



**REQUEST FOR CEO ENDORSEMENT**  
**PROJECT TYPE: Full-sized Project**  
**TYPE OF TRUST FUND: GEF Trust Fund**

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**PART I: PROJECT INFORMATION**

<b>Project Title: Promoting production and utilization of biogas from agro-waste in South-Eastern Botswana</b>			
Country(ies):	Botswana	GEF Project ID: <sup>1</sup>	5628
GEF Agency(ies):	UNDP	GEF Agency Project ID:	5299
Other Executing Partner(s):	Ministry of Environment, Wildlife and Tourism; Botswana Institute for Technology, Research and Innovation (BITRI),	Submission Date:	22 April, 2016
GEF Focal Area (s):	Climate Change	Project Duration(Months)	48 months
Name of Parent Program (if applicable): ➤ For SFM/REDD+ <input type="checkbox"/> ➤ For SGP <input type="checkbox"/> ➤ For PPP <input type="checkbox"/>	N/A	Project Agency Fee (\$):	250,069

**A. FOCAL AREA STRATEGY FRAMEWORK**<sup>2</sup>

<b>Focal Area Objectives</b>	<b>Expected FA Outcomes</b>	<b>Expected FA Outputs</b>	<b>Trust Fund</b>	<b>Grant Amount (\$)</b>	<b>Co-financing (\$)</b>
CCM Objective 3: Promote investment in renewable energy technologies	Favourable policy and regulatory environment created for renewable energy investments	Renewable energy policy and regulation in place	GEF TF	1,997,300	9,206,026
	Investment in renewable energy technologies increased	Renewable energy capacity installed	GEF TF	635,000	7,477,974
<b>Total project costs</b>				2,632,300	16,684,000

<sup>1</sup>Project ID number will be assigned by GEFSEC.

<sup>2</sup> Refer to the [Focal Area Results Framework and LDCE/SCCF Framework](#) when completing Table A.

## B. PROJECT FRAMEWORK

Project Objective: To facilitate low-carbon investments and public-private partnerships in the production and utilisation of biogas from agro-waste in the districts of South-Eastern Botswana.						
Project Component	Grant Type	Expected Outcomes	Expected Outputs	Trust Fund	Grant Amount (\$)	Confirmed Co-financing (\$)
1. Institutional strengthening and capacity building for biogas investment and improved agro-waste management and regulation	TA	<p>Increased capacity of Government, private sector and community stakeholders to develop, finance and implement PPPs in the agro-waste sector.</p> <p>Increased capacity of Government authorities to properly monitor and enforce waste management regulations in the agro-industrial sector. (Outputs 1.1-1.7)</p> <p>Autonomous support systems in place for replication and scale-up of agro-waste technologies post-project. (Outputs 1.8-1.10)</p>	<p>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.</p> <p>1.2 Framework agreement for public-private partnerships (PPPs) in the waste sector adopted and disseminated.</p> <p>1.3 Training conducted for all relevant stakeholders on the new guidelines and PPP framework agreement (1.1. and 1.2)</p> <p>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.</p> <p>1.5 Support provided</p>	GEF TF	458,600	3,622,600

			<p>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.</p> <p>1.6 Review of enforcement practices and support towards enforcement of pollution prevention laws, mainstreamed into relevant organisations' activities: e.g. Councils and DWMPC.</p> <p>1.7 Corrective EIA measures implemented.</p> <p>1.8 Financial institutions trained on best practices in assessing and financing agro-waste projects through BITRI.</p> <p>1.9 Dedicated investment facilitation platform on low-carbon waste-utilisation technologies established at BITRI, and operational with independent budget.</p> <p>1.10 Level playing field created for all energy providers and REFIT in place.</p>			
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2. Facilitation and establishment of the first biogas plants in Botswana	TA	Increased investment in clean-energy technologies and low-carbon practices in the agro-waste sector.	2.1 Sensitisation campaign conducted with district councils, stakeholder and community groups in targeted biogas plant sites	GEF TF	1,142,000	8,252,974
	INV		<p>2.2 Feasibility<sup>3</sup> study conducted for small-scale biogas digester component.</p> <p>2.3 Business plan developed for the three potential medium-scale biogas sites near agro-industrial plants with potential off-take uses analysed.</p> <p>2.4 Feasibility study undertaken on centralised large-scale biogas plant with bio-methane upgrade.</p> <p>2.5 Environmental impact assessment of selected biogas sites (medium-scale) completed.</p> <p>2.6 Tender launched for operators of the 3 medium-scale biogas plants<sup>4</sup>.</p> <p>2.7 Legal establishment of biogas operators based on public-private partnerships and concessional agreements with chosen agro-</p>	GEF TF		

<sup>3</sup> The terms feasibility and market study are used interchangeably. Both refer to a study to determine a detailed overview of the potential for small-scale biogas and the roles and responsibilities of stakeholders and the programme modalities.

<sup>4</sup> At least one company (and probably three) is identified to take on responsibility to operate the digesters through a tender process.

			<p>industrial partners (including guaranteed supply of substrate and purchase agreement for supply of biogas).</p> <p>2.8 Technology agreement signed on North-South or South-South cooperation with selected international biogas equipment providers.</p> <p>2.9 Construction and commissioning of 1,000 small-scale and 3 medium-scale biogas plants.</p>			
3. Facilitation and establishment of appropriate biogas utilisation platforms in at least two districts of South-Eastern Botswana	TA	Increased investment in less GHG-intensive energy systems using biogas.	<p>3.1 Partnership established between biogas plant operators and selected district councils for supply and purchase of biogas from the plants.</p> <p>3.2 District council staff trained on the biogas-utilisation technologies selected for investment, including operations and maintenance.</p> <p>3.3 Monitoring scheme in place to track fuel savings (from switch to biogas) and GHG-emission reductions.</p> <p>3.4 Contracts signed for performance-based incentives, monitored and made available to biogas</p>	GEF TF	911,700	4,015,426

			owners.			
				Subtotal		2,512,300
				Project management Cost (PMC) <sup>5</sup>	GEF TF	120,000
				<b>Total project costs</b>		<b>2,632,300</b>
						15,891,000
						793,000
						16,684,000

### C. SOURCES OF CONFIRMED CO-FINANCING FOR THE PROJECT BY SOURCE AND BY NAME (\$)

Please include letters confirming co-financing for the project with this form

Sources of Co-financing <sup>6</sup>	Name of Co-financier	Type of Co-financing	Amount (\$)
National Government	Ministry of Environment, Wildlife and Tourism	In-kind	75,000
National Government	Department of Waste Management and Pollution Control (DWMPC)	Cash/Grant	309,000

<sup>5</sup> PMC should be charged proportionately to focal areas based on focal area project grant amount in Table D below.

<sup>6</sup> Potential users of the small-scale and medium-scale biogas digesters – piggeries, cattle farms, animal feedlots, households, Councils, etc. – are expected to invest in the installation of the technology themselves. As the identities of the digester users will not be known until the end of Year 1 of project implementation, co-finance letters cannot be provided at this stage and, as a conservative measure, the expected co-finance is not included in the project budget. Nonetheless, it is fully expected to materialise, is likely to be approximately \$12 million in total, and will be reported in PIRs accordingly. The indicators for Component 2 ('Number of biogas digesters constructed and in use'; 'Total capacity (in m<sup>3</sup>) of installed biogas digesters constructed and energy generated') and Component 3 ('Total investment in biogas technology', with a target of 'At least three financial institutions have incorporated the financing of biogas technology in their national portfolios') are specifically designed to capture the digester take-up and investment. The Botswana Meat Cooperation (BMC) has already set aside funds for the investment in a medium-scale biogas digester and its commitment is supported by a letter of co-finance. Barclays Bank of Botswana and the Botswana Development Cooperation (BDC) have indicated that they will offer loans for bankable business proposals relating to the construction of small-scale and medium-scale biogas digesters. BDC will provide loans or equity to private companies of up to \$4.6m, at 11.7% per annum, with a bankable business plan as the main requirement. Barclays will provide loans to private companies of up to \$2m, at 9% per annum, again with a bankable business plan as the main requirement. Furthermore, Insight Consulting, a locally-based business accelerator, has committed to connecting a private Botswanan company with European or American financiers for biogas plant construction and will help to arrange a loan with an interest rate of between 5-10% per annum. All three institutions have long-standing track records in Botswana.

National Government	Department of Waste Management and Pollution Control (DWMPC)	In-kind	1,150,000
Private Sector	Botswana Development Corporation	Cash/Grant	4,600,000
Private Sector	Botswana Meat Commission	Cash/Grant	3,000,000
Private Sector	Botswana Meat Commission	In-kind	7,150,000
National Government	BITRI	In-kind	200,000
GEF Agency	UNDP	Cash	200,000
<b>Total Co financing</b>			<b>16,684,000</b>

#### D. TRUST FUND RESOURCES REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY<sup>1</sup>

GEF Agency	Type of Trust Fund	Focal Area	Country Name/ Global	(in \$)		
				Grant Amount (a)	Agency Fee (b) <sup>2</sup>	Total c=a+b
UNDP	GEF TF	Climate Change	Botswana	2,632,300	250,069	2,882,369
<b>Total Grant Resources</b>				<b>2,632,300</b>	<b>250,069</b>	<b>2,882,369</b>

<sup>1</sup> In case of a single focal area, single country, single GEF Agency project, and single trust fund project, no need to provide information for this table. PMC amount from Table B should be included proportionately to the focal area amount in this table.

<sup>2</sup> Indicate fees related to this project.

#### F. CONSULTANTS WORKING FOR TECHNICAL ASSISTANCE COMPONENTS:

Component	Grant Amount (\$)	Co-financing (\$)	Project Total (\$)
International Consultants	301,000	12,000	313,000
National/Local Consultants	98,700	15,500	114,200

#### G. DOES THE PROJECT INCLUDE A “NON-GRANT” INSTRUMENT? NO

(If non-grant instruments are used, provide in Annex D an indicative calendar of expected reflows to your Agency and to the GEF/LDCF/SCCF/NPIF Trust Fund).

## PART II: PROJECT JUSTIFICATION

### A. DESCRIBE ANY CHANGES IN ALIGNMENT WITH THE PROJECT DESIGN OF THE ORIGINAL PIF<sup>7</sup>

#### Summary of Original PIF

1. The project PIF identified the desirability of constructing a 7 MW agro-waste bio-methane production facility.
2. This proposed biogas plant design would have used substrates such as abattoir waste, feedlot waste and poultry manure from various sources to anaerobically produce biogas which would have been purified into bio-methane (CH<sub>4</sub> > 98%).
3. Bio-methane produced by the plant would then have been compressed into high-pressure cylinders as compressed bio-methane gas (CBG) and sold as a substitute for LPG and diesel.

<sup>7</sup> For questions A.1 –A.7 in Part II, if there are no changes since PIF and if not specifically requested in the review sheet at PIF stage, then no need to respond, please enter “NA” after the respective question.

4. The PIF assumed co-financing from Gaborone City Council, South East District Council, Lobatse Town Council, Kweneng District Council and Kgatleng District Council towards the proposed biogas project.

### **Evolution of Concept**

The PPG team undertook a fact-finding mission in Gaborone and with surrounding Councils in September 2014 and a stakeholder meeting was held to present the concept, confirm the roles of the key stakeholders in the project and solicit support from the stakeholders with regard to sharing information during the pre-feasibility study and situation analysis stages. The workshop also served to create awareness of biogas and bio-methane among stakeholders who will play a major role in implementation of the project.

After meeting with all of the key stakeholders and assessing the outcomes of the detailed baseline analysis, the project team's conclusion was that some of the financial and operational commitments expressed by stakeholders at the time of the PIF had changed and were no longer valid. At the time of the stakeholder consultation, the District Councils could no longer commit to the originally-envisaged US\$ 5 million co-finance and the US\$ 1.3 million pledged by BioSys could also not be confirmed.

Stakeholders indicated that the proposed 7 MW bio-methane plant was a welcome prospect for Botswana but was nonetheless over-ambitious as a first-step and should, instead, be reached via a number of intermediate technological steps. Moreover, there was a strong preference to work with local stakeholders at the District Council and Municipal level, reflecting Councils' interest in installing biogas digesters in school kitchens to reduce the costs associated with using LPG. Stakeholders were in agreement that the other two project components – on institutional strengthening and waste management and utilisation platforms – remain relevant.

A revised project strategy, aligned with the evolved expectations and aspirations of Government, District Councils and Municipalities, was developed by the project team and presented to the stakeholders at a second stakeholder meeting (November 2014) for input, to obtain overall consensus and secure buy-in from stakeholders. Also, the willingness to invest by the private sector (agro-industry) was further explored.

### **Original Proposal**

- Construction of a single 7 MW centralised biogas demonstration plant with methane upgrading facility.
- Approximately US\$ 15 million capital investment requirement.
- Proposed \$2.6 million GEF grant for technical assistance component.

### **Current Proposal**

- Construction of 1,000 small-scale biogas digesters<sup>8</sup> to cater for smaller quantities of agro-waste streams. Approximately US\$ 2 million capital investment by small-scale agro-industrial firms, schools and other institutions, and households for small-scale biogas sector development.
- Construction of three 1 MW decentralised medium-scale biogas digesters<sup>9</sup>. Approximately US\$ 3 million capital investment for each digester.
- Proposed \$2.6 million GEF grant for technical assistance component.
- Given the refocusing of the project on biogas rather than (expensive, technically-sophisticated) purification into bio-methane, the title of the project has been adjusted ('bio-methane' has been replaced by 'biogas').

The objective of Component 2 ('Facilitation and establishment of the first biogas plants in Botswana') is to develop capacity at national and district levels to facilitate the development of a sector for the construction of small-scale biogas digesters. These small-scale biogas digesters (4-300 m<sup>3</sup>) will utilise agricultural waste streams

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<sup>8</sup> Small-sized biogas digesters range from 4-300 m<sup>3</sup> and are operated by small-scale agro-business, small-scale livestock producers, households with dairy and or beef, schools and other institutions. **The cost of a small-sized digester ranges from US\$ 800 (6 m<sup>3</sup>) to US\$50,000 (300 m<sup>3</sup>).**

<sup>9</sup> Medium-sized biogas digesters range from 300-5,000 m<sup>3</sup> and are operated by agro-industry in partnership with Councils and additional interested stakeholders. **The cost of a medium-sized digester ranges from US\$ 1.5-3.5 million (with a central indicative estimate of US\$ 3 million), depending on the design, size and customer requirements.**



as feedstock. These will include waste streams from small-scale farms (primarily cow dung), medium-scale cattle farms (cow dung), small-scale abattoirs (slaughter house waste and cow dung), school kitchens (kitchen waste) and small-scale processing industries (mixed waste streams). The biogas will be used for direct heating, power generation through portable generator sets, and production and utilisation of bio-slurry. The preferred technology is the fixed dome biogas model, which can be constructed by local masons and construction companies.

The waste streams from larger agro-processing industrial plants<sup>10</sup> (approximately 15-35 tonnes per day) will serve as feedstock for medium-scale biogas digesters of approximately 5,000 m<sup>3</sup> capacity each, with an installed electric generation capacity of 1 MW each. In addition, waste streams collected by the Councils will constitute additional feedstock. In each case, the agro-industrial firm and the relevant Council will enter into a Public-Private Partnership (PPP) whereby the firm will be the principal owner of the biogas digester and the Council the co-owner, able to use the digester as a means of disposing of the organic waste collected by the Council. During the project implementation period, three such medium-scale biogas digesters will be constructed at three different locations. The output of each medium-scale biogas digester will be electricity produced by a Combined Heat and Power (CHP) unit; the electricity will be for the daily used operations of the agro-industrial firm and surplus power will be fed into the grid. Surplus heat from the CHP unit will be used for the operation of the agro-processing plant. The bio-slurry will be processed, dried and pelletised and sold as a locally-produced bio-fertilizer.

Through these initial projects, policy-makers and interested investors (of whom there are already a number in the commercial banking sector) can be convinced of the benefits and technical viability of biogas technology in Botswana, and capacity will be developed for the design, construction and operation of biogas, and subsequently bio-methane, technology.

**A.1 National strategies and plans or reports and assessments under relevant conventions, if applicable, i.e. NAPAS, NAPs, NBSAPs, national communications, TNAs, NCSA, NIPs, PRSPs, NPFE, Biennial Update Reports, etc.**

No substantive changes since the PIF. Please see Section 1 of the Project Document.

**A.2. GEF focal area and/or fund(s) strategies, eligibility criteria and priorities. Renewable Energy and Climate Change.**

No substantive changes since the PIF. This UNDP-implemented, GEF-financed project has been designed to be consistent with the GEF-5 climate change strategy, Strategic Priority #3 to “Promote investment in renewable energy technologies”. The project seeks to remove the current existing barriers to investment in biogas technology in Botswana, while promoting market-based solutions.

**A.3 The GEF Agency’s comparative advantage.**

No changes. The GEF Agency’s comparative advantage is as detailed in the PIF. Having undertaken the project preparation process, including extensive stakeholder consultations, the GEF Agency has further strengthened its ties and contacts with the relevant stakeholders.

**A.4. The baseline project and the problem that it seeks to address.**

The project baseline includes conditions that could provide incentives to the development of a biogas sector in Botswana.

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<sup>10</sup> E.g. chicken manure, poultry abattoir, cow dung, cattle abattoir waste, etc.  
GEF5 CEO Endorsement Template-February 2013.doc

1. Botswana's National Development Plan of 2010-2016 places prominent emphasis on sustainable utilisation of biogas in the country.
2. The current policy environment does address organic waste management, though it is not effectively enforced.
3. There is an abundance of livestock manure, agricultural/animal waste and other forms of biomass that offer significant potential for the increased use of biogas in Botswana and, in particular, South-Eastern Botswana where the majority of abattoirs are concentrated.

However, these baseline conditions have not been sufficient in themselves to create an enabling environment for investment in biogas projects in Botswana. Indeed, in some respects, these conditions have created new barriers. The emission of greenhouse gases produced by the environmentally unsustainable disposal of agro-waste products combined with the use of imported fossil fuels is identified as a key problem. Due to the abundance of livestock manure, agricultural/animal waste and other forms of biomass, there is, in principle, very good potential for the increased use of biogas in Botswana.

Key barriers identified that need to be addressed to allow for truly transformative development of the biogas sector include the following:

- There are no suitable demonstration projects for technology penetration since the current use of biogas in Botswana is extremely limited (there are believed to be no operational biogas digesters in the entire country) and there is no institutional biogas plant operating at either an abattoir or a landfill.
- There is insufficient knowledge among various 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 benefits of biogas technologies, including: the production of green energy – both electricity and heat; the substitution of bio-methane for LPG; biogas's considerable environmental advantages; reduced spending on artificial fertilizer due to the use of digestate as bio-fertilizer; and the associated local benefits of green jobs and employment arising from the operation and maintenance of biogas plants.
- Private-sector companies seeking Public Private Partnerships (PPPs) in the waste sector have been discouraged by bureaucratic hurdles and an inability to obtain concessional rights or secure contracts for the use of waste substrates originating from public-owned assets such as landfills and abattoirs. Similarly, there is an overlap of roles and mandates between national and local stakeholders governing the sector, which makes it difficult for investors to know with whom they should be negotiating. For example, several companies have sought a concessional agreement to sustainably treat and utilise effluents from Botswana Meat Commission (BMC) abattoirs, but this has been obstructed as a result of the lack of a framework for PPPs in the sector and (mis)understandings about who should share the costs and benefits of such a scheme (as well as concerns about technical viability).
- 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 wastewater. There is a need for standardised waste management methods, detailed guidelines for different kinds of waste (including agro-waste), and defined policies and legislation. The Botswana Waste Management Strategy (1998) only made recommendations in this regard but did not provide specific guidelines. At present, there is no specific legal and regulatory framework for the utilisation of biogas from agro-waste and wastewater, nor an institutional framework aimed at providing best practices in this sub-sector. The Draft Energy Policy of July 2014 sees potential in biogas for households, schools and farms. However, the national Energy Policy has been in formulation since early 2000. This Policy cannot be relied on to support the development of a biogas sector in Botswana as it is unlikely to be published or implemented on time. Nonetheless, in theory, the latest Draft of February 2015 is scheduled for final adoption in the latter part of 2015.

- There is poor infrastructure maintenance and weak monitoring and enforcement of waste treatment regulations. Most abattoirs discharge into municipal sewers, have their own waste disposal or have waste disposed of by the relevant district councils. Under the Waste Management Act, licences must be issued for the operation of sewerage and wastewater facilities. Holders of these licences are to comply with the relevant pollution conditions. Excessive polluters are charged the equivalent of US\$ 110, plus US\$ 54 per day, if the offence continues. As the fines levied are relatively low, the business-as-usual scenario is that abattoirs, for example, have little incentive to address unsustainable practices and shift to more sustainable waste treatment platforms. There is a need to empower the appropriate authorities to better perform their regulatory mandates and improve consistency between laws, regulations, institutions and practical day-to-day waste management. These include the Department of Environmental Affairs (DEA), councils and the Department of Waste Management and Pollution Control (DWMPC). The framework within which they operate is unclear, with hazy demarcation of institutional responsibilities.

- Banks and financial institutions in Botswana (including the Botswana Development Corporation, BDC) have insufficient capacity to assess the technical risks and benefits of investing in biogas technologies. Town and district councils are interested in providing finance but are handicapped by their unfamiliarity with the chosen technologies and associated business models, as well as the lack of clarity on institutional roles and PPP frameworks. At present, there is no framework for systematic cooperation between actors, which would help facilitate financing in clean technology investments across the country and maintain a database of projects.

- Lack of a level playing field: the Botswana Power Corporation (BPC) supplies electricity at BWP 0.43/kWh (USD 0,04/kWh)<sup>11</sup> and is subsidised. For a biogas digester to produce electricity on cost-recovery terms, a minimum price of BWP 1.4/kWh (USD 0,14kWh) is required. To stimulate investment in biogas technology, a level playing field has to be created.

- The lack of enforcement regulations and inadequate institutional organisation: it is not clear who is responsible for monitoring and enforcement, and too many offices are involved in licensing and industry inspections. Clear and transparent guidelines and procedures need to be in place and communicated to all parties involved. In addition, the focus on the implementation of waste management is through enforcement, and no attractive and effective incentives for the private sector have been identified to stimulate voluntary compliance with waste management policies. Offering low rates for the disposal of waste at a landfill does not necessarily address the root problem. Issues related to waste management are merely transferred from one owner to another and from location A to location B.

- Lack of dialogue and joint responsibility between Government, private sector and civil society: there are no institutionalised structures in place to allow stakeholders to take on joint responsibility for waste management and the promotion of biogas technology. Without support across the board at the national, district and village level, the successful implementation of waste management policies is likely to be unsuccessful. Furthermore, the general public are not fully aware of the environmental and health hazards related to uncontrolled waste management.

- Currently, there is one (successful) Public–Private Partnership (PPP) in Botswana, namely the Debswana/Botswana Government PPP (a 50:50 diamond mining joint venture). The success of Debswana is apparent in the sustained profitability of the company while, at the same time, providing the Government with a major source of revenue to fund public spending programmes (development expenditure in particular). Councils have recently acquired the legal mandate to enter into PPPs and this opens up opportunities for partnerships with agro-industrial enterprises to address waste management issues. The PPP approach will be supported by the GEF-financed project as a financially sustainable, risk-sharing, innovative and ultimately highly replicable investment model.

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<sup>11</sup> BPC 2012 rates.  
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The main options to remove or reduce the impact of these barriers are presented in the table below (the Outcomes referred to relate to the UNDP-implemented, GEF-financed biogas project):

<b>Barriers</b>	<b>Reduction or Removal of Barrier</b>	<b>Outputs</b>
No suitable demonstration of well-functioning biogas technology.	Facilitate the construction of small-, medium- and large-scale biogas digesters. (Outcome 2)	1,000 small-scale and 3 medium-scale biogas digesters constructed; design and planning for a large-scale biogas digester.
Insufficient knowledge among all stakeholders on waste management and biogas technology.	Capacity development for waste management and biogas technology.	Stakeholders have adequate knowledge to formulate and have input on the development of waste-management policies and biogas technology. Knowledge and skills to construct and operate biogas digesters exists.
Lack of enabling environment for private-sector companies and Public-Private Partnerships (PPPs) in the waste sector.	Facilitate the establishment of PPPs for waste management and biogas utilisation. (Outcome 3)	Biogas digesters constructed through partnership between private sector and councils.
Lack of specific guidelines or policies on biogas resources and absence of an appropriate legal and regulatory framework for the utilisation of biogas from agro-waste and wastewater.	Support multi-stakeholder platforms to address regulatory issues related to waste management and biogas.	Conducive enabling environment in place with broad consensus of stakeholders. Stakeholders responsible for implementation and monitoring.
Poor infrastructure maintenance and weak monitoring and enforcement capacity of waste treatment regulations.		
Insufficient capacity to assess the technical risks and benefits of investing in biogas technologies.	Capacity development of key council staff, private sector and financial institutions on biogas technology.	Stakeholders have the capacity to develop and assess business plans relating to biogas technology.
Lack of a level playing field within the energy sector.	Support the Ministry of Minerals, Energy and Water Resources in developing detailed sectoral strategies with detailed action plans and resources.  Create equivalent (non-preferential) conditions for investment in conventional and renewable energy technologies.	Detailed strategies that outline the roles played by all key stakeholders exist.  Equivalent subsidy for all energy technologies or suitable renewable energy feed-in tariff (REFIT) in place.
The lack of enforcement regulations and inadequate institutional arrangements.	Strengthen the Department of Environmental Affairs within the Ministry of Wildlife, Environment & Tourism and the Ministry for Local Government & Rural Development (MLG&RD) through removal of grey areas related to enforcement.  Clarify the enforcement roles of	Existence of clear roles and responsibilities within DEA, councils and DWMPC regarding enforcement of waste-management regulations.  Corrective measures outlined in EIAs are implemented.

Barriers	Reduction or Removal of Barrier	Outputs
	DWMPC and the Department of Environmental Health within MLG&RD and the councils.  Establish follow-up procedures for corrective measures stipulated in EIAs.	
Lack of dialogue and joint responsibility between stakeholders, Government, private sector and civil society.	Support multi-stakeholder (Government, private sector, civil society) platforms to encourage joint responsibility for addressing issues related to waste management and biogas.	Projects designed and developed by stakeholders with all stakeholders involved.
Public's inability to realise economic potential of organic waste.	Create awareness on potential income activities that can be undertaken within the organic waste sub-sector.	Women, men and the youth generate income from organic waste.

**A. 5. Incremental /Additional cost reasoning: describe the incremental (GEF Trust Fund/NPIF) or additional (LDCF/SCCF) activities requested for GEF/LDCF/SCCF/NPIF financing and the associated global environmental benefits (GEF Trust Fund) or associated adaptation benefits (LDCF/SCCF) to be delivered by the project:**

The overall objective of the project is to facilitate low-carbon investments and public-private partnerships in the production and utilisation of bio-methane from agro-waste (for substitutes of diesel and/or LPG) in the districts of South-eastern Botswana. In order to achieve the project objective, and address the identified barriers, the project's intervention has been organised into three components:

- Component 1: Institutional strengthening and capacity building for biogas investments and improved agro-waste management and regulation.
- Component 2: Facilitation and establishment of the first biogas plants in Botswana.
- Component 3: Facilitation and establishment of appropriate biogas utilisation platforms in at least two Districts of South-Eastern Botswana.

The GEF-financed activities (GEF funding: US\$ 2.6 million) will lead to USD 16.7 million<sup>12</sup> in direct co-financing.

The project, implemented by the Ministry of Environment, Wildlife and Tourism, will facilitate the engagement of key stakeholders. The UNDP-implemented, GEF-financed project will build on the work done to date in Botswana with regard to waste management.

It will facilitate the most practical and affordable biogas technology that can meet the operational conditions in Botswana and address the most critical waste issues and energy demands. The project will build on the work done by the DWMPC, the Department of Energy and other relevant institutions. It will facilitate low-carbon investments and public-private partnerships in the production and utilisation of biogas that will result in improved waste-management practices and give access to secure and sustainable biogas energy for agro-industry, institutions, residences and council services. The project has four strategic objectives:

<sup>12</sup> Investment in 1,000 small-scale digesters is estimated at US\$ 7 million in total; the estimated cost for a medium-scale biogas digester is US\$ 3 million each. The private sector (agro-industry and financial institutions) are the main investors.

- Creating an enabling environment that supports the market development of agro-waste management and biogas technology, stimulating investments in biogas technology and increasing uptake of such technologies through new policies, tools and financial incentives.
- Institutional and private-sector strengthening and capacity development for biogas technology development and servicing, and improved agro-waste management and regulation through awareness-raising, training and information dissemination sessions. These two objectives are addressed by Component 1.
- Facilitation and establishment of biogas installations: these include small, medium and utility-scale biogas plants in South-Eastern Botswana (Component 2).
- Facilitation and establishment of appropriate utilisation and knowledge platforms<sup>13</sup> (Component 3).

### **Component 1**

The project will encourage institutional strengthening and capacity building to promote improved agro-waste management and regulation for centralised and decentralised, grid- and non-grid-connected power generation, with a particular focus on the application of biogas installations. Under the umbrella of the process for developing an updated National Waste Policy and a National Waste Management Plan, guidelines and standards will be developed for low-carbon solutions and the utilisation of biogas technologies for (agricultural) solid and liquid waste.

A framework agreement for public-private partnerships in the waste sector will be developed and disseminated. The project will support this process through the establishment of a multi-stakeholder platform specifically set up for this purpose. The members of this multi-stakeholder platform will identify and implement the appropriate actions to make PPPs in the biogas sector a reality. The outcome of this multi-stakeholder platform will be communicated by the same participants to relevant parties and, where required, specific training will be offered.

The project will support the required background analysis, consultations, awareness-raising and capacity-building of the key stakeholders in order to finalise the drafting of the guidelines for waste management, standards for biogas technology and PPP framework. It will build on the experiences and lessons-learned in other countries and will benefit from the results of a number of international projects that have been undertaken in other countries. Topics will include legal, regulatory and institutional barriers to successful development of a biogas sector utilising agro-waste.

Through workshops, seminars and networking meetings, relevant stakeholders will be informed and put in a position to develop and formulate the guidelines on waste management, standards for biogas technology and PPP framework on waste management and biogas technology. When required, the project will bring in relevant human resources to deliver on selected issues.

### **Component 2**

At the beginning of the project, a baseline study will gather key information on the proposed sites for biogas digester installations, with potential waste streams for biogas at district/town/city council level providing the base for monitoring and evaluation so that judgements can be made later about (the contribution to) the quantity and quality of development results achieved by the intervention. A component of the baseline study will be a comprehensive supply-chain and demand-side analysis.

The project will support the Department of Waste Management and Pollution Control (DWMPC), town councils and city councils in improving the monitoring and enforcement of Trade Effluent Agreements (TEAs) between industries and local authorities. Stakeholders will, as soon the Integrated Waste Management Policy has been formulated, determine their modalities to improve the monitoring and enforcement in conjunction with the Ministry of Local Government and Rural Development.

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<sup>13</sup> Stakeholders will meet periodically to exchange information and experiences; topic experts will be invited to prepare tailor-made training; lessons-learned and best practices are documented and disseminated at district, national and international conferences and workshops.

For small-scale biogas digesters, GEF investment funds will be used to facilitate upfront financing. Upon completion of construction, each small-scale biogas digester will receive USD 50 and the first 200 small-scale digesters will receive an additional USD 125 payment as a promotional tool for early adopters. These rates have been determined in such a way that the investment is 'pulled over the line' to invest in biogas. The total funds set aside for the small-scale digesters are USD 75,000.

For medium-scale biogas digesters, a fee per kWh<sup>14</sup> produced will be paid for a pre-determined period depending on the total investment, operational cost and other factors influencing the financial analysis. The amount for topping-up was determined on the basis of the cost of producing a kWh with biogas technology and the assumed rate for the feed-in tariff. The current BPC rate is BWP 0.43/kWh (USD 0.04). Calculations indicate that the power generated from biogas will cost approximately BWP 1.4/kWh (USD 0.14). This will mean a top-up of BWP 0.97/kWh (USD 0.10). Power generated by a diesel generator is BWP 3/kWh (USD 0.3), making biogas a financially attractive option in comparison. The amount set aside for the performance-based payment is estimated to be sufficient for the duration of the project period. It is assumed that, during the project period, the feed-in policy will be fully operational and will offer an acceptable rate as a feed-in tariff. The consequence of the GEF support is that the Government is committed to supporting biogas, introducing a feed-in tariff for renewables and increasing electricity tariffs.

This will serve to accelerate the return on investment and ensure continuous output. If a project fails to generate power, it will be at the expense of the investor(s). Provision of performance-based incentives will be an important marketing tool. Options such as investment subsidies or grants have been considered but are not favoured as these options do not ensure continued operation of the biogas digesters. There is a risk with an upfront investment subsidy or grant that the technology will be constructed but that there is no drive to keep the biogas digester working.

The performance-based incentives will be linked to pre-defined quality standards (only quality-certified projects will qualify for incentives) and will support private sector investment in biogas technology and its construction. The construction of medium-scale biogas plants will be financed by private-sector partners, commercial banks and Government partners (BMC or BDC).

The Government of Botswana is in the process of introducing a renewable energy feed-in tariff (the REFIT) after many years of preparations.<sup>15</sup> The performance-based incentive support from the GEF-financed project can therefore be considered as a bridging arrangement. After the project implementation period (i.e. after 4 years), the REFIT will almost certainly be operational and can take over as a de facto performance-based payment.

BPC is gradually increasing the tariffs of electricity sold to consumers<sup>16</sup>. This development will close the gap between the cost for production of power and the sale of power, suggesting that power supply will in the near future be at commercial rates and a level playing field will be created. BPC can, under existing legislation, enter into a power purchase agreement (PPA) with a biogas power producer if the price is considered reasonable. The

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<sup>14</sup> Approximately 1 BWP/kWh at 2015 prices.

<sup>15</sup> The Intended Nationally Determined Contribution (INDC) for Botswana states that "Botswana is developing a Climate Change Policy and Institutional Framework which will be supported by a Strategy and Action Plan to operationalise the Policy. The Policy will be approved by Parliament in 2016." The reductions will be realised from the energy sector. The country will also continuously implement mitigation measures for the livestock sector to reduce CH<sub>4</sub> emissions mainly from enteric fermentation, though these initiatives are not estimated in the 15%. Initiatives for emission reductions will be developed from the long-term low-carbon strategy. The REFIT is in the Energy Draft Bill which will be discussed in Parliament during the December 2015 sitting. If it passes, then the REFIT is highly likely to happen during the lifetime of the project. The project will take note of the required transitional arrangements regarding institutional, legal and administrative issues which might cause delays in implementation, but it is important to note that there is political willingness associated with the Energy Bill (and hence the REFIT).

<sup>16</sup> In April 2015, BPC announced tariff increases effective 1st April 2015. The tariff for domestic customers consuming up to 200 kWh increased by 7.5%, while domestic category customers consuming more than 200 kWh per month was increased by 10%; a 10% increase for Small Scale Business category customers consuming 500 kWh or less per month was implemented, while a 17.5% increase was levied for small-scale business category customers consuming more than 500 kWh per month; a 17.5% electricity tariff increase was imposed for Medium and Large Scale Business, Water Pumping, Mining and Government customer categories. Further increases are expected at periodic intervals.

GEF-funded performance-based payment will no longer be required one year after the project period. For the performance-based payment, total funding of USD 635,000 is required, representing 24% of the total GEF budget. The output of the power producers will be monitored; based on each kWh produced and supplied to BPC each month or quarter, a payment will be made.

Biogas is a new technology and the performance-based payments can be considered a stimulus measure towards the development of the sector. Through these payments, the project will maintain control over the quality of the proposed biogas technology, appropriateness of design and service delivery by technology providers. Further, with a performance-based payment system in place, it will be easier to bring in investors to support biogas market development in the country. By the end of the project, local investors such as BDC will have gained sufficient capacity and confidence to support biogas technologies in the commercial sector.

To ensure that competitively-priced biogas technology is of good quality and related after-sales services are effective and lead to customer satisfaction and market growth, a credible and effectively enforced quality-control scheme is required. Through the participation of stakeholders, including regulators, system designers, constructors, equipment vendors, potential manufacturers, system installers and repair and maintenance specialists in the South-Eastern region, quality and operational standards will be developed, and will be augmented with training materials and manuals, workshops and 'on-the-job' training.

The project will facilitate training of key stakeholders, including the public authorities responsible for implementing the waste management policy and biogas programme and local service providers, such as installers, to meet the minimum quality requirements. For this, the project will cooperate closely with local universities and professional and vocational schools<sup>17</sup> to ensure that, for instance, there will be a sufficient number of trained and certified biogas technicians available in the market.

A certification scheme will be developed, which will be managed by the Botswana Training Authority (BOTA) and the Botswana Bureau of Standards (BOBS). The scheme will verify that adequately trained and skilled biogas installers are hired and that the biogas hardware supplied for installation projects comes with (inter)nationally recognised quality certificates and has adequate warranties. In the case of faults, the installers will be responsible for providing service under warranty and for communicating with equipment manufacturers throughout the warranty period of the installation.

Masons, both women and men, and construction companies will be trained in technical aspects of biogas installation and operation (construction, maintenance and repair), and also on promotion (how to attract new clients), plant sizing and selection, user outreach (how to explain operation and maintenance tasks to the user, including trouble-shooting and minor repairs) and handling user feedback. A typical new mason's training will be divided into two parts and will include 14 days' training at a training institute, plus on-the-job training in the form of constructing a biogas digester under close supervision (supervised training).

A suitable training institute will be identified in South-Eastern Botswana for facilitating training on biogas technology. The staff of this institution will undergo a tailor-made training programme and will be authorised to conduct training on biogas. The institute will be authorised to accredit certified biogas technicians.

Individual masons and construction companies will be responsible for the construction of 1,000 small-scale biogas digesters in Botswana, the provision of user training, after-sales service and guarantees. Agro-waste firms and other potential owners of biogas digesters will finance the construction cost of these small-scale biogas digesters themselves as it will be economically viable to invest in biogas technology.

The international biogas companies that are identified, through a tendering process, to construct the first medium-scale biogas digesters in Botswana will be responsible for training the staff of the institute offering

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<sup>17</sup> This will involve the University of Botswana.  
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biogas training and the staff of the company identified for the day-to-day operation of the biogas installation. The training institute will, in turn, train staff of town councils, district councils, agro-industry and the private sector. The initial training will be offered at a reduced rate and will gradually be offered on a full cost-recovery basis. The international companies will be asked to prepare a capacity development plan as part of the overall tender for the construction of medium-scale biogas plants.

The financial sector in Botswana has not yet fully recognised the full potential of biogas technology as an investment opportunity. The absence of such recognition and support from financial institutions is a barrier to potential investors when they need capital to install biogas digesters. Biogas technology has high initial capital requirements. For that reason, financial measures will be put in place to overcome this barrier.

### **Component 3**

The project will support awareness-raising on waste management and the application of biogas technology. DWMPC will play an important role to: (i) promote biogas technology; (ii) represent the interests of the supply-side in further policy dialogue; and (iii) become a knowledge-management and eventual training centre for issues associated with further promotion of the biogas sector in Botswana.

Stakeholders, including financial institutions, council and municipality staff and the private sector, will be trained in best practice in assessing and financing agro-waste projects, with a particular focus on biogas. Initial capacity development will be supported by the GEF-financed project. Vocational-training centres will integrate a module on waste management and biogas into their existing curricula. It is planned that these courses will initially be supported by the GEF<sup>18</sup> and, over time, be offered at cost-recovery rates.

At the national level, Government institutions, NGOs, the private sector, the mass media, microfinance institutions, community-based organisations such as cooperatives and others will be mobilised in order to create general awareness on waste management and the promotion of biogas. Coordination of promotional activities will be the responsibility of a Biogas Working Group (BWG)<sup>19</sup>. Stakeholders will jointly implement activities including: development of a detailed plan of action to disseminate information on biogas; the printing/distribution of different written information materials; organisation of orientation training to institutions and agro-industry on the benefits of biogas; establishment of networks with organisations working in the biogas sector and dissemination of biogas information through these networks; participation in exhibitions and national school competitions; council-level promotional campaigns and biogas-awareness workshops; use of (social) media and mobile-phone messages.

As part of the project's awareness-raising, study tours will be arranged to relevant countries – notably South Africa – with agro-waste biogas projects. In addition, visits will be arranged to industry events, such as trade shows. The objective is to create a group within Botswana that is well connected to the international waste management and biogas industry and is well aware of market developments, so that this group can exploit these developments for the benefit of Botswana.

### **Global Benefits**

Components 1, 2 and 3 are expected to work in synergy, organising and enhancing the baseline project so as to promote global environmental benefits (enhanced climate change mitigation) and make the transition from loosely-connected concepts to biogas sector development and targeted investments. The project contributes to GEF Climate Change Focal Area Objective #3, to “Promote Investment in Renewable Energy Technologies”, recognising that renewable energy plays an indispensable role not only in combating global climate change but also in addressing energy access, energy security environmental pollution and sustainable development.

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<sup>18</sup> Reference is made to the budget for details on costs for capacity development.

<sup>19</sup> The BWG is a multi-stakeholder platform whereby participants set the agenda and determine how promotion is undertaken in the context of this project. Participants will, in turn, be responsible for implementation.

### Direct GHG Emissions Reductions:

Biogas generated by the small-scale biogas digesters will be predominantly used for direct heating. There is no detailed information yet on the type and quantity of fuel that will be replaced by the use of biogas, as the baseline for every installation will be subtly different, depending upon the baseline fuels that are displaced and the applications for which the biogas is used. This information will be collected and stored during project implementation, and the relevant emission reduction calculations will be reported in annual PIRs and the Mid-Term and Final Tracking Tools. The three medium-scale biogas digesters will each generate 1 MW of electricity. The heat produced by the Combined Heat and Power Unit by each medium-scale digester will be partly used for heating the biogas digester and the remaining heat will be used to pre-heat industrial boilers or other similar applications. The electricity produced by these biogas digesters will mainly replace electricity that was previously provided through the grid.

For the purpose of the GHG calculations, the total energy value for biogas is considered to be 6 kWh per cubic metre<sup>20</sup>. The calculation is presented in four steps:

- 1- Calculation of an emission factor for electricity displaced by project electricity or equivalent
- 2- Calculation of the energy generated by the project, according to GEF Guidelines
- 3- Calculation of GHG emissions avoided
- 4- Calculation of leakage of biogas

At each step, the most conservative assumptions are used.

#### Step 1:

According to the draft Botswana National Energy Policy,<sup>21</sup> the overall goal is to provide affordable, reliable and adequate supply of energy for sustainable development, as well as to improve access to and efficient use of energy resources. There is no specific mention in the draft policy of specific targets for GHG reduction although there are favourable conditions for the application of biogas:

- Botswana Power Corporation (BPC) will be responsible for base load requirements to meet the national power demand.
- Facilitation of the participation of Independent Power Producers to meet national power demand peaks and for regional exports.
- Electricity must be generated in a manner that facilitates cost-recovery, efficiency and provides for future investment with tariffs that are export-competitive.
- Facilitation of the development and use of all available resources, especially renewable resources.
- Promotion of the development and use of cleaner technologies.
- Attract the private sector to participate in electricity generation.
- Advocacy for opening up the electricity market to international bidders.
- Adoption of the renewable energy feed-in tariff (REFIT) policy.

According to the National Development Plan (NDP 10), the use of renewable energy at present is minimal in Botswana but the Government aims to increase the share of renewable energy usage to 25% by 2030.

Source	Fraction of Generation	Emission Factor (kg CO <sub>2</sub> /kWh)	Weighted emission factor
Diesel/Coal	0.75	0.82	0.615
Renewables	0.25	0	0
Botswana Emission Factor 2030 (kgCO <sub>2</sub> /kWh)			0.615

<sup>20</sup> University of Southern Denmark (2008), *Biogas Handbook*.

<sup>21</sup> October 2014.

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According to UNFCCC Guidelines, emission factors for off-grid diesel generation range from 0.82 kg CO<sub>2</sub>/kWh to 2.4 kg CO<sub>2</sub>/kWh, depending on the size of the diesel generator and operating conditions.<sup>22</sup> In order to maintain conservativeness in the GHG emission reduction calculations, the lower emission factor (0.82 kg CO<sub>2</sub>/kWh) has been used in the calculation of the weighted emission factor.

If it is assumed that Botswana progresses linearly from the present to its future emission factor, then the average emission factor over the project period (up to 2020) is 0.615 kg CO<sub>2</sub>/kWh.

**Step 2:**

For the 1,000 small-scale biogas digesters: using a 15-year lifespan for biogas and a capacity factor of 360 days a year<sup>23</sup>, the direct output of the small-scale biogas digesters is equivalent to 63,202 MWh/year (948,030 MWh over 15 years/1,000 digesters). For the medium-scale biogas digesters: using a 20-year lifespan for biogas technology in accordance with GEF guidelines, and a capacity factor of 360 days a year<sup>24</sup>, the 3 MW installed as a direct result of the project will produce 25,920 MWh/year (i.e. 518,400 MWh over 20 years).

Estimated Electricity Production equivalent (Small-Scale Biogas only)								
Category	[m <sup>3</sup> / day]			Number of digesters	Electricity			
	min	max	Ave		[m <sup>3</sup> /year]	kWh/m <sup>3</sup>	total annual MWh	Share
Small	4.6	5.6	5.1	600	1,101,600	6	6,610	10%
	23	28	25.5	200	1,836,000	6	11,016	17%
	75	90	82.5	150	4,455,000	6	26,730	42%
	159	190	174.5	50	3,141,000	6	18,846	30%
Total				1,000	10,533,600		63,202	
				Average MWh/year/digester			63.2	

**Step 3:**

Multiplying the average grid emission factor (0.615 kgCO<sub>2</sub>/kWh) by the calculated energy generated from biogas power as a result of the project, the avoided greenhouse gas emissions are 901,836 tCO<sub>2</sub>e.

Avoided Direct Emissions						
Type	Power equivalent			Emission Factor		Avoided Emissions tCO <sub>2</sub> e
	Unit	period	Value	Unit	Value	
Small-Scale	MWh	15 year	948,000	tCO <sub>2</sub> e/MWh	0.615	583,020
Medium-Scale	MWh	20 year	518,400	tCO <sub>2</sub> e/MWh	0.615	318,816
<b>Total</b>			<b>1,466,400</b>			<b>901,836</b>

**Conservativeness of the approach:**

The approach above is conservative as:

- The actual baseline for small-scale biogas digesters that will be used by small-scale agro-businesses and schools, which will principally be coal for cooking and space heating, is likely to be considerably ‘dirtier’ (i.e. more GHG-intensive) than the grid emission factor used here. Data for calculating an accurate baseline will be collected during the process of installing the small-scale digesters: all households and businesses

<sup>22</sup> UNFCCC, Appendix B of the simplified modalities and procedures for small scale (up to 15 MW) CDM project activities.

<sup>23</sup> A small-scale digester should operate year-round and only a limited number of days are needed for repairs and cleaning per year.

<sup>24</sup> On average, 5 days a year are required for maintenance of the plant.

installing such digesters will be required to complete a form detailing their current sources and uses of energy.

- The approach assumes that all medium-scale biogas plants displace grid electricity, which has a lower emission factor than coal or diesel.
- The calculation estimates only the emission reductions associated with fuel displacement and does not take into account avoided baseline atmospheric methane emissions arising from anaerobic disposal of agro-waste. This baseline will vary considerably on a digester-by-digester basis: some digesters will displace an anaerobic disposal baseline, others an aerobic baseline. As with the baseline fuel data, estimates of the methane venting baseline will be made during the process of installing the digesters.

## Indirect GHG Emissions Reductions

### Top-down analysis:

The targeted potential for renewable energy in Botswana is 25% of generation capacity by 2030, generating some 1.97 TWh/year.<sup>25</sup> Using the calculated average grid emission factor of 0.615 kgCO<sub>2</sub>/kWh and taking into account planned dynamic developments in the power generation system, the emissions reductions can be estimated in the ten-year post-project period as per the GEF methodology,<sup>26</sup> assuming:

- 7.5% of the 25% renewable electricity generation capacity target is provided by biogas/bio-methane.
- 40% of this biogas/bio-methane is attributable to the GEF-financed project (i.e. a Level 2 causality factor: “The GEF contribution is modest and substantial indirect emission reductions can be attributed to the baseline”).
- Augmenting the 7.5% of biogas/bio-methane electricity generation is an accompanying 41.4 Mm<sup>3</sup>/year (equivalent to 248,400 MWh/year) of small-scale biogas digesters/bio-methane thermal generation (displacing, as a highly conservative assumption, a baseline with an equivalent emission factor to that of the electricity grid) – see table below:

Category	size		[cum/day]	No. Cons	[cum/year]
	min	max	Ave		
Small Scale	4	10	5	6.000	11.016.000
	20	50	26	500	4.590.000
	75	150	83	450	13.365.000
	175	300	175	200	12.564.000
<b>Total</b>				<b>7.150</b>	<b>41.535.000</b>
<b>Average cum biogas/digester</b>					<b>5809</b>

then the top-down indirect emission reductions over the 10-year post-project influence period are estimated as:

- 363,465 tCO<sub>2</sub> associated with clean electricity generation
- 611,064 tCO<sub>2</sub> associated with clean thermal energy generation

For a total of 974,529 tCO<sub>2</sub>.

### Bottom up analysis:

The GEF guidelines provide a formula for bottom-up emissions assessment as:

$$CO_2 \text{ indirect BU} = CO_2 \text{ direct} * RF$$

<sup>25</sup> <http://www.reegle.info/policy-and-regulatory-overviews/bw> (demand 902 MW by 2020, of which 25% is from renewables).

<sup>26</sup> GEF (2008), Manual for Calculating GHG Benefits of Projects: Energy Efficiency and Renewable Energy Projects. GEF5 CEO Endorsement Template-February 2013.doc

where RF is the Replication Factor. The GEF guidelines estimate a default RF of 2 for biogas projects. For the project at hand, a default replication factor of 2 is estimated – noting, however:

- The GEF guidelines for renewable energy are based on 2008 figures, when biogas technology was far less competitive with alternatives. Today, biogas technology is developing rapidly, with increasing uptake in Africa.
- Power shortages in Botswana provide an additional incentive to seek alternative power sources.

A Replication Factor of 2 is used but is, for these reasons, considered conservative. With a replication factor of 2, the bottom-up indirect emissions are 1,803,672 tCO<sub>2</sub> over the 10-year post-project period.

**Step 4:**

Research<sup>27</sup> on the leakage of bio-methane highlights the following issues: the IPCC (2006) estimates that 5-15% of the potential methane production can be emitted as ‘leakage’. The CDM (2012) then further estimates ‘leakage’ from the digestate after it has been removed from the digester and distinguishes between liquid and solid digestate. Liebetrau (2011) measures leakage from 10 anaerobic digesters in Germany; he finds CH<sub>4</sub> leakage from the digesters themselves, 0.4-2.4% CH<sub>4</sub> leakage during gas utilisation, and 0.2-11% of the total CH<sub>4</sub> produced during storage of the digestate.

A further consideration is the project baseline. Given that the baseline for most (but potentially not all) of the agro-waste that will be used as feedstock in the biodigesters would be anaerobic decomposition (i.e. with associated production of methane), leakage from the biodigesters would not necessarily add to atmospheric methane emissions (since such emissions would anyway occur, even in the absence of the digesters).

At this stage, it is difficult to precisely estimate methane emissions due to leakage over and beyond baseline CH<sub>4</sub> emissions. Instead, a simple but defensible approach of discounting the calculated emission reduction benefits of the project by 12% has been adopted. During project implementation, precise measurements will be made of (a) baseline emissions and (b) project leakage emissions, and accurate GHG emission reductions will be calculated.

<b>Net Emission Reductions with Leakage Discount (tCO<sub>2</sub>e)</b>				
<b>Category</b>	<b>Emission Reductions</b>	<b>Average Leakage</b>	<b>Net Emission Reductions</b>	<b>Cost (GEF US\$/tCO<sub>2</sub>e)</b>
<b>Direct</b>	901,836	12%	793,616	3.32
<b>Direct post-project</b>	-	-	-	-
<b>Indirect bottom-up</b>	1,803,672	12%	1,587,231	1.66
<b>Indirect top-down</b>	974,529	12%	857,586	3.07

**Innovativeness**

Three innovative aspects stand out in this project.

First, the project will support the functioning of Multi-Stakeholder Platforms (MSPs), which will be responsible for creating the enabling environment and, at the same time, take on responsibility for enforcement of policies and guidelines. MSPs will bring together key stakeholders from Government, the private sector and civil society to take on joint responsibility for policy formulation and implementation. During the course of the project, these

<sup>27</sup> <http://johnpaulprofessional.com/2015/09/24/methane-emission-leakage-from-co-digestion-on-dairy-farms/>

stakeholder platforms will mature and assume more responsibilities related to the development of the biogas sector, leading to the establishment of a well-functioning network promoting the waste-management agenda in Botswana and accelerated up-scaling of the proposed technologies and waste management systems. Through MSPs, the following baseline (and hitherto enduring) issues will be addressed: overlapping Government institutional mandates; unclear institutional responsibilities; lack of coordination between the public and private sectors; and limited engagement of civil society in waste management and investment decisions. MSPs will be a completely new development in Botswana.

Second, biogas technology will be introduced in Botswana in such a way that stakeholders are sufficiently capacitated to continue with the development of a biogas sector after the project period. Staff of the national implementing partner, the national Government, District Councils, financial institutions, technology providers, biogas companies and other relevant stakeholders will be capacitated. Through doing so, knowledge will be widely available and not locked up within one institution. The promotion of biogas technology is an integral part of the Integrated Waste Management Policy to be developed during the project period. This will be a driver to apply biogas technology in a sustained, coordinated manner. This in contrast to a (demonstration) project approach, unfortunately very common in other African countries, whereby all activities come to a standstill after the project period.

Third, councils and private companies will be facilitated and enabled to establish Public-Private Partnerships that will lead to joint investment toward the construction and operation of biogas technology. The concept of PPPs is almost entirely new in Botswana, there being only one current example in the country (in the diamond sector). District Councils have been, since 2014, allowed to engage in bilateral PPPs without the participation of central government. For example, the Kgatleng District Council is proactive in engaging with technology providers to replace a landfill with an alternative solution. The GEF project will support these nascent developments to make PPPs a business-as-usual model.

### **Sustainability**

Botswana's National Report for the United Nations Conference on Sustainable Development (Rio+20) states that "Management of waste as waste is wasteful". The National Development Plan of 2010–2016 places increased emphasis (compared to previous plans) on sustainable utilisation of renewable energy (primarily solar and biogas) to respond to the country's abundance of solar resources and agro-waste by-products. The *Energy Policy Brief – Reflecting on the Challenges of Attaining a Green Economy for Botswana*<sup>28</sup> indicates that meat abattoirs and sewage-treatment plants are priority areas for intervention in order to achieve the country's vision for a Green Economy. The Draft Energy Policy also specifically points to the need for Government strategies that promote investments in infrastructure to produce bio-energy from the by-products of agro-processing.

Biogas applications are proven in providing lasting, relatively cheap, and environmentally sound and green eco-solutions to organic waste management and low-carbon energy in developing economies. The potential for scaling-up biogas technology is evident; this project only focuses on one part of the country but, given the availability of agro-waste in Botswana<sup>29</sup>, there is the potential to extend the technologies to many other parts of the country. Biogas technology is applicable to other agro-processing industries and has potential for utilisation in households, schools, the livestock industry, meat-processing plants, landfills and wastewater-treatment plants around the country.

The city of Gaborone alone generates 100 kg of waste per person per annum, amounting to 85 tonnes per day for the entire city. This waste is currently completely unutilised and, furthermore, actively contributes to atmospheric and water pollution. Waste generation in Botswana is estimated to be increasing at a rate of 7% per

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<sup>28</sup> This Policy Brief was prepared with assistance from UNDP in support of the Ministries of Environment, Wildlife and Tourism, Finance and Development Planning, and Foreign Affairs and International Cooperation in preparation for the United Nations Conference on Sustainable Development in June 2012 and for subsequent use within the country to advance sustainable development.

<sup>29</sup> Local abattoirs, BMC Francistown, BMC Maun, organic waste from villages and towns, cattle farms, etc.  
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annum<sup>30</sup> and so the potential substrates for use in biogas technologies will increase in the coming years. Experience has proven that “seeing is believing” and the actual demonstration of these technologies will have a powerful effect in inducing further investment in the waste-management/biogas sector.

It should also be noted that Component 3 is only intended to cover two councils initially; however, there are four other councils interested in scaling-up the project. The success of this project can have a major impact on Botswana’s waste sector since more than 50% of Botswana’s population lives in the geographical jurisdictions of these 7 councils and more than 50% of the country’s poultry and intensive beef-farming waste is generated in this area. The project offers a combination of both “sticks” (improved monitoring and enforcement) and “carrots” (financial incentives, facilitation and training for technology dissemination and showcasing of low-carbon commercial business models) to foster the long-term development of the sector. As noted earlier, the absence of updated regulations and punitive measures for non-compliance – combined with a lack of knowledge of the available low-carbon alternatives – perpetuates a business-as-usual scenario in the waste sector whereby entities such as abattoirs have little incentive to address unsustainable practices and shift to more sustainable waste-treatment platforms.

### **Replicability**

The latent market potential for biogas in Botswana is considerable. The project takes a facilitation and demonstration approach to introducing biogas technology from agro-waste. Through this approach, the four-year project is designed to achieve a well-functioning enabling environment whereby waste-management policies and regulations are implemented and enforced, demonstration biogas plants constructed and operational, and investment in biogas technology demonstrably increased. The project is designed to facilitate capacity development and learning. It incorporates a feedback loop to ensure that results on approaches and activities are collected and fed into an annual review by key stakeholders. This will enable analysis and adaptation of the model and ensure activities remain aligned with the achievement of results.

Results from the project will be disseminated within and beyond the project intervention zone through existing and new information-sharing networks and forums. The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks which may be of benefit to project implementation through lessons-learned. The project will identify, analyse and share lessons-learned that might be beneficial in the design and implementation of similar future projects. There will be a two-way flow of information between this project and other projects of a similar focus.

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<sup>30</sup> <http://unhabitat.org/publications-listing/challenges-of-municipal-finance-in-africa-with-special-reference-to-gaborone-city-botswana/>  
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**A.6 Risks, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and measures that address these risks:**

<b>Risk</b>	<b>Level of Risk</b>	<b>Mitigation Action</b>
<p>The technologies proposed – while proven in other countries – are unfamiliar in Botswana and technical capacities in this area are limited.</p> <p>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.</p>	Moderate	<p>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.</p> <p>Through extensive training programmes, sufficient capacity will be developed to ensure guaranteed operation of biogas digesters.</p>
<p>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)<sup>31</sup>.</p>	High	<p>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 as a transitional precursor to the introduction of the REFIT. This will reduce the financial risks for investors and ensure bankable projects. Further, the project will help to realise the potential of the Public-Private Partnership modality, whereby investment risks will be shared, a reliable source of organic feedstock will be assured and regulatory risks will be removed.</p>
<p>There is limited capacity in Botswana on biogas technology and to manage high-end biogas systems. There is, therefore, inadequate and/or non-capacitated human resources to successfully implement the project and support the mainstreaming of its results.</p>	Low	<p>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 option to invest in biogas technology in Botswana.</p>
<p>Lack of adequate and reliable market data to facilitate the monitoring of project impacts and planning of further policy measures.</p>	Low	<p>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 on monitoring.</p>
<p>There is a risk of the Government</p>	Low	<p>The Government, via the Economic Diversification</p>

<sup>31</sup> BPC tariff rates (12% VAT inclusive) effective 1st April 2014.  
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Risk	Level of Risk	Mitigation Action
introducing alternative or subsidised fuels, thus making biogas-based systems less viable and less attractive as an alternative.		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.
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 the biogas operator and the provider of the substrate for use in the plant.	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 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.
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.
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 materials) and curb the practice of washing solids into drains (which transfers waste solids to

Risk	Level of Risk	Mitigation Action
		<p>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 medium-scale biogas plants, 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.</p>
<p>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 head, following 3 years of drought.</p>	<p>Moderate</p>	<p>The shift has been made to move away from one large biogas digester to construct 3 medium-sized and 1,000 small-scale biogas digesters with the assumption that each agro-business has its own steady supply of feedstock. This in contrast to the large-scale biogas digester, for which co-digestion would have been a prerequisite to ensure efficient and continued operation. In addition, the proposed feasibility studies will address in depth the issues of quantity and quality of feedstock at constant cost. The size of the biogas digesters will be primarily determined by the availability of feedstock.</p> <p>The feedstock risk to the project will also 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.</p>
<p>The time for approval by Parliament of the Integrated Waste Management Policy is lengthy and hence implementation of the policy is delayed.</p>	<p>High</p>	<p>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</p>

Risk	Level of Risk	Mitigation Action
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	local population. 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, there will be improved financial viability for RE projects in Botswana <sup>32</sup> .
Construction and operation of a biogas plant comes with a number of safety issues, potential risks and hazards for humans, animals and the environment.	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 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.

#### A.7. Coordination with other relevant GEF financed initiatives

UNDP has been assisting the Government of Botswana with a national process whose primary purpose is to build a framework for local economic development (LED) in Botswana. The development of a 'National LED Implementation Plan' under that process is envisaged as informing the strategy and structures adopted under the GEF-financed project; in return, the innovative models of LED and decentralised technology dissemination proposed under the GEF-financed project will provide real-life case studies and lessons-learned to shape LED in Botswana over the long-term.

UNDP has recently supported the Department of Waste Management and Pollution Control (\$123,510 USD in total support) to develop Guidelines for Recycling of Municipal Solid Waste under the project, 'Municipal Recycling Guidelines for Botswana Municipalities.' The development of these guidelines will provide a reference point and lessons-learned for the development and adoption of similar guidelines for the agro-waste sector supported under Component #1.

The UNIDO-implemented, GEF-financed project, 'Promoting organic waste-to-energy and other low-carbon technologies in small and medium and micro-scale enterprises (SMMEs): accelerating biogas market development' (PMIS 5704) was CEO-endorsed in January 2016. The UNIDO and UNDP project development teams have been in close contact throughout their respective project preparation periods.

Under Component 1 ('Capacity building and technology system') of the UNIDO project, UNIDO plans to hold a regional training workshop in conjunction with the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) in Namibia to enhance the capacity of market actors to assess and characterize waste streams, to understand biogas technology options and to realize investment projects. The two GEF-financed projects have agreed that the Botswana UNDP-GEF project will assist in the design and funding of this workshop. A second

<sup>32</sup> SE4All Rapid Assessment and Gap Analysis – Botswana (2014).  
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joint regional workshop will focus on standardized training of biogas technicians; this will, in turn, inform (and be informed by) a collaborative effort to develop a longer-term SADC-recognized training programme for technicians. In the absence of such a programme, the region – including Botswana – will be served by variable-quality technicians poorly-equipped to catalyze the sector, and who may actually serve to undermine investors' confidence and sector credibility.

**B. ADDITIONAL INFORMATION NOT ADDRESSED AT PIF STAGE:**

B.1 Describe how the stakeholders will be engaged in project implementation and detailed organizational information.

<b>Stakeholder</b>	<b>Description</b>	<b>Participation in project implementation (current commitment)</b>
Ministry of Environment, Wildlife and Tourism	MEWT coordinates all activities to ensure there is synergy and coordination in management of resources.	METW is the national executing partner and will chair the Project Steering Committee.
Ministry of Infrastructure, Science and Technology (through BITRI)	BITRI is a newly established research and development parastatal organisation	<p>As the organisation with delegated operational implementation responsibilities for the project, BITRI will host the biogas / bio-methane project implementation unit, complete with staff and associated resources.</p> <p>BITRI will coordinate policy review and alignment of policies by liaising with DWMPC, DEA and EAD.</p> <p>BITRI will collect information from demonstration plants as well as local communities where the plant is based (monitoring and evaluation).</p> <p>The Minister of Infrastructure, Science and Technology will bring required political will and support to the project through budget approval and regular updates to the office of the President.</p>
Ministry of Local Government & Rural Development (Kgatlang District, Kweneng, South East,	Currently, district councils in the South-Eastern region <sup>33</sup> of the country (where most of the population lives and most waste is generated) are spending 21 million Pula per year (approximately US\$2.5 million) on waste management activities. A large portion of this budget is spent on diesel for incinerators at landfills and operating a fleet of diesel-powered refuse and waste collection	MLG&RD will cooperate with MEWT during the implementation of the project, provide support to the Councils and support the establishment of Public-Private Partnerships between private sector and the Councils.

<sup>33</sup> District Councils (Gaborone City Council, South-East District Council, Lobatse Town Council, Southern District Council, Jwaneng Town Council, Kweneng District Council, Kgatleng District Council).

<p>Southern District Councils; Lobatse and Jwaneng Town Councils; Gaborone City Councils)</p>	<p>trucks. MLG and the councils are working on developing more cost-effective and sustainable models of waste treatment.</p> <p>Since 2014, district councils have been mandated to invest in Public-Private Partnerships (PPPs) to enhance development. This is a new governance arrangement under the Ministry of Local Government and Rural Development and, to date, no PPPs have been established. This governance arrangement opens up opportunities for agro-industry and councils to jointly develop programmes to utilise waste streams for productive use.</p>	
<p>Botswana Meat Commission (BMC)</p>	<p>BMC currently slaughters approximately 700 cattle per day. The main waste produced is rumen and fat, while off-cuts are used to produce carcass and blood meal for sale. The Commission has stand-by diesel generators and uses coal to produce steam for sanitation purposes. BMC is currently working on an EIA for a feedlot to be established 15 km from Lobatse. The feedlot will hold 15,000 cattle at any given time and will start operations in late-2015.</p>	<p>BMC will participate in the planning for a demonstration feedlot whereby fresh dung is collected and entered directly into one of the medium-scale biogas digesters.</p> <p>BMC will contribute financial resources towards construction of one of the medium-scale biogas digesters.</p> <p>BMC will pro-actively establish a PPP with Lobatse Town Council to ensure sound disposal of organic waste collected by the Council.</p> <p>BMC will participate in the development of the Integrated Waste Management Policy.</p>
<p>DWMPC</p>	<p>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 also registers and licenses waste carriers, waste disposal sites and waste management facilities, and monitors the collection, disposal and treatment of controlled wastes, as well as the trans-boundary movement and disposal of hazardous waste. 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.</p>	<p>DWMPC will review the Botswana Strategy for Waste Management 1998 and the Waste Management Act 1999 to include biogas / bio-methane.</p> <p>DWMPC will develop an Integrated Waste Management Policy while sourcing input from the GEF-financed biogas /bio-methane project.</p>
<p>Department of Environmental Affairs (DEA)</p>	<p>The Department of Environmental Affairs (DEA), which falls under the Ministry of Environment, Wildlife and Tourism, was heavily involved in the development of the Environmental Impact Assessment Act (EIA Act). It is the focal point for implementation</p>	<p>DEA will review the EIAs for each of the three medium-scale digesters. For each medium-scale biogas digester, one EIA will be undertaken.</p> <p>DEA will facilitate awareness creation</p>

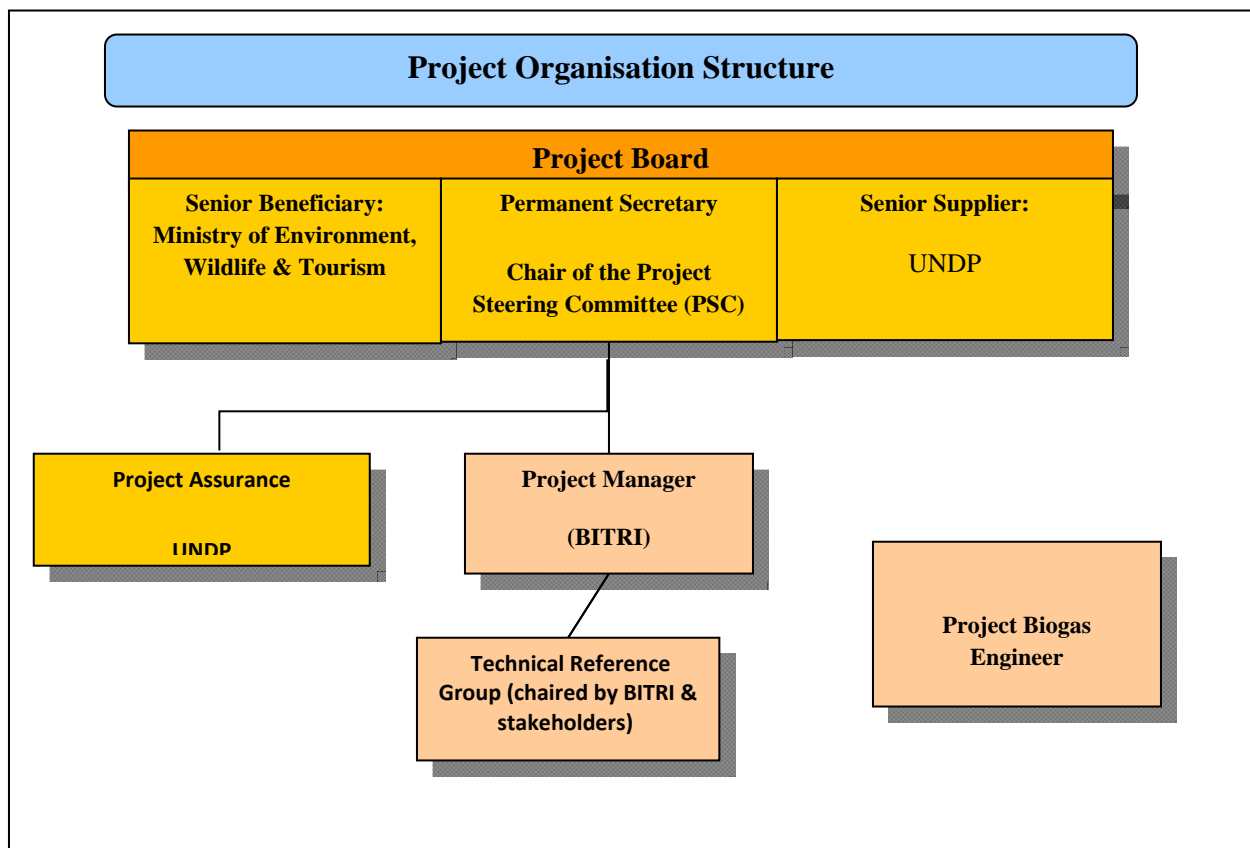
	of action plans relating to Agenda 21 and, recently, the Sustainable Development Goals and Post-2015 processes. DEA is also the GEF focal point in Botswana.	through two divisions: the Environmental Information Management Unit, which is responsible for online publication; and the Environmental Education and Awareness Unit, which uses print, television and radio to disseminate environmental education.
Energy Affairs Division (EAD)	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. EAD has recently completed a Draft Energy Policy (February 2015), which places emphasis on the development of the renewable energy sector, including biogas. '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.	EAD will participate in the policy review (Component 1).  EAD will develop calibrated feed-in tariffs under the REFIT for the benefit of biogas.
Financiers (Botswana Development Corporation (BDC), Barclays,)	The Botswana Development Corporation (BDC) was established in 1970 to be the country's main agency for commercial and industrial development. The Government of Botswana owns 100% of the issued share capital of the Corporation. BDC can provide financial loans (and equity contributions in special circumstances) to qualified enterprises in Botswana for a maximum contribution of 25% of the project cost.  Barclays Bank of Botswana has operated in Botswana for more than 60 years and has the largest branch network in the country. Barclays Bank Botswana intends to invest in renewable energy projects and, like BDC, requires a bankable business plan and a power purchase agreement when providing a loan. Barclays has an energy and infrastructure desk which has expressed interest in the provision of financing (loans and working capital) for biogas projects in the country.	BDC will provide a loan or equity to private companies for biogas / bio-methane investments of up to \$4.6m, at 11.7% per annum. A bankable business plan is the main requirement.  Barclays will provide loans to private companies of up to \$2m, at 9% per annum. A bankable business plan is the main requirement.  Insight Consulting will connect a private company with European or American financiers for biogas plant construction. Loans of between 5-10% per annum will be provided.

**Information on partners, their experience and capacity and the co-financing / financing means available**

Name of the organisation	Operational Since	Main Activities	Number of Professional Staff (MSc and above)	Estimated Annual Budget	Financing towards GEF-supported activities
1. Botswana Institute for Technology Research and Innovation	2014	Technology Research in Technologies (ICT & Energy) and Natural Resources and Materials (Nanomaterials, Building Materials and Climate Change)	61 Researchers (30 PhDs)	Estimated annual budget for 2015/16: USD 6.1 million (Recurrent), USD 7.2 million (R&D)	BITRI: USD 200,000 in-kind for office space, staff salaries and a waiver for 20% overhead costs.
2. Botswana Meat Commission	1965	Cattle abattoir and cutting plant; Canning facility	20	USD 103 million	USD 3 million in cash for investment in biogas technology, USD 7.15 million in-kind for recurrent costs, operational costs and participation in policy formulation.
3. Department of Environmental Affairs (DEA)	First established as National Conservation Strategy in 1992	Policy development and enforcement of the Environmental Assessment Act	8	USD 3 million	In-kind contribution (staff time regarding EIAs of biogas projects).
4. Department of Waste Management and Pollution Control (DWMPC)	2005	Development of policy and standards. Licensing, inspections and environmental audits. Prevention and monitoring of pollution to the environment.	10	USD 2.23 million	USD 1.5 million in-kind for development of integrated waste management policy and enforcement.
5. Ministry of Environmental Affairs, Wildlife and Tourism	Ministry established in 2002 (National Conservation Strategy, then renamed Department of Environmental Affairs)	<i>Refer to DWMPC and DEA</i>	<i>Refer to DWMPC and DEA</i>	<i>Refer to DWMPC and DEA</i>	USD 75,000 in-kind for waste management policy development, knowledge management and sharing, and high-level support from ministry management (additional contribution through DEA and DWMPC).
6. Botswana Development Corporation	1970	Developmental financial institution providing	10	<i>Cannot be revealed</i>	USD 4.6 million for commercial loans

n		funding to commercially viable projects			
7. Energy Affairs Division	1995	National Energy Policy and Renewable Energy Policy Development	8	USD 2 million	Staff time regarding development of a bioenergy strategy.
8. Ministry of Local Government & Rural Development: Department of Primary Healthcare Services	2009	Coordinate implementation of environmental health programmes for councils.	2 (the relevant division only has 3 staff)	USD 2.3 million	Staff time to support councils to participate in the project.

## Management Arrangements



Implementation of the project will be coordinated by the Ministry of Environment, Wildlife and Tourism (MEWT), as represented by Botswana Institute for Technology, Research and Innovation (BITRI). BITRI, in close cooperation with the Department of Waste Management and Pollution Control of MEWT, will take overall responsibility for the project's implementation, and the timely and verifiable attainment of project objectives and outcomes. MEWT will nominate a high-level official as a UNDP Focal Point, who will provide



Government oversight and guidance on the project's implementation. The MEWT project Focal Point will not be paid from the project funds but will, rather, represent a Government in-kind contribution to the project.

Working closely with BITRI, the UNDP Country Office will be responsible for: (i) providing financial and audit services to the project; (ii) recruitment of project staff and contracting of consultants and service providers; (iii) overseeing financial expenditures against project budgets approved by the Project Steering Committee; (iv) appointment of independent financial auditors and evaluators; and (v) ensuring that all activities, including procurement and financial services, are carried out in strict compliance with UNDP-GEF procedures. A Programme Associate (a BITRI staff member) will be assigned with responsibility for the day-to-day management and control of project finances. BITRI will ensure a Mid-Term Review and Terminal Evaluation are conducted, and will ensure that they are thorough and completely independent.

A Project Steering Committee (PSC) will be established at the inception of the project to monitor its progress, to guide its implementation and to support the project in achieving its listed outputs and outcomes. It will be chaired by the Ministry of Environment, Wildlife & Tourism and co-chaired by UNDP, and will include the Focal Point from the Ministry of Local Government and Rural Development, a member from the Ministry of Minerals, Energy and Water Resources (MMEWR), a representative of BITRI, and members of the financial and private sectors. Other members can be invited at the discretion of the PSC on an as-needed basis, all the while ensuring that the PSC remains sufficiently lean to be operationally effective. The final list of PSC members will be completed at the outset of project operations and presented in the Inception Report by taking into account the envisaged role of different parties in the PSC. The Project Manager serving as the Secretariat will be responsible for compiling a summary report of the discussions and conclusions of each PSC meeting.

The Project Steering Committee is responsible for making executive decisions for the project and provide guidance as required by the Project Manager. The PSC will receive the reports and make recommendations as well as approving the work-plans and budgets. It also ensures that required resources are committed and arbitrates on any conflicts within the project or negotiates a solution to any problems with external bodies. Based on the approved Annual Work Plan, the Project Steering Committee also considers and approves the quarterly plans (if applicable) and also approves any essential deviations from the original plans. The Project Steering Committee decisions will be made in accordance with standards that shall ensure management for development results, best value for money, fairness, integrity, transparency and effective international competition. In case consensus cannot be reached within the PSC, the final decision shall rest with UNDP.

The day-to-day management of the project will be carried out by a Project Management Unit (PMU) housed at BITRI and under the overall guidance of the Project Steering Committee. The Project Manager (PM) will report to BITRI, UNDP and the PSC. The Terms of Reference of the Project Manager are presented in an annex of the Project Document. The project personnel will be selected on a competitive basis in accordance with the relevant UNDP rules and procedures and in consultation with the UNDP-GEF Regional Technical Advisor. Gender balance will be observed as much as possible.

The PM will produce Annual Work and Budget Plans (AWPs & ABPs) to be approved by the PSC at the beginning of each year. These plans will provide the basis for allocating resources to planned activities. Once the PSC approves the Annual Work Plan, it will be sent to the UNDP Regional Technical Advisor at the UNDP Regional Centre in Addis Ababa for revision and approval. Once the Annual Working Plan and Budget is approved by the Regional Centre, it will be sent to the UNDP-GEF Unit in New York for final approval and release of the funding. The PM will further produce quarterly operational reports and Annual Progress Reports (APRs) to the PSC, or any other reports at the request of the PSC. As in the case of the Annual Work Plans, these reports are sent for approval and clearance to the UNDP Regional Centre in Addis Ababa. These reports will summarise the progress made by the project versus the expected results, explain any significant variances, detail the necessary adjustments and be the main reporting mechanism for monitoring project activities.

The Project Manager will be supported by international and national experts taking the lead in the implementation of specific technical-assistance components of the project. Contacts with experts and institutions in other countries that have already gained experience in developing and implementing renewable energy policies and financial-support mechanisms are also to be established.

For successfully reaching the objective and outcomes of the project, it is essential that the progress of different project components will be closely monitored both by the key local stakeholders and authorities as well as by the project's international experts, starting with the finalisation of the detailed, component-specific work plans and implementation arrangements and continuing through the project's implementation phase. The purpose of this is to facilitate early identification of possible risks to the successful completion of the project.

**B.2 Describe the socioeconomic benefits to be delivered by the Project at the national and local levels, including consideration of gender dimensions, and how these will support the achievement of global environment benefits (GEF Trust Fund/NPIF) or adaptation benefits (LDCF/SCCF):**

With the construction of small-scale biogas digesters (4-300 m<sup>3</sup>) employment will be created for local masons and small-scale construction companies. An estimated 50 masons will find employment over the project period (1 mason constructs approximately 20 digesters per year). A small workforce is required for a short period of time (typically up to 3 weeks) for the construction of medium-scale (300-5,000 m<sup>3</sup>) biogas digesters. After construction, at least one operator and assistant will be employed full time per medium-sized biogas digester. Local companies will be hired from time to time to perform maintenance and repair. Staff of councils, the financial sector, etc. will take on biogas-related duties as an additional task. It is expected that the number of masons / operators / others will increase after the project period, as the project is expected to expand throughout the country.

In Botswana, woodfuel, in the form of firewood, continues to be a major source (80%) of energy for rural and low-income urban communities. It is mainly used for cooking, space heating and lighting. There are opportunity costs associated with the long hours spent by women and girls collecting fuelwood. Studies conducted on gender and energy in Botswana since 2003 by organizations such as AFRPREN and ENERGIA reached some of the conclusions below:

- Females are the individuals most involved in fuelwood collection, spending on average over 3 hours a day on the task. This adds to the drudgery and insecurity of their daily lives and deprives women of time they could have used to improve their lives, for example by undertaking income-generating activities. Moreover, women are more amenable to adopting energy-efficient technologies, especially if the technologies can help reduce their workload.
- The time and physical effort expended by women and girls in gathering fuel and carrying water limits their ability to engage in educational and income-generating activities. Much of the women's time is taken up with difficult and time-consuming chores related to producing and processing food without mechanical or electrical equipment and to cooking without clean-burning fuels and energy efficient appliances.
- Women make decisions on which energy technologies and fuels to use for cooking – which is an important consideration as far as adoption of cleaner energy fuels/sources is concerned.
- Female-headed households had lower incomes than their male counterparts in both rural and urban areas. There were also more female-headed households (41%) below the poverty datum line than male-headed households (34%). Both income and poverty levels affect affordability of energy services, thus making provision of energy in the country a gender-skewed issue.
- Both income and poverty levels affect affordability of energy services, thus making provision of energy in Botswana a gender issue.
- The number of female professionals in major energy organisations in the country is insignificant (<5%).

The findings from the studies above point to a significant gender dimension with regard to energy use in the rural context. The inability to address this critical issue during the planning, implementation and monitoring of an energy programme can lead to the programme being unable to achieve some of its objectives. It is therefore fully recognised as imperative that gender is mainstreamed in the GEF-financed biogas project. This will involve gender training for project stakeholders, gender analysis of the biogas project prior to its implementation in order to establish the detailed biogas requirements of both women and men, and development of gender indicators to be used during implementation, monitoring and evaluation.

In order to achieve gender equity in the Botswana GEF-financed biogas project, project activities with specific gender equality outputs outlined below will be undertaken:

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

Social and economic benefits to be derived from the Botswana project include increased incomes for women and men through construction and marketing of biodigesters, and increased output from agro-businesses such as horticulture (vegetable production) due to the application of bio-slurry as well as sale of excess bio-slurry and increased availability of food.

### **B.3. Explain how cost-effectiveness is reflected in the project design:**

The GEF financing for Component 1 will consist of grants for technical assistance, which will support the further development of policies, regulations, and baseline studies, technical requirements for waste management and biogas technology to support the waste management and biogas / bio-methane sector in Botswana. Together, these initiatives are expected to foster a regulatory environment for attracting investments for privately-owned, off-grid and grid-connected biogas systems for power generation, direct use and utilisation of bio-fertilizer and for facilitating effective monitoring, quality control and dissemination of the results of the RE investments made.

In addition, the activities of Component 2 create an overall environment for the development of biogas technology. The deployment of GEF funds is cost-effective as the output of the project will be the development of a sector that will continue even after the project period. Widespread capacity will be developed, thereby enabling national Government and district council staff to promote and realise the utilisation of agro-waste for biogas generation. Numerous barriers have to be removed if a conducive environment is to be created, and there is a need for stakeholders from within the Botswana Government, private sector, financial sector, civil society and the general public to coordinate within the framework of the GEF-financed project to successfully implement the Integrated Waste Management Policy and construct, manage and operate biogas technology.

The GEF support related to Component 2 will support<sup>34</sup> the construction of 1,000 small-scale biogas digesters that will handle waste streams produced by small-scale agro-industrial enterprises and households. In addition, support will be rendered for the construction of 3 medium-scale biogas digesters (1 MW each) at large agro businesses such as the Botswana Meat Commission. The benefits will include secure and independent power

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<sup>34</sup> Support includes: training of masons, promotion, quality control, monitoring, user training, financing.  
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supply at competitive cost, and reduced CO<sub>2</sub> emissions at a reasonable cost to the GEF of GEF USD 1.66/tCO<sub>2</sub>e<sup>35</sup>.

The GEF funding will help support the optimal design and operation of these plants, resulting in the highest efficiency achievable and, therefore, the greatest reduction in greenhouse gas emissions. In the absence of GEF support, it is likely that the construction of biogas plants will be considerably delayed and, when constructed, it is likely that the plants would suffer sub-optimal performance. Therefore, the relatively small GEF funding will catalyse a relatively large deployment of biogas technology and effective utilisation of that capacity, resulting in a very cost-effective reduction of greenhouse gas emissions.

### *Digestate*

Medium-scale digesters: After digestion, the digestate will be separated into a wet fraction and a dry fraction. The wet fraction will be stored or used directly to fertilize feedlots or other plantations close to the biogas facility. The dry fraction will be dried using the excess heat of the CHP. The dried digestate will be sold to an organic fertilizer company or pelletized at the biogas facility itself. The organic fertilizer pellets can then be easily transported throughout Botswana.

Small-scale digesters: The digestate will be collected in compost pits and mixed with organic materials. From time to time, the mixture will be tilted. When composting is completed it can be removed from the pit and transported to nearby farmers and applied as organic fertilizer. The risk of pathogen contamination in food grown using bio-slurry is less than that using fresh farm yard manure<sup>36</sup>, the current predominant standard practice. Nonetheless, simple-to-use guidance materials will be provided to small- and medium-scale digester owners, advising them on how to safely use digestate.

A private company, Organic Fertilizer Manufacturers Botswana, currently applies South African standards for bio-fertilizer in order to be able to export bio-fertilizer. The project will adopt these standards as an interim measure and thereafter stakeholders will agree on quality standards and appropriate utilisation of biogas digestate<sup>37</sup>. Monitoring and certification will be done by the Ministry of Agriculture as part of ongoing agricultural support activities. Under the Integrated Support Programme for Arable Agriculture Development (ISPAAD), the Ministry provides farmers with fertilizers and also provides, through district demonstration officers, guidance to the farmers (commercial and subsistence) on the use of fertilizers. An inventory on the annual use of fertilizers is also maintained. The Ministry is also currently certifying performance standards for horticultural activities, agricultural engineering and sorghum production. The GEF project will use this existing Ministry architecture for regulating fertilizer use.

In sum, the activities of the UNDP-implemented, GEF-financed project will combine to mobilise considerable co-financing (USD 16.7 million) and enable future investments that would be very difficult to achieve through a less comprehensive intervention

### **C. DESCRIBE THE BUDGETED M & E PLAN:**

The project will be monitored through the following M&E activities. The M&E budget is provided in the table below.

#### **Project start:**

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<sup>35</sup> The bottom-up indirect emissions (inclusive of leakage “12%”) are 1,587,231 tCO<sub>2</sub> over the 10-year post-project period. The GEF Project cost of USD 2,632,300 divided by the total indirect emissions are at USD 1,66 tCO<sub>2</sub>e.

<sup>36</sup> Alterra Wageningen UR & Nutrient Management Institute NMI (2014), *Bio-slurry as Fertilizer*, [http://www.academia.edu/18055905/Bioslurry\\_as\\_a\\_fertilizer](http://www.academia.edu/18055905/Bioslurry_as_a_fertilizer).

<sup>37</sup> Appropriate management of biogas digestate will have benefits including: lower gaseous emission; less diffuse pollution from surface run off and leaching; reduced odours, improved veterinary safety, plant pathogen reduction and the reduction of weed seeds. Source: IEA Bioenergy (2010), *Utilisation of Digestate from Biogas Plants as Biofertiliser*.

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A Project Inception Workshop will be held within the first 2 months of project start with those with assigned roles in the project organisational structure, the UNDP Country Office and, where appropriate/feasible, regional technical policy and programme advisers, as well as other stakeholders. The Inception Workshop is crucial to building ownership for the project results and to plan the first year's annual work plan.

The Inception Workshop will address a number of key issues, including:

- Assist all partners to fully understand and take ownership of the project. Detail the roles, support services and complementary responsibilities of UNDP CO and RCU staff vis-à-vis the project team. Discuss the roles, functions and responsibilities within the project's decision-making structures, including reporting and communication lines, and conflict-resolution mechanisms. The Terms of Reference for project staff will be discussed again as needed.
- Based on the project results framework and the CC-M GEF Tracking Tool, finalise the first annual work plan. Review and agree on the indicators, targets and their means of verification, and re-check assumptions and risks.
- Provide a detailed overview of reporting, monitoring and evaluation (M&E) requirements. The Monitoring and Evaluation work plan and budget will be agreed and scheduled.
- Discuss financial reporting procedures and obligations, and arrangements for the annual audit.
- Plan and schedule Project Steering Committee meetings. Roles and responsibilities of all project organisation structures should be clarified and meetings planned. The first Project Steering Committee meeting will be held within the first 12 months following the inception workshop.
- An Inception Workshop report is a key reference document and will be prepared and shared with participants to formalise various agreements and plans decided during the meeting.

#### **Quarterly:**

Progress made will be monitored in the UNDP Enhanced Results Based Management Platform. Based on the initial risk analysis submitted, the risk log will be regularly updated in ATLAS. Risks become critical when the impact and probability are high. Based on the information recorded in Atlas, a Project Progress Reports (PPR) can be generated in the Executive Snapshot. Other ATLAS logs can be used to monitor issues, lessons learned, etc. The use of these functions is a key indicator in the UNDP Executive Balanced Scorecard.

#### **Annually:**

Annual Project Review/Project Implementation Reports (APR/PIRs): This key report is prepared to monitor progress made since project start and in particular for the previous reporting period (30 June to 1 July). The APR/PIR combines both UNDP and GEF reporting requirements. The APR/PIR includes, but is not limited to, reporting on the following:

- Progress made toward project objective and project outcomes – each with indicators, baseline data and end-of-project targets (cumulative).
- Project outputs delivered per project outcome (annual).
- Lessons learned/good practice.
- AWP and other expenditure reports
- Risk and adaptive management
- ATLAS QPR

#### **Periodic monitoring through site visits:**

The UNDP Country Office will conduct visits to project sites based on the agreed schedule in the project's Inception Report/Annual Work Plan to assess project progress at first-hand. Other members of the Project Steering Committee may also join these visits. A Field Visit Report/BTOR will be prepared by the CO and will be circulated no less than one month after the visit to the project team and Project Steering Committee members.

#### **Mid-term of project cycle:**

The project will undergo an independent Mid-Term Review at the mid-point of project implementation (approximately October 2017). The Mid-Term Review will determine progress being made toward the achievement of outcomes and will identify course correction if needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. The organisation, terms of reference and timing of the Mid-Term Review will be decided after consultation between the parties to the project document. The Terms of Reference for this Mid-Term Review will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit. The GEF Climate Change Mitigation Tracking Tool will also be completed during the Mid-Term Review cycle.

**End of project:**

An independent Terminal Evaluation will take place three months prior to the final Project Steering Committee meeting and will be undertaken in accordance with UNDP and SOF (GEF) guidance. The final evaluation will focus on the delivery of the project's results as initially planned (and as corrected after the Mid-Term Review, if any such correction took place). The final evaluation will look at the impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefits/goals. The Terms of Reference for this evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit.

The Terminal Evaluation should also provide recommendations for follow-up activities and requires a management response which should be uploaded to PIMS and to the [UNDP Evaluation Office Evaluation Resource Center \(ERC\)](#).

The GEF Climate Change Mitigation Tracking Tool will also be completed during the Terminal Evaluation.

During the last three months, the project team will prepare the Project Terminal Report. This comprehensive report will summarise the results achieved (objectives, outcomes, outputs), lessons-learned, problems met and areas where results may not have been achieved. It will also lay out recommendations for any further steps that may need to be taken to ensure sustainability and replicability of the project's results.

**Learning and knowledge sharing:**

Results from the project will be disseminated within and beyond the project intervention zone through existing information-sharing networks and forums.

The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks which may be of benefit to project implementation through lessons-learned. The project will identify, analyse and share lessons learned that might be beneficial in the design and implementation of similar future projects.

Finally, there will be a two-way flow of information between this project and other projects of a similar focus.

### M&E workplan and budget

<b>Type of M&amp;E activity</b>	<b>Responsible Parties</b>	<b>Budget US\$ <i>Excluding project-team staff time</i></b>	<b>Time Frame</b>
Inception Workshop and Report	Project manager supported by an International Expert, MEWT, BITRI UNDP CO, UNDP GEF	Indicative cost: 10,000	Within first two months of project start-up
Measurement of Means of Verification of project results.	Project manager will oversee the hiring of specific studies and institutions, and delegate responsibilities to relevant team members	Indicative costs: 15,000	Start, mid- and end of project (during evaluation cycle) and annually when required.
Measurement of Means of Verification for Project Progress on output and implementation	Oversight by project manager Project team	Indicative costs: 15,000	Annually prior to ARR/PIR and to the definition of annual work plans
ARR/PIR	Project manager and team MEWT, BITRI, UNDP CO, UNDP RTA	None	Annually
Periodic status/ progress reports	Project manager and team	None	Quarterly
Mid-Term Review	Project manager and team, MEWT, BITRI, UNDP CO, UNDP RCU External consultants (i.e. evaluation team)	Indicative cost: 35,000	At the mid-point of project implementation.

<b>Type of M&amp;E activity</b>	<b>Responsible Parties</b>	<b>Budget US\$ <i>Excluding project-team staff time</i></b>	<b>Time Frame</b>
Terminal Evaluation	Project manager and team, BITRI, UNDP CO, UNDP RCU External Consultants (i.e. evaluation team)	Indicative cost: 35,000	At least three months before the end of project implementation
Project Terminal Report	Project manager and team UNDP CO Local consultant	15,000	At least three months before the end of the project
Financial Audits	UNDP CO Project manager and team	Indicative cost per year: 3,000	Yearly
Visits to field sites	UNDP CO UNDP RCU (as appropriate) Government representatives	For GEF-supported projects, paid from IA fees and operational budget	Yearly
<b>TOTAL indicative COST</b> Excluding project-team staff time and UNDP staff and travel expenses		US\$122,000 (+/- 5% of total budget)	




**PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)**

**A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT(S) ON BEHALF OF THE GOVERNMENT(S):**  
 (Please attach the [Operational Focal Point endorsement letter\(s\)](#) with this form. For SGP, use this [OFP endorsement letter](#)).

NAME	POSITION	MINISTRY	DATE (MM/dd/yyyy)
<b>Khulekhani Mpufu</b>	Chief Natural Resource Officer & GEF Operational Focal Point	MINISTRY OF ENVIRONMENT, WILDLIFE AND TOURISM	16 <sup>TH</sup> JUNE 2015

**B. GEF AGENCY(IES) CERTIFICATION**

This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for CEO endorsement/approval of project.

Agency Coordinator, Agency Name	Signature	Date (Month, day, year)	Project Contact Person	Telephone	Email Address
Adriana Dinu, UNDP/GEF Executive Coordinator		April 22, 2016	Robert Kelly EITT Regional Technical Advisor	+251 91250 3306	<a href="mailto:Robert.kelly@undp.org">Robert.kelly@undp.org</a>

**ANNEX A: PROJECT RESULTS FRAMEWORK** (either copy and paste here the framework from the Agency document, or provide reference to the page in the project document where the framework could be found).

**This project will contribute to achieving the following Country Programme Outcome (CPO) as defined in CPAP or CPD:** The project specifically contributes to CPO: Improved National capacity and community participation (especially women and youth) in the management of water resources including trans-boundary management, sanitation and hygiene; CPAP: Strengthened capacity for management of water resources, pollution and sanitation for increased awareness and UNDAF Outcome 4, Environment and Climate Change: By 2016, the rural poor, especially women, are deriving greater benefits from the environment and natural ecosystems.

**Country Programme Outcome Indicators:** UNDP Country Programme Output 4.3 on Enhanced National Capacity for Climate Change Adaptation and Mitigation.

**Primary applicable Key Environment and Sustainable Development Key Result Area:**

**1. Mainstreaming environment and energy**

**Applicable GEF Strategic Objective and Programme:** GEF-5 FA Objective # 3 (CCM-3): “Promote Investment in Renewable Energy Technologies”

	Indicator	Baseline	Targets End of Project	Source of verification	Risks and Assumptions
<b>Project Objective</b> To facilitate low-carbon investments and public-private partnerships in the production and utilisation of biogas from agro-waste in the districts of South-Eastern Botswana.	Amount of reduced CO <sub>2</sub> emissions as a result of investments facilitated by the project.	0 <sup>38</sup>	Installations in place and operating to achieve direct and indirect reductions of 1.65 million tonnes CO <sub>2</sub> .	Project monitoring reports and final evaluation.	It is assumed that the DWMPC will formulate an updated Waste-Management Policy that includes CO <sub>2</sub> reduction.
	Project beneficiaries	0	Minimum of 3 medium-scale agro-industries installed and operational; 1,000 small-scale agro-businesses utilising agro-waste streams for biogas digestion; at least 2 District Councils utilising organic waste for biogas digestion. At	Project monitoring reports and final evaluation.	The project’s barrier removal strategy can be successfully implemented. The Government maintains the commitments it has stated in Parliament and in Botswana’s INDC.

<sup>38</sup> During the project preparation period, the PPG team visited a number of sites with agro-waste and it was observed that waste was in all instances deposited into a pit or lagoon type of storage. No systematic plans for installing biogas technology are known of by Government, local council and local bank stakeholders. The baseline may feature occasional, ad hoc, isolated biogas installations in the coming years but the baseline can accurately be characterised as essentially business-as-usual (i.e. no significant biogas developments).

	Energy generation using biogas	0	least 2 companies constructing biogas digesters and 75 masons trained and employed.  350,000 MWh	Project monitoring reports and final evaluation. Performance-based payments to medium-scale digester operators.	Sustained O&M of digester units to ensure ongoing usage.
	Number of new development partnerships with funding for improved sustainable energy solutions	0	3 Public-Private Partnerships in place to facilitate biogas investment.	As applicable, post-project market monitoring and evaluations.	It is assumed that Councils will pursue their legal ability and stated interest in entering into PPPs.
<b>Outcome 1</b> Increased capacity of Government, private sector and community stakeholders to develop, finance and implement PPPs in the agro-waste sector.  Increased capacity of Government authorities to properly monitor and enforce waste management	Extent to which policies and regulations for waste management in the agro-sector are adopted and enforced.  Extent of willingness of stakeholders to invest to scale-up waste management and biogas technology.	Poor infrastructure maintenance and weak monitoring and enforcement capacity of waste treatment regulations.  Lack of specific guidelines or policies on biogas resources and absence of an appropriate legal and regulatory framework on the utilisation of biogas from agro-	Specific guidelines on low-carbon alternatives and utilisation technologies for agro-waste and wastewater developed and disseminated.  Framework agreement for at least 3 public-private partnerships (PPP) in the waste sector and biogas related in place and implemented.  Up-to-date regulations developed and adopted for the successful monitoring of	Official Government publications.  Project final evaluation.  Post-project monitoring, as applicable.	The proposed legal and regulatory improvements pass swiftly through the Government approval process.  Adequate demand for, and competitively priced financing products able to provide, long-term financing. Banks' requirements for securities within clients' limits.

<p>regulations in the agro-industrial sector.</p> <p>Autonomous support systems in place for replication and scale-up of agro-waste technologies post-project.</p>		<p>waste and wastewater. Insufficient capacity of relevant financial institutions and stakeholders (including banks) to assess the technical risks and benefits of investing in biogas technologies.</p>	<p>effluent flows.</p> <p>Financial institutions invest in at least 3 biogas plants.</p> <p>Investment funds easily available for development of agro-waste project with biogas technology.</p>		
<p><b>Outcome 2</b></p> <p>Increased investment in clean-energy technologies and low-carbon practices in the agro-waste sector.</p>	<p>Number of biogas digesters constructed and in use.</p> <p>Total capacity (in m<sup>3</sup>) of installed biogas digesters constructed and electricity generated.</p>	0	<p>One thousand (1,000) small-scale biogas digesters constructed and operational.</p> <p>Three medium-sized biogas digesters constructed and operational.</p> <p>Finalised proposal to construct a centralised biogas digester of an estimated 15,000 m<sup>3</sup> or larger with facility to upgrade to bio-methane and utilisation.</p> <p>At least 3,000 m<sup>3</sup> biogas per annum and 3 MW of electricity installed.</p>	Project monitoring reports and final evaluation.	
<p><b>Outcome 3</b></p> <p>Increased investment in less</p>	Total annual investment in biogas technology.	0	At least three financial institutions have incorporated the financing of biogas technology in their national	Annual reports.	The investment in biogas technology is no longer deemed bankable; focus on other technologies for waste

GHG-intensive energy systems using biogas.			portfolios.		management.
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**ANNEX B: RESPONSES TO PROJECT REVIEWS** (from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion and the Convention Secretariat and STAP at PIF).

<b>STAP Comments</b>	<b>CEO Endorsement reply</b>
Biogas is corrosive. Please identify the materials that will be used in construction to prevent corrosion of the plant.	Pre-treated steel panels with a ceramic-like coating <sup>39</sup> can be used to prevent corrosion. In addition, the project will ensure that stakeholders are aware of corrosion-related issues and will ensure that high-quality and durable biogas technology will be selected.
Waste-to-energy through the biogas route can add value, depending on whether the biogas is scrubbed to produce bio-methane for use as a transport fuel, for electricity generation, or simply combusted uncurbed to provide heat. Power generation linked with solar PV is one case study under evaluation.	Initially, the project will focus on the direct use of biogas for power generation or direct use for heating. In the third or fourth year of the project, stakeholders will have gained adequate knowledge to design and develop a larger scale (> 15,000 m <sup>3</sup> ) biogas digester. One of the options that could be incorporated at that stage is to design a hybrid system including solar PV in combination with biogas for power production. This option will be explored in detail at the appropriate time.
The comparative costs of displacing LPG with some biogas are not clear. Cost analyses should include the value available for soil nutrients and conditioners from applying the co-product solid residues to the soils after AD.	<p>For bio-methane upgrading: to replace LPG with compressed biogas requires a large investment. First, the upgrade from biogas to bio-methane requires substantial investment (e.g. the investment cost to upgrade to bio-methane with capacity of 200 m<sup>3</sup>/hour is an estimated US\$ 1.1 million). Second, the bio-methane has to be compressed to 200-25 bar, which requires yet another large investment. Third, special gas bottles are required. In addition to working with high pressure, compressed bio-methane requires additional safety measures as well as compliance with strict health and safety regulations.</p> <p>For small-scale and medium-scale: the income from the production and sale of bio-fertilizer is included in the financial analysis presented in the Project Document. As there are no reliable data on the potential use of bio-fertilizer, the revenues on the sale of bio-fertilizer used in the financial analysis are conservative figures. During the implementation of the project, the benefits of bio-organic fertiliser will be studied.</p>
It is not clear why Weltec was selected to provide the AD technology when a very wide range of AD manufacturers exist worldwide. Was this the result of an open tender process?	Weltec has not been selected through a tender process but was included in the PIF as the company has established close links with BIOSYS. BIOSYS is a locally registered company and the managing directors used to work with staff of WELTEC. Stakeholders expressed concerns on this issue during project preparation and, as a result, the Project Document contains an explicit condition that transparent tender procedures will be followed during procurement, as is anyway required by the Government of Botswana and by UNDP.
The GHG emission reduction analysis is logical but there are concerns over leakage of bio-methane (with a GWP ~ 23) which can negate the benefits observed to date. The GHG missions avoided depend on the estimates used for using bio-methane as alternative fuel in small LDVs, diesel rail, power plants, and the time of generation and dispatch.	Due to the change of project strategy, a new GHG calculation has been undertaken. The plan to upgrade biogas to bio-methane has been postponed to the second half of the project period. Initially, the project will focus on the construction of small- and medium-scale biogas digesters as necessary skill-building and experience-building intermediate steps to the deployment of large-scale bio-methane facilities. A discount factor (12%) has been applied to (over-)compensate for potential leakage.
The project proposes to conduct feasibility	A spatial analysis will not be included in the feasibility study.

<sup>39</sup> Coated with titanium oxide or other porcelain materials or epoxy coated steel tanks.  
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<p>studies at three potential sites, one of which has already been selected (BMC Lobatse abattoir). Has there been any spatial analysis (e.g. using a GIS) (or will there be as part of the feasibility study) to ensure that the fuel supply and demand are optimized? There are many studies that use a GIS-based approach for exactly this purpose.</p>	<p>Following consultations with stakeholders, it has become apparent that no such analysis has been conducted before in the waste sector and local capacities to implement or oversee such a study are limited. A baseline study will be carried out to map sites that contain waste streams suitable for biogas utilisation.</p>
<p>The proposal outlines the potential economic benefits of the project. It might be helpful to cite sources stating that biogas from anaerobic digestion are relatively labour-intensive and can play a positive role in maintaining and developing the rural economy.</p>	<p>The construction of small-scale biogas digesters (4- 250 m<sup>3</sup>) will be undertaken by local masons and companies. This translates into an estimated 50 masons over the project period (1 mason constructs approximately 20 digesters per year). For the construction of medium-scale (300-5,000 m<sup>3</sup>) biogas digesters, a small workforce is required for a short period of time (typically up to 3 weeks); thereafter, one operator and assistant will be employed full time per biogas digester. Staff of councils, the financial sector, etc. will take on biogas-related duties as an additional task. It is expected that the number of masons / operators / others will increase after the project period, as the project is expected to expand throughout the country.</p>
<p>Has the project taken maintenance costs into consideration? An estimate for maintenance costs for a digester in Tanzania is \$50,000/year.</p>	<p>For the financial analysis of a medium-scale biogas digester, 10% (a standard rule-of-thumb used in the industry worldwide) of the total investment cost is allocated for operational and maintenance costs. The level of operational cost and maintenance is variable and is influenced by the size of the digesters, the selected technology and the type of feedstock. Only at the time of a detailed feasibility study can the exact cost be calculated. For now, the 10% figure is indicative and serves the purpose of this proposal.</p>
<p>The proposal lists two moderate/high risks that are of significant concern: scarce water supplies and potential reductions in rainfall that will result in major losses of livestock, upon which the bio-methane project is dependent. Has the project considered the longer term risks associated with changes in ecosystem productivity and structure due to both biotic (human) and abiotic factors? What about prolonged dry periods due to ENSO potentially exacerbated by climate change.</p>	<p>The availability of livestock for abattoirs is subject to seasonality. Before the dry period, farmers tend to sell more cattle; during the wet season, farmers tend to retain cattle. It is therefore crucial that the design of the biogas digesters takes this seasonality into consideration. This has been addressed in the UNDP-implemented, GEF-financed project through (i) appropriate design and sizing of the medium-scale biogas digesters with a variable holding period of the feedstock from 10-20 days and (ii) opportunity for supplementary feeding: in case one feedstock is in short supply another feedstock can be added to the biogas digester ensuring consistent gas production. The project has not considered the long-term effects of the biotic and abiotic factors as these are considered beyond the scope of this project framework.</p> <p>The North-South water carrier is nearing completion and will connect dams located in North Eastern Botswana to South Eastern Botswana. This North-South carrier will provide sufficient and reliable water supply to the population and industry in South Eastern Botswana.</p>
<p><b>GEF Council comments: <i>Germany approves the following PIF in the work programme but asks that the following comments are taken into account:</i></b></p>	
<p>The PIF provides many details. Germany would like to suggest elaborating further on the assessment of the appropriateness of using the biogas to replace fossil fuels in vehicles. It is also suggested to exchange with producers of biogas fuel stations and a project funded by the</p>	<p>Following in-depth analysis and extensive stakeholder consultations, it was decided that large-scale biogas digesters with bio-methane and compression facilities are not an appropriate technology choice in the current Botswanan context. Stakeholder are not ready to invest and the benefits of a large-scale project are not convincing at this stage. Therefore, the use of biogas in vehicles, which would require</p>

<p>International Climate Initiative of the German Federal Ministry for the Environment, Nature Protection, Nuclear Safety and Construction (BMUB) regarding a similar project funded in Brazil and implemented by the Fraunhofer Institute for Interfacial Engineering and Biotechnology.</p>	<p>such purification (to result in bio-methane) and compression, has not been explored in greater detail. However, when stakeholders investigate the viability of large-scale biogas digesters in the third or fourth year of the project, the suggestion of the Government of Germany will certainly be taken into consideration.</p>
<p><b>GEF Secretariat Comments</b></p>	<p><b>CEO Endorsement Reply</b></p>
<p>Details are expected by CEO endorsement, on how the project will ensure the financial means necessary to continue the needed training will be sustained beyond project completion.</p>	<p>After the project implementation period comes to an end, training of masons and supervisors (who will be responsible for the construction of small-scale biogas digesters) will be undertaken by a training institution (to be identified) on commercial terms. Training for staff of medium-scale biogas digesters will be performed by the technology provider and is included in the overall cost of construction and operations.</p>
<p>The CEO endorsement request is expected to clarify what the co-financing sources (and UNDP in particular) will support and how these activities are necessary for the achievement of the project's objectives.</p>	<p>Co-financing is allocated for creating an enabling environment for waste management and development of biogas technology, supporting investment in biogas technology, and for capacity development. The sources of co-finance and the functions this co-finance will perform are listed below:</p> <ul style="list-style-type: none"> <li>- MEWT: USD 75,000 in-kind for waste management policy development, knowledge management and sharing aspects of the project include high level support from ministry management</li> <li>- DWMPC: US\$ 1.459 million in-kind for development of integrated waste management policy and enforcement.</li> <li>- BITRI: US\$ 200,000 in-kind for office space, staff salaries and a waiver for 20% overhead cost.</li> <li>- BMC: US\$ 3 million in cash for investment in biogas technology, US\$ 7.15 million in-kind for recurrent costs, operational costs and participation in policy formulation.</li> <li>- UNDP: US\$ 200,000 in cash towards project management.</li> <li>- BDC: US\$ 4.6 million for commercial loans</li> </ul>
<p>Details are expected at CEO endorsement request on the eventual further need for subsidies for replications, and the proposed investment facilitation platform, its partners, their experience and capacity and the co-financing/financing means available (especially for the investments facilitation).</p>	<p>Considering the outcome of an ongoing initiative of the Government of Botswana to address renewable energy, it cannot be predicted what level of subsidy will be needed in 2020. It is envisaged that an attractive REFIT policy will shortly be in place to support grid-connected renewable energy investment projects, including biogas projects. Meanwhile, the work of the GEF-financed project to develop the supply- and demand-side of the market and to involve private sector actors (including domestic banks) will serve to build a self-sustaining commercial dynamic to market development.</p>

## **PIMS 5299 – Promoting production and utilisation of biogas from agro-waste in South-Eastern Botswana**



Questions	Secretariat Comment At CEO Endorsement (FSP)	Response	Reflection in CEO ER
7. Are the components, outcomes and outputs in the project framework (Table B) clear, sound and appropriately detailed?	Please clarify what will happen to the remaining wastes after biogas fermentation. If an agricultural use is considered, please clarify (i) how the quality of the product will be monitored and certified, and (ii) whether the distribution of the remaining waste can be organized in a range wide enough to avoid too high concentration of fertilizer in soil and subsequent run-off.	<p>Large Scale: After digestion, the digestate will be separated into a wet fraction and a dry fraction. The wet fraction will be stored or used directly to fertilize feedlots or other plantations close to the biogas facility. The dry fraction will be dried using the excess heat of the CHP. The dried digestate will be sold to an organic fertilizer company or pelletized at the biogas facility itself. The organic fertilizer pellets can then be easily transported throughout Botswana.</p> <p>Medium/small scale: The digestate will be collected in compost pits and mixed with organic materials. From time to time, the mixture will be tilted. When composting is completed it can be removed from the pit and transported to nearby farmers and applied as organic fertilizer. The risk of pathogen contamination in food grown using bio-slurry is less than that using fresh farm yard manure<sup>40</sup>, the current predominant standard practice. Nonetheless, simple-to-use guidance materials will be provided to small- and medium-scale digester owners, advising them on how to safely use digestate.</p> <p>A private company, Organic Fertilizer Manufacturers Botswana, currently applies South African standards for bio-fertilizer in order to be able to export bio-fertilizer. The project will adopt these standards as an interim measure and thereafter stakeholders will agree on quality standards and appropriate utilisation of biogas digestate<sup>41</sup>. Monitoring and certification will be done by the Ministry of Agriculture as part of ongoing agricultural support activities. Under the Integrated Support Programme for Arable Agriculture Development (ISPAAD), the Ministry provides farmers with fertilizers and also provides, through district demonstration officers, guidance to the farmers (commercial and</p>	ProDoc: text added page 49-50 CEO Endorsement: Text added to B.3. Explain how cost-effectiveness is reflected in the project design:

<sup>40</sup> Alterra Wageningen UR & Nutrient Management Institute NMI (2014), *Bio-slurry as Fertilizer*, [http://www.academia.edu/18055905/Bioslurry\\_as\\_a\\_fertilizer](http://www.academia.edu/18055905/Bioslurry_as_a_fertilizer).

<sup>41</sup> Appropriate management of biogas digestate will have benefits including: lower gaseous emission; less diffuse pollution from surface run off and leaching; reduced odours, improved veterinary safety, plant pathogen reduction and the reduction of weed seeds. Source: IEA Bioenergy (2010), *Utilisation of Digestate from Biogas Plants as Biofertiliser*.

		subsistence) on the use of fertilizers. An inventory on the annual use of fertilizers is also maintained. The Ministry is also currently certifying performance standards for horticultural activities, agricultural engineering and sorghum production. The GEF project will use this existing Ministry architecture for regulating fertilizer use.	
8. (a) Are global environmental / adaptation benefits identified? (b) Is the description of the incremental/additional reasoning sound and appropriate?	Details are expected at CEO endorsement request on the proposed facility, its partners, their experience and capacity and the cofinancing / financing means available (especially for the investments facilitation).	<p>The PIF originally envisaged constructing a 7 MW agro-waste bio-methane production facility. As outlined in the CEO Endorsement Request (page 7), stakeholders indicated during the PPG that the proposed 7 MW bio-methane plant was a welcome prospect for Botswana but was nonetheless over-ambitious as a first-step and should, instead, be reached via a number of intermediate technological steps:</p> <ul style="list-style-type: none"> <li>• The large-scale bio-methane facility (16,000 m<sup>3</sup>) would require continuous feedstock of approximately 300 tonnes per day, including chopped wheat bran and maize to ensure that sufficient biogas is generated for upgrading to bio-methane. Using this type of feedstock is considered inappropriate as food security is an issue in Botswana.</li> <li>• In addition, multiple waste streams would be required for operating the bio-methane facility. Currently, these waste streams can be collected for free. However, an initial risk analysis indicates that this situation might change over time and owners of waste streams might start charging in the near-future as waste becomes a valuable commodity. This would jeopardise the functioning of the bio-methane facility, with a high risk that the cost of its operation might exceed income. Such high risk is likely to deter potential investors.</li> <li>• The large-scale bio-methane facility would be centralised and require waste streams from all the councils of South-Eastern Botswana. A pre-condition is that councils would have to invest jointly in such an approach. Councils have indicated they prefer to pursue smaller-scale approaches</li> </ul>	The table presented in Annex 1 below has been added to the ProDoc (Annex 8.4 Organisational Information) and to the CEO Endorsement Request (Section B.1, Stakeholder Engagement)

		<p>within their jurisdictional boundaries.</p> <p>Consequently, the design of the project has been amended to involve the construction of three 1 MW decentralised medium-scale biogas digesters<sup>42</sup> instead, involving approximately US\$ 3 million capital investment for each digester.</p> <p>The waste streams from larger agro-processing industrial plants<sup>43</sup> (approximately 15-35 tonnes per day) will serve as feedstock for the medium-scale biogas digesters of approximately 5,000 m<sup>3</sup> capacity each, with an installed electric generation capacity of 1 MW each. In addition, waste streams collected by the Councils will constitute additional feedstock. In each case, the agro-industrial firm and the relevant Council will enter into a Public-Private Partnership (PPP) whereby the firm will be the principal owner of the biogas digester and the Council the co-owner, able to use the digester as a means of disposing of the organic waste collected by the Council. The output of each medium-scale biogas digester will be electricity produced by a Combined Heat and Power (CHP) unit; the electricity will be for the daily used operations of the agro-industrial firm and surplus power will be fed into the grid. Surplus heat from the CHP unit will be used for the operation of the agro-processing plant.</p> <p>The proposed technology will be provided by international biogas companies with a proven track record. Various technology options are available: lagoon biogas digesters, High Rate Anaerobic Ponds (HRAPs), Continuous Stirred Tank Reactor (CSTRs) and plug flow, each with its own characteristics and suitability for the Botswanan context. These technologies change rapidly and improve continuously with increased efficiency. To ensure that the most efficient and effective technologies are installed, the final selection of the technology for each site</p>	
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<sup>42</sup> Medium-sized biogas digesters range from 300-5,000 m<sup>3</sup> and are operated by agro-industry in partnership with Councils and additional interested stakeholders.

<sup>43</sup> E.g. chicken manure, poultry abattoir, cow dung, cattle abattoir waste, etc.

		<p>will be determined during the implementation of the project. For each site, a number of companies will be shortlisted and invited to conduct a feasibility study on a cost-recovery basis. Based on these feasibility studies, three companies will be invited to participate in a tendering process.</p> <p>The financial viability of the business model for the medium-scale biogas plants is based on an assessment of the cash flows from revenue-based sales of various products produced by the plant (biogas, pelletised organic fertilizer, heat, electricity provision). A further driver for investing in small- and medium-scale biogas technologies will be the enforcement of the newly-drafted Waste Management Policy and Guidelines, which will be supported by the GEF-financed project. An additional driver will be the GEF-supported nationwide awareness campaign and green certification programme. Agro-industry will be able to utilise the green certification as a marketing tool.</p> <p>Annex 1 below provides further details on project co-financiers. With regard to the medium-scale digesters specifically, these will be financed by the private sector (agro businesses – e.g. BMC – with agro-waste streams) through their own investment, by financial institutions (BDC and Barclays Bank), and by town/district councils. In addition, biogas technology providers will be encouraged to invest to enhance ownership and participation in the project. The bulk of the investment will come from the private sector. The exact allocation of investment funds is not known at this juncture and will be determined during the implementation of the project. The estimated amounts for investment are presented in the co-finance letters and are summarized in Annex 1.</p>	
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<p>12. Is the project consistent properly coordinated with related initiatives in the region?</p>	<p>The proposal refers to two joint regional workshops with UNIDO's program whereas "a detailed description of such collaboration" was announced to "be presented at CEO Endorsement". Please complete the requested detailed description at PIF stage.</p>	<p>The UNIDO-implemented, GEF-financed project, 'Promoting organic waste-to-energy and other low-carbon technologies in small and medium and micro-scale enterprises (SMMEs): accelerating biogas market development' (PMIS 5704) was CEO-endorsed in January 2016. The UNIDO and UNDP project development teams have been in close contact throughout their respective project preparation periods.</p> <p>Under Component 1 ('Capacity building and technology system') of the UNIDO project, UNIDO plans to hold a regional training workshop in conjunction with the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) in Namibia to enhance the capacity of market actors to assess and characterize waste streams, to understand biogas technology options and to realize investment projects. The two GEF-financed projects have agreed that the Botswana UNDP-GEF project will assist in the design and funding of this workshop. The second joint regional workshop will focus on standardized training of biogas technicians; this will, in turn, inform (and be informed by) a collaborative effort to develop a longer-term SADC-recognized training programme for technicians. In the absence of such a programme, the region – including Botswana – will be served by variable-quality technicians poorly-equipped to catalyze the sector, and who may actually serve to undermine investors' confidence and sector credibility.</p>	<p>Text added to paragraph no. 127 &amp; 128 of the ProDoc. Text added in CEO ER under heading A.7. Coordination with other relevant GEF financed initiatives</p>
<p>14. Is the project structure/design sufficiently close to what was presented at PIF, with clear justifications for changes?</p>	<p>The budget for each of the three components has changed since the PIF approval. Even if clear justifications for changes are presented, for the components 2 and 3, the changes are beyond the acceptable limit of 10% of the total GEF funding. In such a case, the new project proposal</p>	<p>We thank the GEF reviewer for noting the budget issues associated with Components 2 and 3. This stemmed from a misallocation – due to the iterative CEO Endorsement writing process – of the results-based payment funds to Component 2 rather than Component 3 (where they properly belong). This misallocation has been corrected, leading to properly-balanced component budgets. (Note that the results-based payment funds are referred to as Materials and Goods in UNDP budgeting terminology).</p>	<p>Changes made to the budget.</p>

	<p>requires additional approval by the Council Members after a 4 weeks consultation process. The agency may wish to avoid this new consultation process and prefer adjusting the budget and content of the project components to stay below the 10% limit in the component allocation changes.</p> <p>Please consider this GEF rule and its implications in elaborating the last version of the proposal.</p>																	
<p>15. Has the cost-effectiveness of the project been sufficiently demonstrated, including the cost-effectiveness of the project?</p>	<p>Please clarify the calculation of the cost of the t CO<sub>2</sub> emission avoided and provide an estimate of the digester prices (small and medium scale).</p>	<p>Mitigation cost is calculated as the GEF project budget (US\$ 2,632,300) divided by the relevant emission reduction. The detailed calculation of the emission reductions is presented in the Global Benefits section of the CEO ER (page 17-21) and the GHG Calculations section of the Project Document (page 109-113), as presented in the table below:</p> <table border="1" data-bbox="786 1104 1286 1417"> <thead> <tr> <th>Category</th> <th>Net Emission Reductions</th> <th>Cost (GEF US\$/tCO<sub>2</sub>e]</th> </tr> </thead> <tbody> <tr> <td><b>Direct</b></td> <td>793,616</td> <td>3.32</td> </tr> <tr> <td><b>Direct post-project</b></td> <td>-</td> <td>-</td> </tr> <tr> <td><b>Indirect bottom-up</b></td> <td>1,587,231</td> <td>1.66</td> </tr> <tr> <td><b>Indirect top-down</b></td> <td>857,586</td> <td>3.07</td> </tr> </tbody> </table> <p>The expected investment cost for small-scale biogas digesters ranges from US\$ 800 (6 m<sup>3</sup>) to US\$ 50,000 (300 m<sup>3</sup>). The estimated cost of a medium-scale digester is US\$ 1.5-3.5 million (with a central indicative estimate of US\$ 3 million), depending on the design, size and customer requirements.</p>	Category	Net Emission Reductions	Cost (GEF US\$/tCO <sub>2</sub> e]	<b>Direct</b>	793,616	3.32	<b>Direct post-project</b>	-	-	<b>Indirect bottom-up</b>	1,587,231	1.66	<b>Indirect top-down</b>	857,586	3.07	<p>This table has been added under 8.8 GHG Calculations section 4 of the ProDoc and to the CEO Endorsement (Global Benefits section).</p> <p>The digester prices have been added in the ProDoc on page 6 and are referred to in footnote 13 of the CEO Endorsement.</p>
Category	Net Emission Reductions	Cost (GEF US\$/tCO <sub>2</sub> e]																
<b>Direct</b>	793,616	3.32																
<b>Direct post-project</b>	-	-																
<b>Indirect bottom-up</b>	1,587,231	1.66																
<b>Indirect top-down</b>	857,586	3.07																

17. At CEO endorsement: Has cofinancing been confirmed?	Please clarify the risk of overlapping between the project requested support and SIDA's grant under discussion with Biosys.	SIDA was contacted during the stakeholder consultation phase (2015) and it indicated that no projects will be supported in Botswana, including the potential collaboration with BioSys that was being considered at one stage. There is therefore no overlap.	n/a
18. Is the funding level for project management cost appropriate?	The co-financing ratio for the project management cost has much decreased since PIF approval (from to \$604,160 to \$92,000). It is too low compared to the co-financing ratio of the project's activities. Please increase the co-financing for the project management cost as requested in November 2013.	The co-financing figure for the project management cost has been increased to USD 793,000.	The budget in CEO Endorsement has been updated.
26. Is CEO endorsement/approval being recommended?	Please correct the overlap of the chart p.30 of the CEO Endorsement Request.	Overlap has been removed.	Overlap has been removed

**ANNEX C: STATUS OF IMPLEMENTATION OF PROJECT PREPARATION ACTIVITIES AND THE USE OF FUNDS<sup>44</sup>**

A. PROVIDE DETAILED FUNDING AMOUNT OF THE PPG ACTIVITIES FINANCING STATUS IN THE TABLE BELOW:

<b>PPG GRANT APPROVED AT PIF: \$100,000</b>			
<i>Project Preparation Activities Implemented</i>	<i>GEF/LDCF/SCCF/NPIF Amount (\$)</i>		
	<i>Budgeted Amount</i>	<i>Amount Spent To date</i>	<i>Amount Committed</i>
1. Technical review and baseline studies	92,500	76,162.47	16,337.53
2. Institutional arrangements, stakeholder meeting, financial planning and co-financing investments and validation workshop	7,500	4,179.20	3,320.80
<b>TOTAL</b>	<b>100,000</b>	<b>80,341.67</b>	<b>19,658.33</b>

**ANNEX D: CALENDAR OF EXPECTED REFLOWS (if non-grant instrument is used)**

Provide a calendar of expected reflows to the GEF/LDCF/SCCF/NPIF Trust Fund or to your Agency (and/or revolving fund that will be set up)

N/A

<sup>44</sup> If at CEO Endorsement, the PPG activities have not been completed and there is a balance of unspent fund, Agencies can continue undertake the activities up to one year of project start. No later than one year from start of project implementation, Agencies should report this table to the GEF Secretariat on the completion of PPG activities and the amount spent for the activities.



**ANNEX E: OPERATIONAL FOCAL POINT ENDORSEMENT LETTER**



Republic of Botswana

Tel: (266) 9022352  
Fax: (266) 9022351 / 90214697  
Email: [env@botswana.gov.bw](mailto:env@botswana.gov.bw)

**Department of Environmental Affairs**  
**Ministry of Environment, Wildlife and Tourism**

Private Bag 0268  
Gaborone  
Botswana

*All Correspondence to be addressed to the Director*

**REF NO: DEA 1/12/7 (1B)**

**16<sup>th</sup> June 2015**

Adriana Dimi  
Officer-in-charge-Deputy Executive Coordinator UNDP/GEF  
United Nations Development Programme (UNDP)  
One United Nations Plaza  
New York, 10021

[Gcoordination@thcgef.org](mailto:Gcoordination@thcgef.org)

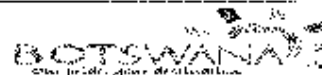
**Subject: Endorsement for Promoting production and utilization of bio-methane from agro-waste in South-Eastern Botswana**

In my capacity as GEF Operational Focal Point for Botswana, I confirm that the above project proposal (a) is in accordance with my government's national priorities and our commitment to the relevant global environmental conventions; and (b) was discussed with relevant stakeholders, including the global environmental convention focal points.

I am pleased to endorse the preparation of the above project proposal with the support of the GEF Agency(ies) listed below. If approved, the proposal will be executed by the Ministry of Environment, Wildlife and Tourism, in conjunction with the Botswana Institute for Technology, Research and Innovation (BITRI). I request the GEF Agency (UNDP) to provide a copy of the project document before it is submitted to the GEF Secretariat for CEO endorsement.

The total financing (from GEF/TF) being requested for this project is US\$2,991,869, inclusive of project preparation grant (PPG), if any, and Agency fees for project cycle management services associated with the total GEF/LDCF grant. The financing requested for Botswana is detailed in the table below:

*An Environmentally sound and friendly nation for Sustainable Development.*



Source of Funds	GEF Agency	Focal Area	Amount (in US\$)			
			Project Preparation	Project	Fee	Total
GEFTF	UNDP	Climate	100,000	2,632,300	259,569	2,991,869
(select)	(select)	(select)				0
(select)	(select)	(select)				0
(select)	(select)	(select)				0
<b>Total GEF Resources</b>			100,000	2,632,300	259,569	2,991,869

I consent to the utilization of Botswana's allocations in GEF-5 as defined in the System for Transparent Allocation of Resources (STAR).

Sincerely,



Khulekani Mpofo  
Chief Natural Resources Officer and GEF Operational Focal Point

**CC: National Focal Point, UNFCCC  
Department of Meteorological Services**

*An Environmentally conscious and friendly nation for Sustainable Development.*

