, etc. The more practically mandated and skilled MENT plays a fairly marginal role in the management and implementation of the project, with the exception of involvement on the Project Steering Committee (PSC). Greater balance in the prominence of certain public entities should be considered; ensuring the most suitable and capable organizations are contributing appropriately

The PSC includes a valuable cross-section of stakeholders including a range of relevant government ministries and operating units. This includes national government as well as district councils and municipal management officials. There might be an argument for greater involvement of the private sector as the potential market/beneficiaries but as the MTR will argue, this biogas programme at this early stage of its implementation, requires greater public sector contributions and support.

- BITRI participation and the Project Management Unit

The establishment of a Project Management Unit (PMU) which comprises both BITRI and UNDP staff while inclusive does not lend itself to greater institutional accountability. The key issue here is that the UNDP staff (Project Manager, Project Engineer and finance specialist) are playing a too prominent role which is either squeezing out or compensating for the expected contribution of BITRI staff. Engagements with the PMU Project Co-ordinator[74] alluded to the fact that he had a number of projects and initiatives under his control and that project funds were not managed by BITRI but by the UNDP, a fairly unusual arrangement for a NIM project. The PSC minutes all suggest that the UNDP staff, seconded to the PMU, represent the biogas programme with very little (or no) prominence accorded BITRI staff.

It was also unclear what specific roles and responsibilities are accorded BITRI staff. There was some reference to 'a chemist' and to some mason training but clear and persistent responsibilities were not evident. To be fair, there is an overall lack of capacity within the energy/technology research sector in Botswana (with regard to biogas) so a level of on-going involvement of UNDP was to be anticipated. However, two years into the project, the persistently prominent involvement of the UNDP members of the PMU is not sustainable. UNDP's approach, and indeed the overall project

[73] The issue of 'role clarity and involvement of stakeholders' was raised in the Project Steering Committee as early as the Q2 PSC meeting in 2017.
[74] Personal communication with Dr Edward Rakgati

design, is to build local capacity to ensure on-going sustainability. The continued prominence in project operations of the UNDP staff within the PMU compromises this.

A further question raised by stakeholders and one the MTR is tasked to address is the question whether BITRI is the most appropriate institution to implement the biogas initiative? BITRI has a track-record in technology and research although the initial impressions are that these capacities and abilities lean more towards 'scientific research' rather than project implementation which requires market mobilisation, understanding the socio-psychology of technology adoption, procurement of goods and services, oversight, etc. It may be, with some reorganization of responsibilities that BITRI remains prominent in the management of the biogas programme (even the lead perhaps) but that entities more suited to practical requirements of implementation are brought into the Project Management Unit.

It is also not clear whether BITRI is providing sufficient leadership to the PMU. This is both a current project requirement and would bode well for future sustainability. Engagements with stakeholders suggested that BITRI was responsible for a certain level of project inertia, including being slow to develop digester plans, not undertaking sufficient research on a range of possible biogas technology options including 'JoJo'[75] tanks, floating dome digester options, biogas bladder[76], etc. Project Research and Development (R&D) is important for testing technology options and market reactions. The current price of small-scale digesters (P20,000) is too high and alternatives, whether in design or materials, need to be identified. The installation of 28 small-scale digesters presented an opportunity to undertake a level of R&D both in terms of technologies used and households/ businesses targeted. Yet all demonstration systems utilize the same fixed dome digester technology and the selection of households and small businesses beneficiaries did not indicate an obvious intention to assess variable, research and impact, options.

Similarly, Output 1.9, the establishment of a 'Dedicated Investment Facilitation Platform' does not appear to have made any progress. This is a research function, where staff at BITRI can investigate best practice options in terms of the mandate, function and institutional character of other such facilities world-wide[77].

The point has been made that there is a level of inertia in the management and participation of BITRI staff within the PMU and that this needs to be addressed. BITRI is a well-resourced and capable public facility which has research capacity and institutional influence which it can bring to bear on other relevant public institutions, agitating for greater public sector participation, quicker decision making, etc. But this does not appear to be happening.

[75] Large water storage tanks.
[76] See, for instance, https://s3.amazonaws.com/academia.edu.documents/34796539/69_IJAET_Vol_III_Issue_I_2012.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1558616914&Signature=6%2BvsyidqjAe9zkJNd1Li5c5o8SA%3D&response-content-disposition=inline%3B%20filename%3DLOW_PRESSURE_SEPARATION_TECHNIQUE_OF_BIO.pdf
[77] An obvious start, given their global leadership in the biogas sector, would be the Nepalese government's 'Alternative Energy Promotion Centre' www.aepc.gov.np

- Adaptive management

Adaptive management is the process whereby managers and decision makers test their assumptions and adjust decisions and actions based on experience. To this end, the PMU presents something of a mixture. On the one hand the PMU motivated for the inclusion of demonstration digesters given the market's slow response to digester interest and sales. On the other hand, they have not researched alternative technology options for biogas (based on the prohibitive price of the current fixed dome option), they have not engaged with outside biogas experts to improve and enhance project prospects, they have not brought their technical experience with materials to look at reducing the material costs of digesters, etc. There is little evidence that monitoring and evaluation frameworks have been put in place to understand the performance and impacts of demonstration digesters. While there is some evidence of the PMU/BITRI's ability to overcome some of the challenges faced, there is also evidence of considerable inertia which suggests that some of these complications have not been resolved. This may also be a by-product of the lack of role clarity and, subsequently, a lack of specific accountability.

Work Planning:

The project was set to commence on the 1st January 2017 but was subject to some delays. A half-day workshop was held on the 20th April 2017 as a 'pre-launch' to ensure stakeholders remained committed and aware before the official launch of the programme. Part of the reasons for such a delay may have been the delayed recruitment of the Project Manager and Project Engineer who only started in their positions during the months April and May 2017.

The PSC noted some early delays[78] regarding some of the outputs and activities. In the recruitment of a consultant to undertake a feasibility study were mentioned during the project's second PSC meeting in September 2017. Minutes of the December 2017 meeting note further that the Inception Report of the feasibility consultant was rejected and the overall contract was terminated.

A further persistent delay was the clarification of roles within the PMU – this was first requested in the July 2017 PSC (Q2). This was again referenced in the September 2017 PSC meeting and again in the December 2017 PSC meeting (Q4: 2017). Again of the 21st March 2018 (Q1:2018), reference was made to the fact that the parties (BITRI, UNDP and DWMPC) had still not met. Finally on the 1st of April 2018 the required meeting was held and roles clarified; MENT and BITRI co-ordinate and manage the project while UNDP provides 'quality assurance and technical guidance'[79].

Overall there have been some delays but the PSC appears to be aware of these and has been engaging with the PMU and fulfilling the strategic support role envisaged. Annual Work Plans (AWP)

[78] All the references made to item within the PSC meeting were gleaned from the PSC Minutes.
[79] Minutes of Q2 Project Steering Committee Meeting (3rd July 2018).

have been produced and approved for 2017, 2018 and 2019. A Project Implementation Report was undertaken mid-2018[80].

Finance and co-finance:

The project has underspent over the first two years; $509,546 (2017) and $313,124 (2018) with an accumulative figure of $842,670

Table 9: Project expenditure to-date

BIOGAS PROJECT FINANCIAL ANALYSIS (2017 - 2019)				
Year	**2017**	**2018**	**2019**	**2020**
Budget (ProDoc ASL)	*716,650*	*715,650*	*618,150*	*581,850*
Budget Revisions	*387,500*	*490,650*	-	
Expenditure	207,104	382,526	**144,654**	**Expenditure:** As at 24th May'19
Total (Available Resources)	509,546	333,124	473,496	581,850
Cummulative Available Resoures				**1,898,017**

Original funding commitments and current status:

Table 10: Finance and Co-Finance

Total resources		**Status at MTR**	**Comments at MTR stage**
Total resources allocated	**$19,316,300**		
GEF	$2632,300		Project funding is committed
Other cash contributions			
DWMPC	$309,000		These funds are used in support of the DWMPC's efforts to conclude/adopt the Integrated Waste Management Policy
BDC	$4,600,000		These funding commitments were to be realized through commercial loans
BMC	$3,000,000		These funds were to finance a medium-scale digester which is unlikely to be developed within project timeframe
In kind contributions			
MENT	$75,000		Funds invested in developing waste management policy,

[80] The overall ratings issued by the PIR were as follows; Overall Development Objective (DO) rating – Moderately Satisfactory, Overall Implementation Progress (IP) Moderately Unsatisfactory, Overall Risk Rating; Moderate.

			knowledge sharing and high level support
DWMPC	$1,150,000		Funding associated with the development of the Integrated Waste Management Policy and subsequent enforcement.
BMC	$7,150,000		These funds were to be used for recurring costs associated with operating the digester
BITRI	$200,000		Confirmed and on-going contribution towards office space, staff salaries, etc.

Financial commitments as anticipated	Financial commitments may be slow but on-track	Financial commitments extremely unlikely to happen

Co-funding to the value of $14,750,000 is very unlikely to materialize as it is associated with the direct costs of constructing, financing and operating medium-scale digesters which appear very unlikely to be constructed and commissioned by project close. This is not to say that such funding will not be realized in the post-project period.

Project-level Monitoring and Evaluation Systems:

M&E reports and/or evaluation frameworks have not been shared with the MTR consultant. There are constant meetings through the PSC as well as quarterly progress reports which contain a fair amount of detail on project activities and progress. From a project implementation point of view, it is not very clear what the M&E strategy is or who is responsible for it. The M&E expert[81] within the UNDP did indicate his willingness to get further involved in planning, suggesting that greater quality of planning would produce greater quality of results. But it seems this task lies with BITRI as the project implementers. Greater M&E is required on at least two levels: overall project implementation and the specific performance of project outputs.

In terms of project implementation, an overall Gantt chart or detailed Dashboard would convey a clearer sense of project progress and indicate where interventions are required. Such a tool was not evident in the PSC presentations and/or the Quarterly Progress Report.

The second level of M&E required is at the level of certain project activities. Understanding baselines and subsequent impacts of activities is critical. From community meetings to demonstration digester households, the situation before and at various stages after (impacts) need to be understood. One example involves biogas demonstration units where there is no obvious impact or feedback framework developed. No baseline indicating energy behaviour[82] before installation and no systematic follow-up to understand the impact on energy use practices, the possibility of *energy stacking*[83], operation and maintenance issues, cost savings, etc. Data is critical in a technology

[81] Personal communication with Mr Bame Mannathoko, UNDP M&E Specialist
[82] The use of 'energy diaries' might be an option for understanding energy use practices. See, for instance, http://l-ift.com/wp-content/uploads/2015/07/Energy-Diaries-Overview-book-1-29-17-web.pdf
[83] The use of multiple energy sources at the same time, for instance, woodfuel, biogas, etc at the same time.

development project, effectively providing market intelligence, which will enable the project to engage with the market more effectively. The same data collection frameworks should be used to measure the impact of community information workshops, mason training activities, amongst others.

Stakeholder Engagement:

The project is fairly inclusive both in the sense that the PSC draws on a wide range of stakeholders and that the programme undertakes a range of workshops, training initiatives and outreach programmes to sensitize, capacitate and inform communities within the participating districts. There is nothing of particular concern about the number of engagements and the subject of these engagements. If a reflective comment must be made, it would be encouraging to see more systematic structure and purpose to these engagements as opposed to achieving a certain number of engagements or training sessions within a particular time frame. For instance, there are a number of people to be trained (40) on PPP framework agreements, 30 sensitization campaigns, to be conducted, etc. It would be more useful to link these sensitization activities with, for instance, the installation of a demonstration biogas digester. To ensure a link between the training of masons to the purchase and installation of digesters as opposed to mason training being an independent activity.

Reporting:

The project is committed to a range of reporting requirements which includes Quarterly Progress Reports, Minuted PSC Meetings, Annual Work Plans, etc. All of these requirements appear effectively fulfilled. The Consultant is not aware of an annual report produced by the PMU which may be useful when capturing progress (and challenges) over time, providing more context and sense of change over time than a 'snapshot' quarterly report. Perhaps a more longitudinal representation of the project's progress would be the Gantt chart referred to earlier.

In terms of GEF reporting requirements;

- The PSC has met regularly (quarterly) since July 2017 and received updates on activities from the PMU.
- A PIR was completed in 2018 which concluded with the following overall ratings;

Table 11: PIR (2018) overall ratings

Overall DO Rating	Moderately Satisfactory
Overall IP Rating	Moderately Unsatisfactory
Overall Risk Rating	Moderate

An issue that is more effectively addressed in the Conclusions/Recommendations section is the overall risk rating which the PIR determined as 'Moderate'. The key project risks relate to the ability to sell/market biogas digesters, the essence of the programme. If this is not effectively addressed then the risk status may well be more severe than *Moderate*.

Communications:

Internal communications include PSC meetings which are generally well attended. The minutes from these meetings appear effective and are distributed timeously. A number of outputs/activities include engagements at various levels, including sensitization at community and local government level, the proposed engagement around the PPP framework, the interaction at the demonstration digester sites, etc. However, there are further communication and information dissemination opportunities that are not being exploited. BITRI is an established and respected public sector entity which one would assume has access to key government ministries and leaders. A challenging initiative such as this, promoting a new technology and attempting to secure a place of prominence within off-grid strategies and relevant energy policies requires on-going support and profiling. BITRI will need to use its public network to champion biogas and make sure it is on the political agenda.

A number of social media platforms have been created to profile the project and associated activities;

- https://www.facebook.com/pg/UNDP-Botswana-324693204725010/photos/?tab=album&album_id=354798828381114
- https://www.facebook.com/pg/UNDP-Botswana-324693204725010/posts/?ref=page_internal

Table 12: Overall Project Implementation & Adaptive Management rating

Moderately Satisfactory (MS)	Implementation of some of the three components is leading to efficient and effective project implementation and adaptive management, with some components requiring remedial action.

Sustainability

The risks indicated in the ProDoc have been reproduced below with comments from the MTR included to determine the current risk rating 2 years into the project. Key questions include whether or not these risks have materialised and what mitigating actions have been put in place and how effective they have been. Consideration also needs to be given to those risks that are currently evident but were not anticipated by the ProDoc.

Table 13: MTR response to ProDoc risks

Risk	Level of Risk	Mitigation Action	MTR Comments
The technologies proposed – while proven in other countries – are unfamiliar in Botswana and technical capacities in this area are limited.	Moderate	The project intends to utilise proven, feasible and affordable biogas technologies and duplicate solutions that have been successfully introduced in countries with developed biogas sectors. Through extensive training programmes, sufficient capacity will	It is too early to determine to what extent technology quality assurance and performance issues will impact on the project. The biogas digester design (fixed dome) is very similar to the model used in Nepal[84].

[84] The Nepalese biogas programme uses the GGC 2047 model https://www.researchgate.net/figure/GGC-2047-fixed-dome-model_fig2_272652886

Risk	Level of Risk	Mitigation Action	MTR Comments
Technical failures, either due to equipment failure or poor installation, poor operational management, maintenance can lead to loss of trust on the performance of biogas technology.		be developed to ensure guaranteed operation of biogas digesters.	
The agro-waste industry in Botswana is slow to adopt new technologies to address waste management from agro-waste. The sector requires incentives or enforcement to attract investors in waste management / biogas technologies. The investment cost for construction and operating biogas installations are high. 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)[85].	High	The GEF project will support the development of the Integrated Waste Management Policy with clear and transparent guidelines, with inputs from the agro-industry and reinforcement of the policy whereby multiple stakeholders take on responsibility for addressing waste management. The project will support 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 will advocate for the development of a level playing field whereby Independent Power Producers can supply through the grid in commercial conditions.	This risk remains high as the Integrated Waste Management Policy has not been enacted and the associated legal obligations are not in place. Investment costs remain an issue and BPC is very unlikely to enter into PPAs or facilitate IPPs within the project framework. This risk rating remains High and frankly, there is little the project can do to mitigate this risk other than looking at other medium sized digester options for *own consumption* as opposed to supplying the grid.
There is limited capacity in Botswana relating to biogas technology and to managing biogas systems. There is, therefore, inadequate and/or non-capacitated human	Low	Through the GEF-supported training programme, workshops, multi-stakeholder platforms and study tours, sufficient capacity will be created to ensure sound operation of biogas digesters. Stakeholders will be well informed to decide on the most suitable financial and technical	Risk remains low. Such capacity can be developed. The real project risk is developing a commercial market for biogas in the first place as opposed to being able to manage it effectively.

[85] BPC tariff rates (12% VAT inclusive) effective 1st April 2014.

Risk	Level of Risk	Mitigation Action	MTR Comments
resources to successfully implement the project and support the mainstreaming of its results.		option to invest in biogas technology in Botswana.	
Lack of adequate and reliable market data to facilitate the monitoring of project impacts and planning of further policy measures.	Low	Baseline data will be collected on the available waste streams for generating biogas, energy consumption of agro-industries and existing waste management practices at the start of the project and monitoring systems will be developed and implemented by relevant institutions. The approach of the project is that stakeholders have a shared responsibility for monitoring.	This risk level is currently *moderate* rather than *low*. There does not appear to be enough data/insights into market profiles and the potential of different submarkets. In addition, M&E frameworks for analysing & understanding demo digester impacts are lacking. Overall, market intelligence is lacking and consultant's feasibility study (1,000 digesters) does not sufficiently address this.
There is a risk of the Government introducing alternative or subsidised fuels, thus making biogas-based systems less viable and less attractive as an alternative.	Low	The Government, via the Economic Diversification Drive, now enforces the policy of using the Government's buying power to support locally-produced goods and reduce the country's reliance on imports. This extends to the energy sector, where indigenous sources of energy are being prioritised over energy imports. Also, the Government is implementing a programme of phased electricity tariff increases, thereby making biogas a more attractive alternative to grid-supplied electricity.	Level of risk remains *Low*.
PPPs are not yet widely established in Botswana and therefore the establishment of PPPs by this project could face protracted, bureaucratic challenges. Moreover, the success of the project depends on the successful signing of a concessional agreement between	Moderate	The Government is strongly committed to increased private sector participation in the waste sector. Since 2014, district councils have been mandated to invest in PPPs to enhance development. This is a new governance arrangement under the Ministry of Local Government and Rural Development. Engagement with all Government and private sector stakeholders has indicated a strong willingness to partner together, provided that project investments	Level of risk is no longer Moderate but *High.* Insights from BPC suggest that PPPs from an electricity generation/supply options will not feature within the remaining project implementation period. In addition, the Integrated Waste Management Act is not

Risk	Level of Risk	Mitigation Action	MTR Comments
the biogas operator and the provider of the substrate for use in the plant.		make economic and social sense for all concerned parties. The strengthening of enforcement and monitoring under Component 1 will further incentivise waste producers such as BMC to seek solutions to waste management in partnership with Councils.	in place to create further incentives.
DWMPC's capacity to fulfil its regulatory function depends not only on capacity-building but also on a more clearly defined mandate and a source of recurring revenue for enforcement activities. The development of improved regulations for monitoring of effluent flows and by-product waste in all abattoirs in the country will not be effective unless DWMPC and the Councils have the capacity to actually apply them in practice.	Moderate	DWMPC is in the process of developing an Integrated Policy on Waste Management and the GEF-financed project will support this initiative through the facilitation of stakeholder consultations and platforms. UNDP has already closely reviewed many of these issues in the context of its support to DWMPC under the 'Municipal Recycling Guidelines for Botswana Municipalities' project. The lessons-learned and experiences from that project have informed the design of the activities under this project.	Remains moderate (to high). While support has been provided by the project in terms of effluent flows, etc. There is no evidence that this is being implemented and what the impact is. Implemented Waste Policy not in effect.
Water use requirements in the agro-waste processing sub-sector are extremely high, and scarcity of water in the future might oblige the agro-waste processing sector to scale-back production, thus producing less effluent to be treated and utilised in any biogas plant.	Moderate/High	Although not the primary focus of this project, the project will do everything possible to advocate for a strategic approach towards water and wastewater management at abattoirs in accordance with the principles of water conservation, waste minimisation and progressive waste treatment philosophies. Water use licences and trade effluent permits should make provision for conditions that will encourage abattoirs to incrementally progress towards improved waste water quality. The guidelines developed under Output 1.1 will cover best practices on minimisation of waste generation at source (including maximising the recovery of useful	Remains Moderate/High. Will need to consider current drought and future climate change impacts on availability of water.

Risk	Level of Risk	Mitigation Action	MTR Comments
		materials) and curb the practice of washing solids to drain (which transfers waste solids to the liquid medium). BITRI will be encouraged to promote research into cleaner technology and recovery of higher-value products from the waste stream. At present, no abattoir in Botswana operates on a closed water circuit. The reason for this is that wastewater streams generated by abattoirs contain high levels of pollutants and it is generally prohibitively costly to treat to a water quality standard which is fit for recycling or re-use (especially in view of the high intake water quality required). Nonetheless, as part of the feasibility studies for the biogas plant, a variety of water minimisation and treatment/re-use technologies will be costed and analysed, and the principles of water conservation and waste minimisation will be factored into all project activities.	
Botswana is prone to drought and reduced rainfall patterns, which can result in major losses to its livestock population from drought-induced mortality and absence of healthy rangelands – which, in turn, can mean significantly reduced cattle stocks available for agro-processing facilities. The cattle population of Botswana fell by 32% between 1962 and 1966 due to such a drought. Between 1981-84, the national herd is estimated to have decreased by 20% to 2.4 million	Moderate	This is a major external risk to the project which will be mitigated in the context of a variety of other activities and initiatives the Government is undertaking as part of its National Strategy on Sustainable Development (NSSD). Research indicates that a reduction in rainfall and grazing quality may best be addressed not through increases in grazing area (as the land is finite) but through improved systems of land and herd management. Such improvements in herd and range management are needed as cattle farming operates at sub-optimal levels wherein (i) recruitment rates rise and (ii) mortality rates fall but with no commensurate increases in off-take. In the context of this project, this issue will be considered as part of	Remains moderate

Risk	Level of Risk	Mitigation Action	MTR Comments
head, following 3 years of drought.		the feasibility studies for the medium-scale biogas digesters, which will use conservative assumptions regarding the minimum amount of waste effluent feedstock that will be needed to operate on a commercial basis and the risk of an interruption in supply because of drought-related factors.	
The time for approval by Parliament of the Integrated Waste Management Policy is lengthy and hence implementation of the policy is delayed.	High	An approach and detailed work plan with DWMPC, Councils and other stakeholders will be agreed upon that will support the function of the multi-stakeholder platforms. Key stakeholders, notably Councils, can use these platforms to express the importance of having the Policy in place as there is pressure to address environmental issues from the local population.	Remains High – two years into the project and the Policy is still not in place.
Botswana's large coal resource base threatens the deployment of renewable energy; this is also evidenced by the current ongoing expansion of the Morupule Thermal Power Station. Various initiatives on clean coal technologies are also being pursued.	Moderate	The current renewable energy mix is about 1% and the Government has set an official target of 25% by 2030, as communicated to the UNFCCC. It can be expected that the Government will adhere to commitments that have been made at the international level. There are, in addition, opportunities for renewable energy technology deployment in Botswana in the context of increasing electricity tariffs, which have risen from BWP 0.47 to 0.98 BWP in less than 3 years. As these tariff increases continue and as soon as the REFIT is introduced, this will offer improved financial viability to RE projects in Botswana[86].	Level of risk is *Low*. GoB is currently issuing a tender for a 100MW solar plant[87] and has committed to ensuring renewable energy accounts for 25% of generational capacity by 2036.
Construction and operation of a biogas plant comes with a number of safety issues, potential risks and hazards for	Moderate	Proper precautions and safety measures to avoid the related risks and hazardous situations, and ensure a safe operation of the proposed biogas plants, will be undertaken. Training of biogas plant construction	Moderate.

[86] SE4All Rapid Assessment and Gap Analysis – Botswana (2014).

[87] https://www.engineeringnews.co.za/article/botswana-reaffirms-commitment-to-100-mw-solar-project-2017-08-29

Risk	Level of Risk	Mitigation Action	MTR Comments
humans, animals and the environment.		and operating personnel will be aligned with the Government's occupational health and safety regulations. The biogas training will include a specific module on health and safety in the workplace.	
Additional risks emerging from MTR			
Small-scale digesters are considered costly and the lack of resource allocation for subsidies will impact sales.	High	N/A	The current costs of small-scale digesters are P20,000 and unaffordable and/or not competitive with other thermal energy options such as wood and LPG. Efforts to reduce costs and introduce short-term subsidies to catalyse the market will be required.

Financial risks to sustainability:

From an overall project budget point of view, there are mixed indications. On the one hand, the project has considerably underspent on its budget over the first two years. On the other hand, there are project delays across a number of Outputs which will require funding going forward. However, the current project budget should be adequate in terms of project implementation.

One potential budget item for consideration is the provision of subsidies for small-scale biogas digesters. While the project has reworked its budget to cover the costs of 28 demonstration digesters, which were not budgeted for in the original agreement, more financing contributions will be required to subsidize the costs to consumers in order to stimulate access and demand. At P20,000 for a small-scale digester, this will be beyond both the reach of most households and, more importantly, commercially unattractive compared to other household thermal energy options[88].

To the extent that co-financing contributed to the overall financial sustainability of the biogas programme, there are some risks to acknowledge and consider. For instance, the co-financing contribution from the Botswana Development Corporation (BDC) was indicated as $4.6 million. If the medium-scale digester options are not developed within the project framework (which is highly likely), this contribution [largely premised on debt financing these investment] will not be required. Similarly, if the Botswana Meat Commission does not develop a medium-scale biogas digester at all or within the project implementation framework, then the $10.15 million co-financing contribution

[88] For instance, LPG.

(capital and in-kind) is questionable. The same issues apply to the DWMPC, whose fixed contribution of $1.459 million will not materialise if the Integrated Waste Management Policy is not enacted.

However, while these contributions could certainly strengthen the sector both in terms of access to finance as well as providing a visibly broader application of biogas technology, they are not a precondition for success. Indeed, these co-financing expectations are somewhat over-ambitious and more suggestive of or suited to a commercial, established market as opposed the very much emerging status of biogas in Botswana.

There is sufficient budget with the GEF/UNDP project contribution to fulfil the project expectations regarding developing a longer-term sustainable biogas industry and assisting with addressing the agro-waste challenges the country faces. Co-financing, particularly in the form of access to finance, will only be seriously considered or anticipated once the technology has matured and there is a greater level of traction and interest in the market.

Socio-economic risks to sustainability:

A certain 'political' risk is if the government, particularly DWMPC, does not push through the Integrated Waste Management Bill which would omit the imposition of legal inducements to accelerate PPPs in the waste management sector and/or investments in medium-scale digesters for agro-waste management and own energy generation and consumption. The risk of the project being too policy dependent has been discussed. This includes the current government's seemingly lukewarm response to PPPs/IPPs in the energy sector at this point in time.

A further risk is project ownership. While the PSC called for a *role clarification* from the PMU, the MTR still identified a level of ambiguity in role responsibility within the PMU. This being related to the unacceptable prominence of the role taken by the UNDP in project management and operational activities. A government entity, whether it be BITRI and/or MENT, needs to take ownership of the project to ensure outcomes and benefits will be sustained beyond the project lifetime.

The fact that woodfuel is not commoditised and is freely available will continue to pose questions about the commercial viability and appeal of biogas digesters. While there is clear government intent to 'regulate' access to woodfuel[89], such intensions are not currently influencing behaviour as indicated in Figure 1.

A mature biogas market may pose some risk to actors within the LPG distribution network but these would only present themselves at a far more advanced stage of maturity within the biogas sector.

Institutional Framework and Governance risks to sustainability:

Mechanisms such as PPPs, IPPs, REFIT as well as policies such as the Integrated Waste Management Policy will either need to be implemented/adopted very soon, which is by and large beyond the control of this project, or project outcomes and expectations will have to be strategically uncoupled from these developments. For instance, while there remain longer-term medium-scale digester commercial prospects (associated with BMC for instance) there are other more accessible options around public schools which may provide alternative opportunities for developing, showcasing and stimulating the market. To be sure, these are not commercial initiatives which will generate and sell gas or electricity through facilitating frameworks such as PPPs and/or IPPs. However, such initiatives

[89] A number of public sector stakeholders interviewed emphasized this position.

still may have an important role to play in stimulating the early stages of the market, enhancing the role of the public sector in *pushing* the technology in its early stages of development.

Environmental risks to sustainability:

One of the critical environmental factors which is both an incentive and a threat to the industry is climate change. The spectre of climate change and the GoB commitment to reducing GHGs suggests a more prominent role for biogas, particularly in so far as it mitigates some of the GHGs associated with agro-waste. On the other hand, if Climate Change impacts on Botswana include the exacerbation of conditions of drought, this may result in a loss of livestock and the associated biogas feedstock or substrate.

Table 14: Overall rating for project sustainability

Ratings for Sustainability:	
Moderately Likely (ML)	The project is not without its challenges but there is considerable potential for a successful outcome.

Conclusions and recommendations

Conclusions

- Fundamental question: can such a biogas programme succeed where so many others have failed?

Before providing conclusions to the project's evaluation, it is necessary to address a more fundamental question that was posed; is this biogas project worth doing in Botswana? The question is a valid and important one. There are many examples of biogas initiatives failing[90]. Whether it be based on structural limitation in design, maturity of markets, availability of natural resources, water scarcity, operation and maintenance issues, up-front costs, poor policy fit, etc. There are a multiplicity of elements that need to be acknowledged and aligned if biogas programmes are to work. The key requirements are as follows[91];

- **Is there a real problem that biogas technology can address?**

✓ Yes; the vast quantities of agro-waste produced by the livestock and poultry industry is not being properly managed and treated resulting in ground water contamination as well as significant methane emissions (a significant GHG).

- **Can a permanent supply of bio-degradable material be guaranteed at low cost?**

✓ Yes, the agro-waste volumes are considerable both from large scale commercial activities such as abattoirs as well as smaller cattle and poultry operations.

- **Can the financing of biogas systems realistically be solved?**

✓ This challenge needs to be more widely appreciated but there are some budget items that might be converted successfully into financing/subsidy options. There are a number of domestic Development Finance Institutions (DFI) which remain committed once the technology is more established and the financial serviceability and terms are better understood.

- **Are there allies among government and institutional decision makers with a certain degree of awareness of environmental problems?**

✓ Yes; MENT/DWMPC are directly involved as the executing entity and BITRI as the Implementing Partner. Considerable support was evident from both City and District Councils

- **Are there sufficient number of skilled craftsmen available who can be upgraded to be 'biogas technicians'?**

✓ Yes, a masons curriculum and training programme has been developed and the local Brigades (effectively vocational training institutions) are involved in training.

- **Does the number of potential biogas users in the region justify a 'biogas project' or the establishment of private biogas businesses?**
- Yes, 42% of Batswana reside in rural areas and many of those domiciled in urban areas have rural homesteads. Botswana has an estimated cattle population of 2.1 million[92]

[90] For a wide ranging assessment of these challenges see https://www.sciencedirect.com/science/article/pii/S0301421517306869#bib49

[91] The questions are based on https://energypedia.info/wiki/Limitations_of_Biogas_Technology

[92] https://www.export.gov/article?id=Botswana-Agricultural-Sectors

Overall the potential is positive according to the key requirements of success. To be sure, there are very significant, game changing even, questions around affordability and access to finance but there are options and mechanisms to address this. The real threat of failure is not the lack of alignment between biogas technology and the socio-economic, political and environmental realities of Botswana. No, the threat to the success of the project is more controllable than that. The dangers or threats are the way the biogas opportunity is perceived, managed and supported.

- Improved understanding of how technologies mature is required

Certain key project design assumptions, most prominently the installation of 1,000 small-scale digester units within the project timeframe, are more suggestive of a mature, established market than the realities in Botswana. As indicated in (reproduced) graphic in Figure 5 below; the key early stage requirements to initiating markets are more research and development as well as demonstration activities. Significant commercial sales are some way off in the future. It is more about government and academia (research) *pushing* the technology rather than the market *pulling* the technology. The sales expectations, particularly with regard to small-scale digesters, do not align with these realities. Importantly, it is not just a number – the 1,000 units – that is the problem but more critically, the thinking behind it. The assumption that the market is primed means that project activities are likely to be focused on access issues such as finance, technical regulations, mason training, etc which while all important in the long-run are not necessarily the early markers.

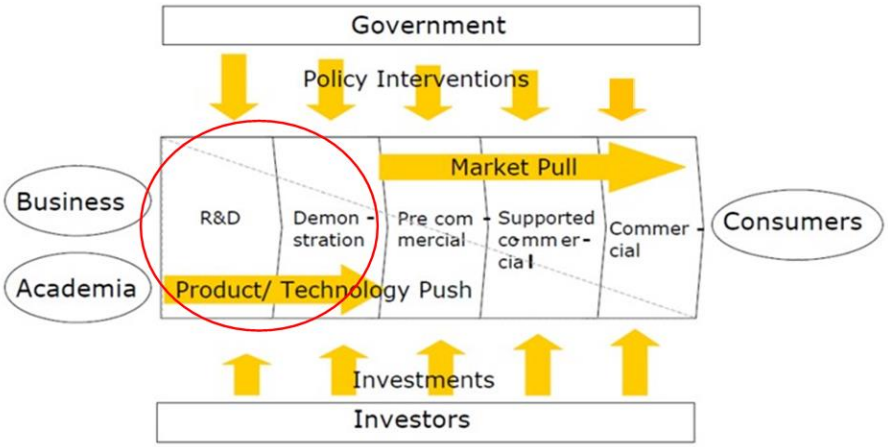


Figure 5: How technologies mature

The project approach needs to be focused more squarely on the early steps in building the market and maturing the technology which includes research around issues such as, for instance, understanding the market's sub-categories. Who are going to be the pioneers? What small-businesses would benefit from biogas? How many such businesses are there? Etc. These issues are unpacked in greater detail in the Recommendations section that follows but suffice it to say here, the project's expectations on various levels are not aligned with or informed by how technologies conventionally mature.

- Project management unit requires more clearly defined roles and responsibilities

As indicated at various stages of the MTR, there is a lack of clarity around individual responsibility within the PMU and BITRI more generally. There is definitely a sense based on feedback from stakeholders as well as minutes from meetings, progress reports, etc. that the UNDP employees (the Project Manager, Project Engineer and Project Finance Administrator) are too actively involved in managing the project and that the BITRI staff are not sufficiently involved. This is not acceptable on a number of levels the most important of which is the impact on the long-term sustainability of biogas in Botswana. BITRI needs to play a far more prominent role, if it is to be retained as the Implementing Partner to ensure sufficient post-project capacity and commitment.

There is certainly an unacceptable level of inertia within the project which can be attributed to the lack of strong leadership and direction within the PMU. There is no value in pointing fingers. The issue will only be resolved when BITRI, not the UNDP, takes full charge of the programme and assigns project operational responsibilities and expectations to specific BITRI staff members. Suitably qualified individuals, of which there are many, need to be assigned specific roles relating to particular project activities and outcomes and need to own those roles. Individual staff members need to be introduced to the PSC and continue reporting on their allotted mandates and responsibilities to the PSC.

- The cost of small-scale digesters is too high

The costs of small-scale digesters are too high. At P20,000 ($1860), they are simply unaffordable and double the price of similar sized digesters in Nepal[93]. With no subsidies and twice the price of similar units in the most successful biogas project globally, this needs to be addressed as a matter of urgency. BITRI needs to be more involved in analysing and costing alternative materials to look for opportunities for cost reduction as well as alternative implementation models to reduce the costs contributions of labour[94].

- The project is too policy dependent

The point has been made during the review. To reiterate briefly; a number of the prominent project outcomes are either linked to the enactment of new legislation and/or the adoption and implementation of various policy frameworks. Significant amongst these include the Integrated Waste Management Act as well as the government's commitment to mechanisms such as PPPs, IPPs and REFIT. Theses project dependencies were identified as potential risks within the ProDoc and are now even more acute at the time of the MTR. The project will have to identify alternative options for achieving project outcomes without relying on these policies and frameworks. Alternatives are proposed within the recommendations section.

[93] Personal communication with Sushim Man Amatya from the Alternative Energy Promotion Centre in Nepal
[94] Labour costs account for up to 60% of overall digester costs. Personal communications with Project Engineer.

- Medium-sized digesters will not be constructed and operational by project close

The three medium scale commercial digester options, including BMC, SENN Food and Kgalagadi Breweries are not likely to be built and operational within the project timeframe. That is not to say that the option is not plausible or financially feasible. It is, as indicated by the financial feasibility commissioned by the project. The challenge is less about the assessment of the technology and more about the market and current political conditions. The BMC is undergoing change, with the government proposing a privatization strategy[95], which suggests the BMC leadership would be cautious about investing in new technology at this stage. More generally, the PMU needs to understand that biogas in Botswana is an emergent and immature sector and it will take considerable convincing and time to get large corporations to adopt this technology. Slowing global economic growth[96] and political uncertainties with the national elections scheduled for October 2019 are not the most conducive conditions for embracing new, capital intensive, technologies.

- Lack of research

There is a critical lack of research being undertaken by the PMU. There is no research being undertaken of digester designs and performance. BITRI is a research institution and is well placed to undertake such research but it is simply not evident. More research on material options particularly around the current fixed dome digester is required if costs are to be reduced. Improved market research is required. The current commissioned study on a market for 1,000 household level digesters is inadequate and does not succeed in categorising the market into more or less favourable submarkets. Improved M&E frameworks are required around demonstration units to benchmark energy consumption patterns before the use of biogas in order to calculate impacts.

- Current marketing and/or sensitization initiatives are inadequate

The overall importance of market engagement, of visible and continued marketing at various levels is not sufficiently evident. For instance, digester demonstration units have no signs outside indicating their presence. Demonstration digester beneficiaries are not in any way obligated to do anything in return. For example, keeping an accurate record of operation and maintenance, maintain an energy diary, market the digester to the local community, etc. The approach, which is taken up further in the recommendations section, is all too passive. There is not enough technology *push*.

[95] See, for instance, http://www.sundaystandard.info/peepa-unveil-bmc-privatisation-strategy-may-2019
[96] https://www.wsj.com/articles/imf-cuts-2019-global-growth-outlook-as-world-economy-stumbles-11554814949

Recommendations

The Nepalese biogas programme may be the current global benchmark for biogas with close to 500,000 household units installed, but this was a long time in the making. The initial interest in biogas was sparked in the 1980s with support from the German and Dutch governments. An official biogas programme was then launched in 1992 and the government is still subsidizing and supporting 20,000 – 30,000 installations a year[97]. The overall ethos and approach of the Botswana biogas programme needs to be recalibrated to reflect these realities.

There needs to be a better understanding of how technologies mature. The 1,000 small-scale digesters targeted, the $4.6 million loan finance facility offered by Botswana Development Corporation, the $1 million BMC digester, the expectations around Independent Power Producers generating electricity and selling it into the grid are almost surreal expectations in a country that by most accounts did not have a single working biogas digester by the time the project was launched 2 years ago. For the programme to succeed it needs to build from the bottom up. To this end, the following sets of recommendations are made;

Project management/Institutional issues

- While BITRI is a very capable organisations with a successful track record independent of the biogas programme, it is clear that it's strengthens are more research than operational. The project management unit needs to incorporate the full range of required skills which, in simple terms must address both research and operational requirements. The following PMU arrangement is proposed;
    - The project is co-managed by BITRI and DWMPC/MENT; BITRI assumes complete responsibility for the research and development requirements while MENT manages the operational requirements including the management of the small-scale and medium scale digester development. It also makes sense for DWMPC/MENT to take responsibility for waste management related activities such as developing Green Certification and waste management/effluent flow monitoring, amongst others. A proposed 'responsibility framework' is include as Annex C and Annex D.
    - BITRI remains the Implementing Partner and MENT the Executing Entity. The key shift will be the inclusion of DWMPC/MENT in the PMU and not simply the PSC which is the current extent of their active involvement.
        - It is proposed that at least one permanent representative from DWMPC/MENT is seconded to the PMU. This would mean that the PMU consisted on the following organizational representatives;
            - BITRI_1 – Project Co-ordinator (Permanent)
            - BITRI_2 – Manager of R&D (Permanent)
            - DWMPC/MENT – Operations Manager (Permanent – part-time[98])
            - UNDP_1 – Project Manager [support role] (Permanent)
            - UNDP_2 – Project Engineer [support role] (Permanent)
            - UNDP_3 – Project Finance & administration [support role] Permanent

[97] Personal communication with Sushim Man Amatya from the Alternative Energy Promotion Center (AEPC) in Nepal

[98] Depending on the level of effort required at various stages of the project the DWMPC/MENT representative will either be full-time or part-time but either way on a permanent [on-going] basis.

- The Depart of Energy (DoE) plays a supporting role. Currently this important ministry is effectively side-lined and the prospects of mainstreaming biogas into off-grid or broader energy policy and programmes is potentially negatively impacted. The DoE is developing a number of off-grid/renewable energy initiatives which include policy and financial support[99] under which it is important that biogas is considered.
- UNDP will also play a more supportive role and not assume specific responsibility for any project activities or outcomes. Responsibility for all activities need to be vested with BITRI and DWMPC/MENT staff. While an ideal situation would see the UNDP secondees transition out of the PMU, this may not be realistic given the key role they have played thus far and the limited time left in the project's implementation. It is recommended that the UNDP secondees remain in the PMU in their current technical capacities/roles but that their contributions are supportive rather leading[100].

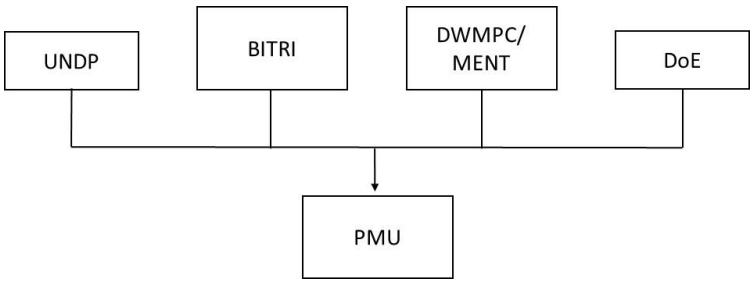


Figure 6: Proposed PMU outline structure

- With regard to specific leadership roles within the PMU, it is proposed that BITRI retain the overall project co-ordinator role but that the participating DWMPC/MENT staff are accorded clear management responsibilities not only for their area of responsibility but for the overall strategic direction of the project.

Table 15: Proposed management focus areas

Leadership	**Component responsibilities**
BITRI	R&D, training, education, framework agreements
MENT	Project implementation, waste management training and support, waste management policy,
DoE	Integrating biomass into energy policy and projects
UNDP	Overall guidance and support

[99] Personal communications with DoE off-grid representatives including Mr James Molenga, Mr Setshedi Ntsowe and Mr Themba Gift Modise

[100] The point being made is that UNDP secondees need to transition leadership of the project tasks to BITRI and MENT PMU personnel and assume a more supportive role, building capacity within the PMU by enabling other public sector officials to take the lead on the full range of project tasks. However, this transition needs to be at a pace that ensures that the experience these secondees have accumulated over the past two years (and prior) is not lost to the PMU through sudden and wholesale shifts in responsibilities.

- With UNDP no longer specifically responsible for any project output (UNDP staff have been very involved in directly managing activities which means some level of hand-over and/or transition should be anticipated), each active output and activity must be assigned to a named staff-member from either BITRI or DWMPC/MENT. In terms of project accountability, staff responsibilities should be specifically allocated and progress should be monitored.
- A Gantt chart needs to be developed which will include the full range of activities and outputs under each component, include anticipated time of conclusion as well as progress over time. The responsible person should be named in the chart. The responsible person, where relevant, should be presenting progress against these expectations at the PSC. To date, it appears that project progress has largely been presented by UNDP staff. Going forward, the responsible parties/individuals will have to present to the PSC.
- Establish more meaningful partnerships with entities that have significant experience in biogas; this would include SNV, GIZ and Nepal's AEPC. Biogas does not have a significant track record in the region and because of this, the necessary technical support is not available. While the project did support a regional trip to Ethiopia, more constant and direct support will be required if the lessons learnt elsewhere are to benefit this Botswana biogas initiative. There are a number of ways that such support might be engaged;
    - Appointment of a [part-time] Chief Technical Advisor (CTA) to the programme. This option was referred to in engagements with UNDP Botswana. This option would enable significant biogas technology and biogas programme experience to support the Botswana biogas initiative. International expertise is advised.
    - Short term consulting support; the programme may choose to contract technical support on a more ad hoc basis through recruitment of short-term consulting services. Again, the use of international consultants is advised.
    - Strategy and Quality Assurance; a further option is the appointment of a strategic advisory and quality assurance consultant. The consultant would be more 'home-based' and provide support on an on-going part-time basis. This might be considered akin to but a less formal version of a CTA.
    - Capacity building; UNDP Botswana may opt to send a Botswana representative on a learning and capacity developing visit to a more established biogas institution or organization. Some of the more prominent options would include the African Biogas Partnership Programme (a partnership between HIVOS and SNV) which has offices in both Kenya and Ethiopia[101]. The Alternative Energy Promotion Centre presents another institutional learning option. They are based in Nepal and are a public sector entity responsible for mainstreaming renewable energy in that country. They are the managing and driving entity of the very successful Nepalese biogas programme[102].
    - Of the options outlined, it is advisable to rely on bringing support into Botswana (CTA, ad hoc consultants, etc.) as opposed to sending representatives out of Botswana to gain such experience. The former resource is already established.
    - One possible challenge is identifying the necessary technical support required. The MTR engaged with a number of international biogas technology experts which the programme is encouraged to engage with in order to identify suitable international consultants. These experts[103] include;
        - Mr Sushim Man Amatya from the Alternative Energy Promotion Centre (AEPC) in Nepal is hugely experienced in biogas from household level to larger more commercial biogas options. The AEPC is a public entity

[101] https://www.africabiogas.org/about-us/
[102] https://www.aepc.gov.np/mission-vision-and-strategy
[103] The individuals mentioned here are well positioned to determine the level of support required and where such support can be found.

designed to support the mainstreaming of renewable energy in Nepal. It has a strong focus on biogas. https://www.aepc.gov.np/

- Mr Saroj Rai; Energy sector leader for SNV in Ethiopia. Saroj was very involved in the Nepal biogas programme and was recruited by SNV to support the African Biogas Initiative headquartered in Ethiopia. SRai@snvworld.org
- Dr Kavita Rai; Kativa currently works as a consultant both in the UK and Nepal. Her clients include DAI and DFID amongst others where she focuses on biogas at both the household and commercial levels. kavita_rai@yahoo.com

Small-scale digesters

- Target of 1,000 units needs to be adjusted. A realistic target needs to be based on consensus between stakeholders. The MTR would suggest in the region of 200 – 300 units within the remaining project implementation period.

- Small-scale units will be sold with a declining amount of financial support. For instance;
  - 30 demonstration units – no customer contribution
  - 30-90 units – 75% subsidy/25% customer contribution
  - 90 - 200 units – 50% subsidy/50% customer contribution
  - 201 – 300 units - 25% subsidy/75% customer contribution

- Assuming the subsidization of the small-scale digesters is agreeable, the units still need to be sold. The project needs to consider a number of sales scenarios. The scenarios differ in the rate of sales including a 'slow, moderate and high' sales scenario. It needs to be acknowledged that no units have been sold on any kind of commercial basis as yet. However, the MTR's position is that greater efforts, shaped around a more strategic focus on *pushing* the technology, should result in greater sales. The three scenarios are outlined in Annex E. A summary of the results include;

Table 16: Summary of sales scenarios

Nature of sales	Over 24 months (Year 3 & 4)		
	Scenario one: Slow	Scenario Two: Moderate	Scenario Three: High
100% subsidy units (demo - 30)	30	30	30
75% subsidy unit (60)	60	60	60
50% subsidy units (Target - 110)	21	78	110
25% subsidy units (on-going)	0	0	36
Total sales (24 months)	111	168	236

- Financial support; given that Nepal still provides a level of financial support to facilitate access to biogas, the Botswana programme needs to carefully consider this. The overall budget would have to be reassessed to make the required funds available. Table 17 below indicates the additional costs to the project if the option mentioned above is implemented. The calculation is based on small-scale digester units at current costs of P20,000 ($1,845)[104]. The almost $55,000 is already factored in since the demonstration units were

[104] This is the 6m3 digester which is the smallest and cheapest of the small-scale options.

approved so the actual addition cost would be between $100,000 - $200,000 depending on the levels of sales achieved over the next 2 years.

Table 17: Cost to project of financial support proposed

Nature of sales	Over 24 months (Year 3 & 4)					
	Scenario 1: Slow	Subsidy	Scenario 2: Moderate	Subsidy	Scenario 3: High	Subsidy
100% subsidy units (demo - 30)	30	$ 55,350.00	30	$ 55,350.00	30	$ 55,350.00
75% subsidy unit (60)	60	$ 83,025.00	60	$ 83,025.00	60	$ 83,025.00
50% subsidy units (Target - 110)	21	$ 19,372.50	78	$ 71,955.00	110	$101,475.00
25% subsidy units (on-going)	0	$ -	0	$ -	36	$ 16,605.00
Total sales (24 months)	111	$157,747.50	168	$210,330.00	236	$256,455.00

- Working with Banks; the current approach to familiarizing banks such as the Botswana Development Corporation (BDC) and the National Development Bank (NDB) with the biogas technology is too passive. While workshops might be effective platforms for introducing new concepts they are inadequate for going much beyond that. The NDB appears the most appropriate finance partner to work with based on mandate and loan size. The PMU is going to have to partner more directly with the NDB, making sure that they interact with the technology on the ground, share results based on the ability of customers to repay loans, share market profiles with the bank, etc. They will need to be convinced over time that the technology works, there is sufficient market demand and there are serviceable financial products. It is proposed, based on reassuring communication with the NDB[105], that a formal partnership or MOU is established which will bring the bank more effectively into the project framework. The relationship needs to be built in steps over time. One way to approach this is bringing the banks in early but not expect any financial involvement until the market matures and the banks' perceived risks are addressed. For instance;

    - Step one: Detailed discussions with banks around the project plans, commercial/credit requirements and the proposed strategy to address the bank's credit risks.
    - Step two: Bank visits demonstration sites and understands technology and potential impact on beneficiaries
    - Step three: Share with bank the re-payment record of partly subsidized small-scale digesters (75%, 50% etc.). Include market intelligence around serviceability of particular household submarkets (small-scale farmers, SMEs, permanent employment, etc.)
    - Step four: Develop a financing plan with the Banks that addresses both bank's credit risk and project financing requirements. This would include subsidy offered by project to deduce the risks on the banks and the cost of capital for households. There are a number of strategies that can be considered in conjunction with the subsidy;
        - This may include other risk mitigating measures such partial credit guarantees. These guarantees (for instance, put forward by UNDP) give banks a greater incentive to lend to SMEs/HHs as the risks associated are somewhat mitigated[106]. If the client defaults, these guarantees would protect the bank. This would be on a 'first loss' basis; i.e. the bank would have an immediate claim against the guarantee in the event of client default.

[105] The NDB is interesting in supporting the Botswana Biogas Programme as it falls within their mandate of supporting socio-economic development.

[106] See, for instance, https://www.worldbank.org/en/news/feature/2018/09/20/unlocking-the-potential-of-smes-with-an-innovative-risk-sharing-financing-solution

        - These partial credit guarantees include 'Second Loss Partial Credit Guarantee (SLPCG)' which is being piloted by the World Bank and which work alongside more conventional 'secured transactions'[107]. For instance, if the banks were to consider moveable assets as collateral, this comes with greater risks to the banks as the market value or legal access to such assets (for instance animals, farm equipment, farm produce, etc.) is not always assured. So the 'first loss' would be covered by the moveable assets failing which, the 'second loss' guarantee scheme would provide security should the bank have problems accessing and/or liquidating these assets.
    - Irrespective of the financial access solution pursued, it must be noted that the UNDP does not have the mandate to make grants directly to private sector organizations. All low-value grants can only be offered to development partners including 'civil society and non-governmental organizations, academic or educational institutions'[108]. Only under 'exceptional circumstances an individual can be a grant recipient when legislation prevents excluded and marginalized groups from organizing and attaining legal status'.
        - If the UNDP Botswana Biogas programme is going to provide grants or direct subsidies to individuals then this would have to be done through the United National Capital Development Fund (UNCDF)[109] through a UN to UN Agency Agreement.

- Improved market awareness and mobilization
    - Demonstration digester beneficiaries have to play a more active role in promoting the technology. They should be required to do [at least] the following;
        - A baseline needs to be established on beneficiary households. Before demonstration units are operational, thermal energy consumption patterns need to be understood. What thermal energy sources are being used, how often are they being used, how are they acquired, what effort/labour is involved and what are the monthly costs?
        - Beneficiary households will have to maintain an energy diary on patterns of gas consumption and the persistence of woodfuel and other thermal energy sources in the household's energy consumption pattern.
        - The diary should include operation and maintenance efforts relating to the running of the biogas digester
        - Beneficiaries will be required to organise *demonstration days* – with the assistance of the PMU where necessary where community groupings can have access to the digester and be informed about its operation and performance.
        - Agree to signage being put in place at their household as well as other strategic areas within the community which will indicate the role of the biogas programme and the location of the demonstration unit.
    - The beneficiary digesters (those not yet allocated/developed) should vary in both design and utility. This is an opportunity to demonstrate different technologies

[107] https://www.worldbank.org/en/news/feature/2018/09/20/unlocking-the-potential-of-smes-with-an-innovative-risk-sharing-financing-solution
[108] UNDP PPM https://popp.undp.org/UNDP_POPP_DOCUMENT_LIBRARY/Public/PPM_Management%20and%20Accountability_Programme%20and%20Project%20Management%20Arrangements.docx
[109] UNCDF is the only UN sister organisation that can grant directly to private sector businesses and individuals.

(although health & safety risks would have to be addressed) and different applications (for instance, gas for cooking, gas for heating, gas to electricity, etc.)

- Research and demonstration
  - Relook at small-scale digester costs;
    - Research on alternative materials
    - Research on alternative digester designs
    - Research on alternative beneficiary contributions (for instance, Nepal beneficiaries contribute labour to digester installation). Currently labour costs in Botswana are P12,000, 60% of the overall costs. A substantial reduction in current labour costs can make a meaningful contribution to reducing overall digester costs. Alternative labour utilization options need to be considered.
  - Digester performance over time. A monitoring framework needs to be established to assess the performance of each of the demonstration units. This could be linked to the beneficiary 'energy diaries'
  - Knowledge platform; establish best practice internationally with regard to managing and supporting national biogas initiatives. A good place to start would be the Nepalese Biogas Programme but closer to home options would include Ethiopia, Kenya and Tanzania. Engagements with GIZ, SNV and DFID[110] would be very useful in this regard.
  - Market intelligence; there is an urgent need to increase the understanding of the market. The different sub-sectors (household, small-business, public services, etc.) need to be identified and product 'packages' tailored to these differing needs. But this needs to be based on effective research and monitoring. The small-scale feasibility study needs to focus more purposefully on understanding the market.
  - Develop business plans based on commercial applications of biogas as part of the tailored 'packages'; for instance, in the case of chicken farming, what are the current heating costs, what would biogas substitution cost, what is the payback, etc.
  - These packages can be produced as brochures which would provide a professional impression and an effective way to communicate information.

Medium-scale digesters

The reality is that the three medium-scale digesters will not be installed and operating by the project close. But this remains an important project component nonetheless. The following recommendations are made:

- The PMU works closely with BMC on advancing the prospects of the entity investing in the proposed biogas digester. Some form of commitment, in writing would be positive in this regard. Further work/research on financing options available to BMC (possibly through the BDC) would be helpful. The PMU needs to push the technology and do what it can to assist and encourage the BMC to go this route. This is the technology push phase.
- The financial and technical feasibility study produced for BMC may provide the template for analysing digester options for both SENN Foods and Kalagadi Breweries. This needs to be explored with the consultants that produced the BMC study.
- Three EIAs to be undertaken based on the 3 technical/financial feasibility studies.
- While not suggesting abandoning the project's interest in the PPPs, IPPs and the REFIT tariff, it is important to uncouple the project's success from these issues. There need to be

[110] The German, Dutch and British development agencies.

other opportunities and platforms for promoting medium scale digesters and which can be leveraged off in terms of assisting with maturing and deepening the markets.

- One such example are biogas digesters proposed at public schools. As indicated in the technology maturation model, the public sector (as opposed to private sector entities such as SENN Foods, etc.) needs to play a stronger role in pushing the biogas sector, particularly at this early stage of its development. There are over 600 primary and secondary government schools[111] in the country. These schools rely on wood and LPG for preparing meals for pupils, a policy that is likely to increase to two meal/day in the near future. This is a great opportunity for government to demonstrate their commitment to biogas, to facilitate the development and gain traction in the medium-scale market and to showcase the technology in a high traffic and important community asset such as a school.
- Working with a private sector organisation such as Kgatleng Beef Producers Association who have expressed an interest in the technology on 'own-consumption' power generation options. Given the constraints around PPPs, IPPs, etc. own consumption may be the only feasible and practical option at this point in time.

Closing comments

The prospects of a biogas initiative such as the '**Promoting production and utilization of biogas from Agro-waste in South Eastern Botswana'** has as much, if not more, chance of succeeding in Botswana than any other Southern African country. While there is very little traction with biogas in the region, Botswana has the right 'fundamentals' in place to back such an initiative. Favourable conditions include sufficient volumes of agro-waste, an increasingly responsible [emerging] waste management policy, lack of access to modern energy services in rural areas, an ecological and eco-tourism policy that values sustainability, an emerging policy acknowledgement of off-grid energy access, amongst others.

While the prospects of success are reasonable there are a number of critical observations that need to guide the programme going forward;

- The Project Document overstated the up-front potential of biogas in the country. While the longer-term prospects might agree with the numerical targets (1,000 small-scale digesters, etc.) such targets will not be achieved within the current project framework. While project management may account for a level of under-performance, these targets were never realistic regardless.
- The implementation approach from the mid-term point onwards needs to better internalise the manner in which technologies mature. There needs to be a greater *push* of the technology rather than waiting for market *pull*.
- Better use needs to be made of international expertise. Nepalese based organisations, GIZ, DFID SNV, amongst others have essential practical programme experience which this biogas initiative needs to benefit from.
- The Promoting production and utilization of biogas from Agro-waste in South Eastern Botswana' will require an extension of at least one year if it is to lay the necessary foundations for a sustainable, commercial biogas industry in Botswana. Principal motivations for the extension include;
    - There needs to be sufficient traction and progress made before the supportive project framework is concluded/removed. If the project formally concludes prior to there being sufficient progress made, the risks of project failure will be enhanced.

[111] Personal communications with Ms Oarabile Serumola

The foundations need to be in place and the market mobilised before direct project support can be confidently withdrawn.

- The extent to which the MTR's recommendations are implemented will require time to operationalise. It may appear more strategically agile to integrate these recommendations in the form of 'running repairs', making the adjustments while the project is still operating. However, it may be advisable to if not suspend, at least reduce project activities while the PMU and PSC engage with the recommendations and agree on their implementation going forward. Consensus and alignment is important. As suggested, this may take some time (2 – 3 months possibly) which will place further pressure on the project's ability to effectively conclude within current timeframes.

Annex A: Ratings Scales

Ratings for Progress Towards Results: (one rating for each outcome and for the objective)		
6	Highly Satisfactory (HS)	The objective/outcome is expected to achieve or exceed all its end-of-project targets, without major shortcomings. The progress towards the objective/outcome can be presented as "good practice".
5	Satisfactory (S)	The objective/outcome is expected to achieve most of its end-of-project targets, with only minor shortcomings.
4	Moderately Satisfactory (MS)	The objective/outcome is expected to achieve most of its end-of-project targets but with significant shortcomings.
3	Moderately Unsatisfactory (MU)	The objective/outcome is expected to achieve its end-of-project targets with major shortcomings.
2	Unsatisfactory (U)	The objective/outcome is expected not to achieve most of its end-of-project targets.
1	Highly Unsatisfactory (HU)	The objective/outcome has failed to achieve its midterm targets, and is not expected to achieve any of its end-of-project targets.

Ratings for Project Implementation & Adaptive Management: (one overall rating)		
6	Highly Satisfactory (HS)	Implementation of all seven components – management arrangements, work planning, finance and co-finance, project-level monitoring and evaluation systems, stakeholder engagement, reporting, and communications – is leading to efficient and effective project implementation and adaptive management. The project can be presented as "good practice".
5	Satisfactory (S)	Implementation of most of the seven components is leading to efficient and effective project implementation and adaptive management except for only few that are subject to remedial action.
4	Moderately Satisfactory (MS)	Implementation of some of the seven components is leading to efficient and effective project implementation and adaptive management, with some components requiring remedial action.
3	Moderately Unsatisfactory (MU)	Implementation of some of the seven components is not leading to efficient and effective project implementation and adaptive, with most components requiring remedial action.
2	Unsatisfactory (U)	Implementation of most of the seven components is not leading to efficient and effective project implementation and adaptive management.
1	Highly Unsatisfactory (HU)	Implementation of none of the seven components is leading to efficient and ineffective project implementation and adaptive management.

Ratings for Sustainability: (one overall rating)		
4	Likely (L)	Negligible risks to sustainability, with key outcomes on track to be achieved by the project's closure and expected to continue into the foreseeable future
3	Moderately Likely (ML)	Moderate risks, but expectations that at least some outcomes will be sustained due to the progress towards results on outcomes at the Midterm Review
2	Moderately Unlikely (MU)	Significant risk that key outcomes will not carry on after project closure, although some outputs and activities should carry on
1	Unlikely (U)	Severe risks that project outcomes as well as key outputs will not be sustained

Annex B: Stakeholders engaged

Stakeholders engaged	**Stakeholder classification**
Ms Jacinta Barrins	UNDP Resident Representative
Mr Innocent Magole	UNDP Environment and Climate Change Programme Analyst
Mr Bame Mannathoko	UNDP M &E Specialist
Ms Ludo Moroka	Biogas Project Manager
Mr Baboloki Autlwetse	Biogas Project Manager
Dr Sebusang Sebusang	BITRI PSC Member
Dr Edward Rakgati	BITRI PSC Member
Dr Oduetse Koboto	MENT PSC Member
Ms Oarabile Serumola	DWMPC PSC Member
Mr Khulekani Mpofu	GEF Focal point
Ms Dorcus Mpedi and Ms Tuduetso Ramokate	MLGRD PSC Member
Mr James Molenga, Mr Setshedi Ntsowe and Mr Themba Gift Modise	Dept of Energy (PSC Member)
Mr Mabitso Setshabelo	South East District Council (PSC Member)
Mr Benjamin Mothulwa	Mason Trainer (Tswelelopele Brigade)
Mr Modiri Garenamotse and Mr Bosiela Saudu	Botswana Meat Commission (BMC) PSC member
Mr Kenneth Syanjibu	Botswana Power Corporation (BPC) PSC Member
Ms Banabotlhe Mooketsi	Gaborone City Council
Mr Levy Chezuva	Jwaneng Town council
Mr Focus Galebotse	Southern District Council PSC Member
Ms Brenda Moruti and Mr John Morobane	National Development Bank
Kgatleng Beef Producers Association	Potential Beneficiary
Ms Faith Gabonthone	Demo digester beneficiary- Moshupa
Mr T. Matale	Demo digester beneficiary- Moshupa
Mr Themba Peloyakgomo	Demo digester beneficiary – Otse
Ms Kefilwe Atamelang Matale	Trained Mason
Ms Obonetse Ramogale	Trained Mason
Mr Oaitse Moselakgoko	Trained Masons

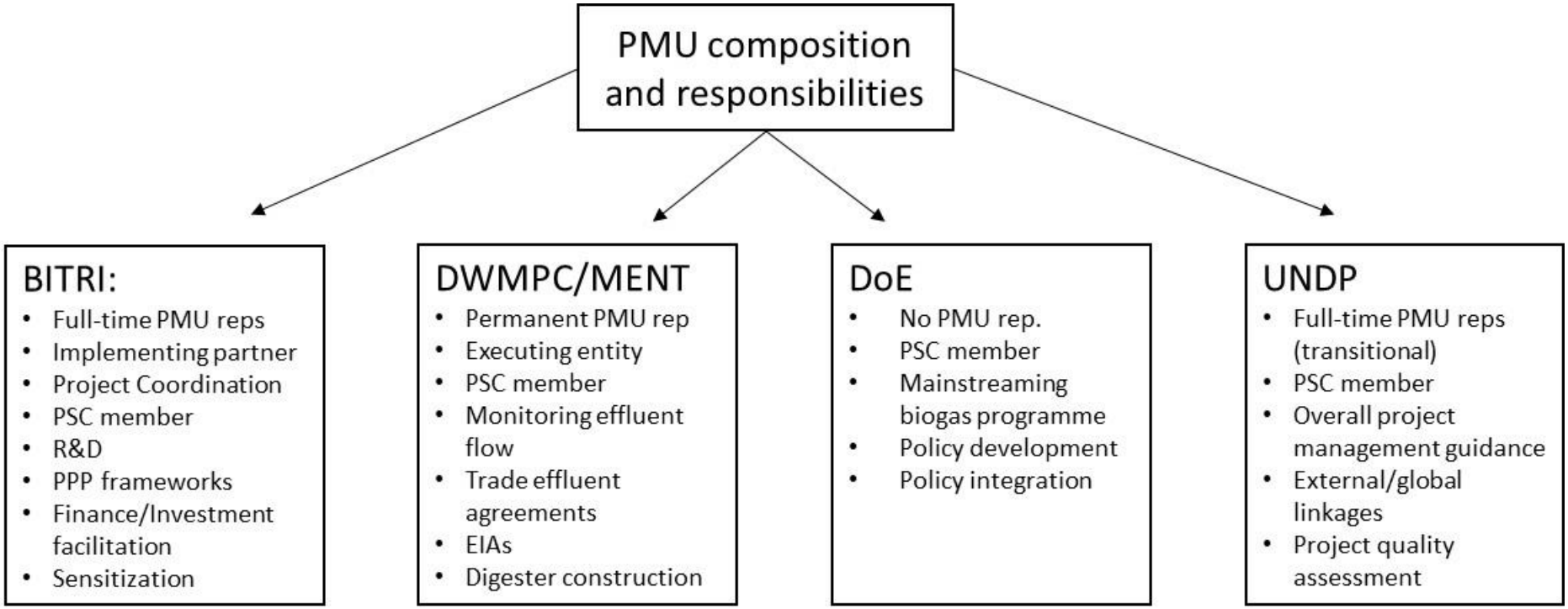
Annex C: Project outputs and management responsibility

Outputs	Responsible party
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.	BITRI
1.2 Framework agreement for public---private partnerships (PPPs) in the waste sector adopted and disseminated.	BITRI
1.3 Training conducted for all relevant stakeholders on the new guidelines and PPP framework agreement (1.1. and 1.2)	BITRI
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.	MENT
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	MENT
1.6 Review of enforcement practices and support towards enforcement of pollution prevention laws, mainstreamed into relevant organizations' activities: e.g. Councils or DWMPC.	MENT
1.7 Corrective EIA measures implemented	BITRI
1.8 Financial institutions trained on best practice in assessing and financing agro-waste projects through BITRI	BITRI
1.9 Dedicated investment facilitation platform on low-carbon waste-utilization technologies established at BITRI, and operational with independent budget	BITRI
1.10 Level playing field created for all energy providers and REFIT in place	BITRI with DoE
1.11 Robust research undertaken for the biogas technology	BITRI
1.12 Training conducted for training institution facilitators and masons for small scale digester construction	BITRI

Outcomes	Responsible party
2.1 Sensitization campaign conducted with district councils, stakeholder and community groups in targeted biogas plant sites	BITRI
2.2 Feasibility study undertaken for small-scale biogas digester component	BITRI
2.3 Business plan developed for the three potential medium-scale biogas sites near agro-industrial plants with potential off-take uses analyzed.	BITRI
2.6 Environmental impact assessment of selected biogas sites completed	MENT
2.9 Construction and commissioning of small scale biogas plants	MENT
(2.9) Construction and commissioning of medium scale biogas plants	MENT

Outcome	Responsible party
3.8 Partnership established between biogas plant operators and selected district councils for supply and purchase of biogas from the plants.	BITRI
3.9 District council staff trained on the biogas-utilization technologies selected for investment, including operations and maintenance.	BITRI

Annex D: PMU composition and responsibilities



Annex E: Sales scenarios to consider

Slow sales

Type of sale	Months (Year 3 & 4)																								Units sold
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
100% subsidy units (demo - 30)	24	3	3																						30
75% subsidy unit (60)				0	1	1	2	3	3	4	4	5	5	6	6	7	8	5							60
50% subsidy units (Target - 110)																			1	2	3	4	5	6	21
25% subsidy units (on-going)																									0
Total																									**111**
Masons # - 4 persons/site					4	4	8	12	12	16	16	20	20	24	24	28	32	20	4	8	12	16	20	24	

Moderate sales

Type of sale	Months (Year 3 & 4)																								Units sold
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
100% subsidy units (demo - 30)	24	3	3																						30
75% subsidy unit (60)				1	2	3	4	5	6	8	9	11	12												60
50% subsidy units (110)														1	2	5	6	7	8	9	10	10	10	10	78
25% subsidy units (on-going)																									0
Total																									**168**
Masons # - 4 persons/site					8	12	16	20	24	32	36	44	48	4	8	20	24	28	32	36	40	40	40	40	

High sales

Type of sale	Months (Year 3 & 4)																								Units sold
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
100% subsidy units (demo - 30)	24	6																							30
75% subsidy unit (60)			5	6	12	12	12	12	12																60
50% subsidy units (110)										4	6	8	12	13	13	13	13	14	14						110
25% subsidy units (on-going)																				2	4	8	10	12	36
Total																									**236**
Masons # - 4 persons/site			20	24	48	48	48	48	48	16	24	32	48	52	52	52	52	56	56	8	16	32	40	48	

Annex F: MTR SCOPE OF WORK, RESPONSIBILITIES AND DESCRIPTION OF THE PROPOSED ANALYTICAL WORK

The MTR team will assess the following four categories of project progress.

i. Project Strategy

Project design:

- Review the problem addressed by the project and the underlying assumptions. Review the effect of any incorrect assumptions or changes to the context to achieving the project results as outlined in the Project Document.
- Review the relevance of the project strategy and assess whether it provides the most effective route towards expected/intended results. Were lessons from other relevant projects properly incorporated into the project design?
- Review how the project addresses country priorities. Review country ownership. Was the project concept in line with the national sector development priorities and plans of the country?
- Review decision-making processes: were perspectives of those who would be affected by project decisions, those who could affect the outcomes, and those who could contribute information or other resources to the process, taken into account during project design processes?
- Review the extent to which relevant gender issues were raised in the project design.
- If there are major areas of concern, recommend areas for improvement.

Results Framework/Logframe:

- Undertake a critical analysis of the project's logframe indicators and targets, assess how "SMART" the midterm and end-of-project targets are (Specific, Measurable, Attainable, Relevant, Time-bound), and suggest specific amendments/revisions to the targets and indicators as necessary.
- Are the project's objectives and outcomes or components clear, practical, and feasible within its time frame?
- Examine if progress so far has led to or could in the future catalyse beneficial development effects (i.e. income generation, gender equality and women's empowerment, improved governance etc...) that should be included in the project results framework and monitored on an annual basis.
- Ensure broader development and gender aspects of the project are being monitored effectively. Develop and recommend SMART 'development' indicators, including sex-disaggregated indicators and indicators that capture development benefits.

ii. Progress Towards Results

Progress towards Outcomes Analysis:

Review the logframe indicators against progress made towards the end-of-project targets using the Progress Towards Results Matrix and following the *Guidance For Conducting Midterm Reviews of UNDP-Supported, GEF-Financed Projects*; colour code progress in a "traffic light system" based on the level of progress achieved; assign a rating on progress for each outcome; make recommendations from the areas marked as "Not on target to be achieved" (red). (See Annex 2)

In addition to the progress towards outcomes analysis:

- Compare and analyse the GEF Tracking Tool at the Baseline with the one completed right before the Midterm Review.
- Identify remaining barriers to achieving the project objective in the remainder of the project.
- By reviewing the aspects of the project that have already been successful, identify ways in which the project can further expand these benefits.

iii. Project Implementation and Adaptive Management

Management Arrangements:

- Review overall effectiveness of project management as outlined in the Project Document. Have changes been made and are they effective? Are responsibilities and reporting lines clear? Is decision-making transparent and undertaken in a timely manner? Recommend areas for improvement.
- Review the quality of execution of the Executing Agency/Implementing Partner(s) and recommend areas for improvement.
- Review the quality of support provided by the GEF Partner Agency (UNDP) and recommend areas for improvement.

Work Planning:

- Review any delays in project start-up and implementation, identify the causes and examine if they have been resolved.
- Are work-planning processes results-based? If not, suggest ways to re-orientate work planning to focus on results?
- Examine the use of the project's results framework/logframe as a management tool and review any changes made to it since project start.

Finance and co-finance:

- Consider the financial management of the project, with specific reference to the cost-effectiveness of interventions.
- Review the changes to fund allocations as a result of budget revisions and assess the appropriateness and relevance of such revisions.
- Does the project have the appropriate financial controls, including reporting and planning, that allow management to make informed decisions regarding the budget and allow for timely flow of funds?
- Informed by the co-financing monitoring table to be filled out, provide commentary on co-financing: is co-financing being used strategically to help the objectives of the project? Is the Project Team meeting with all co-financing partners regularly in order to align financing priorities and annual work plans?

Project-level Monitoring and Evaluation Systems:

- Review the monitoring tools currently being used: Do they provide the necessary information? Do they involve key partners? Are they aligned or mainstreamed with national systems? Do they use existing information? Are they efficient? Are they cost-effective? Are additional tools required? How could they be made more participatory and inclusive?
- Examine the financial management of the project monitoring and evaluation budget. Are sufficient resources being allocated to monitoring and evaluation? Are these resources being allocated effectively?

Stakeholder Engagement:

- Project management: Has the project developed and leveraged the necessary and appropriate partnerships with direct and tangential stakeholders?
- Participation and country-driven processes: Do local and national government stakeholders support the objectives of the project? Do they continue to have an active role in project decision-making that supports efficient and effective project implementation?
- Participation and public awareness: To what extent has stakeholder involvement and public awareness contributed to the progress towards achievement of project objectives?

Reporting:

- Assess how adaptive management changes have been reported by the project management and shared with the Project Board.
- Assess how well the Project Team and partners undertake and fulfil GEF reporting requirements (i.e. how have they addressed poorly-rated PIRs, if applicable?)
- Assess how lessons derived from the adaptive management process have been documented, shared with key partners and internalized by partners.

Communications:

- Review internal project communication with stakeholders: Is communication regular and effective? Are there key stakeholders left out of communication? Are there feedback mechanisms when communication is received? Does this communication with stakeholders contribute to their awareness of project outcomes and activities and investment in the sustainability of project results?
- Review external project communication: Are proper means of communication established or being established to express the project progress and intended impact to the public (is there a web presence, for example? Or did the project implement appropriate outreach and public awareness campaigns?)
- For reporting purposes, write one half-page paragraph that summarizes the project's progress towards results in terms of contribution to sustainable development benefits, as well as global environmental benefits.

iv. Sustainability

- Validate whether the risks identified in the Project Document, Annual Project Review/PIRs and the ATLAS Risk Management Module are the most important and whether the risk ratings applied are appropriate and up to date. If not, explain why.
- In addition, assess the following risks to sustainability:

Financial risks to sustainability:

- What is the likelihood of financial and economic resources not being available once the GEF assistance ends (consider potential resources can be from multiple sources, such as the public and private sectors, income generating activities, and other funding that will be adequate financial resources for sustaining project's outcomes)?

Socio-economic risks to sustainability:

- Are there any social or political risks that may jeopardize sustainability of project outcomes? What is the risk that the level of stakeholder ownership (including ownership by governments and other key stakeholders) will be insufficient to allow for the project outcomes/benefits to be sustained? Do the various key stakeholders see that it is in their interest that the project benefits continue to flow? Is there sufficient public / stakeholder awareness in support of the long-term objectives of the project? Are lessons learned being documented by the Project Team on a continual basis and shared/ transferred to appropriate parties who could learn from the project and potentially replicate and/or scale it in the future?

Institutional Framework and Governance risks to sustainability:

- Do the legal frameworks, policies, governance structures and processes pose risks that may jeopardize sustenance of project benefits? While assessing this parameter, also consider if the required systems/ mechanisms for accountability, transparency, and technical knowledge transfer are in place.

Environmental risks to sustainability:

- Are there any environmental risks that may jeopardize sustenance of project outcomes?

Conclusions & Recommendations
The MTR team will include a section of the report setting out the MTR's evidence-based conclusions, in light of the findings.[112]

Recommendations should be succinct suggestions for critical intervention that are specific, measurable, achievable, and relevant. A recommendation table should be put in the report's executive summary

The MTR team should make no more than 15 recommendations total.

Ratings
The MTR team will include its ratings of the project's results and brief descriptions of the associated achievements in a *MTR Ratings & Achievement Summary Table* in the Executive Summary of the MTR report. See Annex 3 for ratings scales. No rating on Project Strategy and no overall project rating is required.

[112] Alternatively, MTR conclusions may be integrated into the body of the report.

Annex G: MTR stakeholder consultations

BIOGAS – SOUTH EAST BOTSWANA												
DISTRICT AND LOCAL LEVEL MEETINGS												
Time	Activity	Day 1 Sun 14th	Day 2 Mon 15th	Day 3 Tue 16th	Day 4 Wed 17th	Day 5 Thu 18th	Day 19th to 22nd	Day 6 Tue 23rd	Day 7 Wed 24th	Day 8 Thu 25th	Day 9 Fri 26th
A	Travel to Gaborone	Sun									
M	MTR inception meeting with Project Management Unit		Mon								
M	Meeting with Project Management Unit (Ms Jacinta Barrins, Dr. Oduetse Koboto/Mr Innocent Magole, Mr Bame Mannathoko)		Mon								
A	Meeting with Project Management Unit (Ms L Moroka, Mr Autlwetse, Dr Sebusang, Dr Rakgati)										
M	Meeting with **GEF Focal point, Ministry of Local Government & Rural Development, GCC, Dept of Energy, Botswana Energy Regulatory Authority (BERA**)			Tue							
A	Meet with **District Council representatives (South East),** Meet with **Trainer (Tswelelopele Brigade),** Visit **digester beneficiary**										
M	Meeting with **Project Beneficiaries** (Botswana Meat Commission), Meet **small scale beneficiary (Otse**), Meet with **Trainer (Lobatse Brigade)**				Wed						
A	Meet with **District Council representatives (Southern),** Visit **digester beneficiary Moshupa**										
M	Meet with **BPC** then **District Council representatives** (Kgatleng), Meet **Trainer** (Kgatleng brigade) and Farmers					Thu					
A	Travel back to RSA										
GOOD FRIDAY AND EASTER HOLIDAYS											
M	Meeting with **Ministry of Environment**, Meeting with **Banking Institution**, Meeting with **CITF**, Operation companies							Tue			
A	Meeting with **KBL**										
M	Meet with **District Council representatives (Jwaneng)**								Wed		
A	Meeting with **Masons**										
M-A	Review of consultation findings and additional literature and preparation for debriefing									Thu	
M	**End of Mission debriefing** and Presentation of preliminary findings of Biogas to UNDP, MENT, DWMPC, DEA, BITRI										Fri

Annex H: List of documents reviewed

Project Document

- Promoting Production and Utilization of Biogas from Agro-waste in South Eastern Botswana

Progress reports:

- Bio-methane Inception Report
- GEF Projects PSC Report: Biogas Project July 2017
- GEF Projects PSC Report: Biogas Project Sept 2017
- GEF Projects PSC Report: Biogas Project Dec 2017
- GEF Projects PSC Report: Biogas Project March 2018
- GEF Projects PSC Report: Biogas Project July 2018
- GEF Projects PSC Report: Biogas Project Sept 2018
- GEF Projects PSC Report: Biogas Project Dec 2018
- GEF Projects PSC Report: Biogas Project March 2019

Annual Work plans

- Annual Workplan Biogas 2017
- Annual Workplan Biogas 2018
- Annual Workplan Biogas 2019

Project Implementation Review

- 2018 – GEF – PIR – PIMS5299 – GEFID5628

Project Steering Committee Minutes

- Minutes - 27 July 2017
- Minutes – 13 September 2017
- Minutes – 13 December 2017
- Minutes – 21 March 2018
- Minutes – 03 July 2018
- Minutes – 05 September 2018

Other reports

- BMC Feasibility study final report January 2019
- Final Capacity Building Consultancy Report
- Final Module Sludge Management
- Final Module Wastewater Pre-treatment methods
- Final WUC training report
- Mason training curricular
- Draft report: Identification of 1,000 potential participants for the project 'Utilisation of bio-methane in South Eastern Botswana'