REQUEST FOR CEO APPROVAL

PROJECT TYPE: Medium-sized Project
TYPE OF TRUST FUND:GEF Trust Fund

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PART I: PROJECT INFORMATION

Project Title: Sustainable conversion of waste to clean energy for greenhouse gas (GHG) emissions reduction			
Country(ies):	Republic of Kenya	GEF Project ID:[1]	5154
GEF Agency(ies):	UNIDO	GEF Agency Project ID:	120568
Other Executing Partner(s):	• Ministry of Energy (MoE) • Ministry of Industrialization and Enterprise Development (MoIED) • Ministry of Agriculture, Livestock and Fisheries (MoALF)	Submission Date: Resubmission Date:	05/22/2015 07/06/2015
GEF Focal Area (s):	Climate Change (CC)	Project Duration(Months)	48
Name of Parent Program (if applicable): ➢ For SFM/REDD+ ☐ ➢ For SGP ☐ ➢ For PPP ☐		Project Agency Fee ($):	190,000

A. FOCAL AREA STRATEGY FRAMEWORK[2]

Focal Area Objectives	Expected FA Outcomes	Expected FA Outputs	Trust Fund	Grant Amount ($)	Cofinancing ($)
CCM-3 Promote investment in Renewable Energy (RE) technologies	Investments in RE technologies increased	RE capacity installed	GEF TF	1,999,998	9,824,718
		Total project costs		1,999,998	9,824,718

B. PROJECT FRAMEWORK

Project Objective: To promote investments in waste-to-energy (WTE) technologies to increase electrification and to reduce GHG emissions

Project Component	Grant Type	Expected Outcomes	Expected Outputs	Trust Fund	Grant Amount ($)	Confirmed Cofinancing ($)
1. Capacity development and knowledge management	TA	1.1. Improved awareness, knowledge sharing on best practices and capacity building on WTE in the country	1.1.1. Information and the best practices platform (IBPP) for WTE technologies established at Kenya Industrial Research & Development Institute (KIRDI) 1.1.2. Development of human capacities in WTE for policy makers (at least 50	GEF TF	190,000	335,300

[1] Project ID number will be assigned by GEFSEC.
[2] Refer to the Focal Area/LDCF/SCCF Results Framework when completing Table A.

			policy makers), project developers, agro-industries, and other stakeholders (at least 50 persons) 1.1.3. Development and strengthening of institutional capacities in the area of WTE among technical institutions and financial institutions (at least 50 persons from each group)			
2. Establishment of pilot agro-industrial WTE plants	TA	2.1. Increased use of biogas for energy generation	2.1.1. Establishment of standards for medium and large scale biogas plants	GEF TF	34,000	60,000
			2.1.2. Detailed plant design prepared for WTE demonstration plants	GEF TF	56,000	192,000
	INV		2.1.3. WTE plants established for a cumulative capacity of around 1,856 kW_e and 1,397kW_{th}	GEF TF	675,180	6,566,468
3. Scaling up investment in WTE plants	TA	3.1. Increased involvement of private investors in WTE projects	3.1.1. Establishment and implementation of incentive systems for WTE technologies	GEF TF	83,000	50,000
	INV				700,000	2,042,950
4. Monitoring and Evaluation (M&E) and knowledge management	TA	4.1. Effectiveness of the outputs assessed, corrective actions taken and experience documented	4.1.1. Terminal evaluation project report 4.1.2. Lessons learning and information dissemination workshops 4.1.3. Publications and websites	GEF TF	80,000	100,000
			Subtotal		1,818,180	9,346,718
			Project Management Cost (PMC)[3]	GEF TF	181,818	478,000
			Total project costs		1,999,998	9,824,718

[3] PMC should be charged proportionately to focal areas based on focal area project grant amount in Table D below.

C. SOURCES OF CONFIRMED COFINANCING FOR THE PROJECT BY SOURCE AND BY NAME ($)

Sources of Co-financing	Name of Co-financier (source)	Type of Cofinancing	Cofinancing Amount ($)
National Government	MoIED	In-kind	320,000
National Government	MoE	In-kind	300,000
National Government	Migory County	In-kind	1,200,000
National Government	Migory County	Cash	800,000
National Government	Kenya Meat Commission	In-kind	820,000
Private Sector	Green Energy Africa	In-kind	156,250
Private Sector	Strathmore University	In-kind	150,000
Private Sector	Biogas Power Holding	Cash	105,708
Private Sector	Biogas Power Holding	In-kind	82,981
Private Sector	Keekonyokie Butchers Company Limited	Investment	395,000
Private Sector	Dagoretti Environment Management Association (DEMA)	In-kind	476,470
Private Sector	Sosian Energy Limited	Cash	3,500,000
Private Sector	Agro-Chemicals and Food Company Limited	Cash	211,417
Private Sector	Agro-Chemicals and Food Company Limited	In-kind	52,854
Private Sector	Farmer's Choice Ltd	Cash	10,000
Private Sector	Farmer's Choice Ltd	In-kind	552,000
Private Sector	Olivado	Cash	497,790
Private Sector	Olivado	In-kind	44,248
GEF Agency	UNIDO	Grant	60,000
GEF Agency	UNIDO	In-kind	90,000
Total Co-financing			9,824,718

D. TRUST FUND RESOURCES REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY[1]

GEF Agency	Type of Trust Fund	Focal Area	Country Name/ Global	(in $)		
				Grant Amount (a)	Agency Fee (b)[2]	Total c=a+b
(select)	(select)	(select)				0
Total Grant Resources				0	0	0

[1] 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.

[2] Indicate fees related to this project.

E. CONSULTANTS WORKING FOR TECHNICAL ASSISTANCE COMPONENTS:

Component	Grant Amount ($)	Cofinancing ($)	Project Total ($)
International Consultants	222,000	74,000	296,000
National / Local Consultants	248,000	744,000	992,000

F. 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).

Not applicable.

PART II: PROJECT JUSTIFICATION

FINDINGS DURING THE PPG STAGE

Kenya is facing an acute electricity shortage not only due to the limitations of installed capacity but also due to the over-reliance on hydro power that threatens the security of supply in times of drought. As one of the possible options to address this shortage, the proposed project aims at promoting the conversion of waste to clean energy as an alternative electricity generation source. Due to the considerable biogas potential and the regulation of an attractive feed-in-tariff system by the Kenyan Government for biogas technology, biogas technology from anaerobic digestion has been selected for conversion of waste to energy. The most promising sectors for electricity production from conversion of waste to energy are municipal waste and agro-industrial residues substrates. Municipal waste is not generated at one central place, but has to be collected prior to further utilization and biogas effluents have to be dumped or combusted. This leads to logistical problems and additional costs. Agro-industrial residues substrates are accrued at one place during the processing of the agro produce and it has the following advantages:

- Transport costs for the input substrates can be minimized;
- Electricity and waste heat can be used directly for the processing of agro-products;
- Additional electricity can be fed into the national grid;
- Biogas plant effluent can be used on farm as organic fertilizer.

Due to these advantages, the agro-industrial sector has been selected for demonstrating WTE plants while enhancing the processing of agro-produce to be more efficient and sustainable.

A. Describe any changes in alignment with the project design of the original PIF[4]

In the PIF document, Ministry of Environment and Minerals (MEMR) and Ministry of Agriculture, Livestock and Fishery (MoALF)[5] were mentioned as the main executing and co-financing counterparts. However, during later discussions, it was decided that Ministry of Energy (MoE) and Ministry of Industrialization and Enterprise Development (MoIED) will take the lead roles and will thus be the main executing partners in this project due to financial constraints of the ministries. MoE and MoIED will also be the major co-financing partners responsible for the establishment and operation of the proposed financial incentive scheme in conjunction with Ministry of Finance (MoF). Both, MEMR and MoALF will still be part of the project. MEMR will oversee and contribute towards the capacity building activities, involve in the establishment of Information and Best Practices Platform (IBPP) and monitor the bio digested slurry and its farm usage. MoALF, on the other hand, will be responsible for the establishment and operation of demonstration plant at Kenya Meat Commission (KMC). Detailed budget for each output has been made (Annex G). A private investor has shown interest to participate in the proposed project and develop a biogas power plant within its sisal plantation. This increased the proposed cumulative capacity to 1.8 MW_e and 1,379 kW_{th}.

The following changes were made in the project framework due to findings during the PPG stage. The changes are shown in the table below.

[4] 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

[5] Mentioned as Ministry of Livestock in the PIF

Project Component		Expected Outcome		Expected Output	
PIF	**CEO Document**	**PIF**	**CEO Document**	**PIF**	**CEO Document**
1. Capacity development and knowledge management	Not changed	Improved awareness, knowledge sharing on best practices and capacity building on WTE in the country	1.1. Not changed	1.1. Information and best practices platform for WTE technologies 1.2. Development of human capacities in WTE for policy makers, project developers, agro-industries, and other stakeholders 1.3. Development and strengthening of institutional capacities in the area of WTE among technical institutions and financial institutions.	1.1.1. Information and the best practices platform (IBPP) for WTE technologies established at Kenya Industrial Research & Development Institute (KIRDI) 1.1.2. Development of human capacities in WTE for policy makers (at least 50 policy makers), project developers, agro-industries, and other stakeholders (at least 50 persons) 1.1.3. Development and strengthening of institutional capacities in the area of WTE among technical institutions and financial institutions (at least 50 persons from each group)
2. Establishment of agro-industrial WTE plants	2. Establishment of pilot agro-industrial WTE plants	Increased use of biogas in industrial applications	2.1. Increased use of biogas for energy generation	2.1. Detailed plant designs prepared for WTE plants. 2.2. WTE plants established for a cumulative capacity of around 1.3 MW_e and 120 kW_{th}.	2.1.1. Establishment of standards for medium and large scale biogas plants 2.1.2. Detailed plant design prepared for WTE demonstration plants 2.2.3. WTE plants established for a cumulative capacity of around 1,856 kW_e and 1,397kW_{th}

Project Component		Expected Outcome		Expected Output	
PIF	**CEO Document**	**PIF**	**CEO Document**	**PIF**	**CEO Document**
3. Promotion of investment into WTE plants	3. Scaling up investment in WTE plants	Established an incentive facility system through increased involvement of financing institutions in WTE projects	3.1. Increased involvement of private investors in WTE projects	3.1. Establishment and implementation of an incentive system for developers of WTE technologies.	3.1.1. Establishment and implementation of incentive systems for WTE technologies
4. Monitoring and evaluation (M&E)	Not changed	1. Effectiveness of the outputs assessed, corrective actions taken and experience documented 2. Acceptance of the technical and economic viability of WTE plants	4.1.1. Not changed	4.1. Mid-term M&E report 4.2. End of project M&E report prepared 4.3. Lessons learning and information dissemination workshops 4.4. Publications and websites	4.1.1. Terminal evaluation project report 4.1.2. Lessons learning and information dissemination workshop 4.1.3. Publication and websites

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.

The proposed project is consistent with Kenya's national development priorities. It will increase the use of Renewable Energy (RE) and decrease the consumption of fossil fuel required to power the additional generating capacity for grid extension. The proposed project will also support the following Government policies and strategies targeted to increase the percentage of RE in overall energy mix and rural electrification in the country.
The Electric Power Act, 1997: This act facilitated the private sector participation in the generation and distribution of electricity and encouraged rural electrification using RE technologies.

First National Communication of Kenya to UNFCCC, 2002: This policy identified the need for economic incentives, intensified R&D activities, access to appropriate technologies, capacity building and policy formulation in waste management sector, as well as establishment of energy platforms, setting up of demonstration facilities and establishment of district-wide information resource platforms in energy sector.

Technology Needs Assessment (TNA), 2005: This assessment suggested carrying out of inventory on GHG reduction potential, capacity and awareness building on GHG emission reduction as well as promotion of technology transfer of less GHG emitting technology.

Energy Act, 2006 and Vision 2030 (announced in 2008): This act aimed at promotion of development and use of RE technologies, local fabrication, strengthening of O&M capacity, reduction of country reliance on imported fossil fuels,

increase of electrification access, provision of affordable and reliable energy and mobilization of private sector capital for generation of electricity from RE.

National Portfolio Formulation Document (NPFD), March 2011: This document identified the issues of promotion of RE, energy conservation and efficiency, capacity building/policy making for promotion of conservation as well as enhancement of carbon savings through sustainable management of land use and forestry REDD+, as the key areas for climate change mitigation. It is consistent with UNIDO's proposed interventions which includes conversion of WTE from organic waste (municipal solid waste (MSW), water hyacinth, slaughterhouse wastes, agro-farm wastes, etc.) to produce biogas, assessment of organic waste potential for bio-energy technologies from organic wastes, capacity building in the area of RE, etc.

A.2. GEF focal area and/or fund(s) strategies, eligibility criteria and priorities

The proposed project activities promote the use of WTE technologies. This area was selected due to its potential in rapid scaling up and in reducing GHG emissions. This is in line with *GEF-5 climate change focal area strategic programme CCM-3: Promoting the investment in RE technologies.*

The East Africa[6] (a group of 19 countries including Kenya) Ministerial Consultation meeting, held from 18-20th January 2011 organized by GEF secretariat, came up with WTE as one of the priority areas to be considered for East African countries. This project is in line with this identified priority.

A.3. The GEF Agency's comparative advantage

The project is a technical assistance/capacity development intervention that fits within the Climate Change focal area strategic objective 3. The GEF Council paper "Comparative Advantages of the GEF Agencies" (GEF/C.31/5rev.1) recognizes a comparative advantage of UNIDO in this strategic programme.

The mandate of UNIDO is to promote Inclusive Sustainable Industrial Development (ISID) in developing countries and economies in transition. UNIDO's vision is a world where economic development is inclusive and sustainable and economic progress is equitable. UNIDO is well placed to implement this project owing to its experience and expertise in projects related to agro-industries linking access, waste management and productive use activities in other countries. More specifically, UNIDO has proven expertise in developing technology transfer projects on the ground that have direct impact especially in piloting new technologies including WTE, small hydro power, ultra-low head micro hydro power application, etc.

Specific to Kenya, UNIDO was involved in the installation of a pilot plant of 10 kWe capacities using a part of wastes from one of the four slaughterhouses in Dagoretti abattoir cluster. This pilot plant was able to demonstrate the potential of the biogas power plants in waste management, as well as the usefulness and economic potential of such wastes. Based on the successful implementation of this pilot plant, Tanzania is trying to promote investments in WTE technologies for electricity generation in the agro-industries sector under GEF-5 cycle and UNIDO will be the implementing agency.

UNIDO has a full-fledged country office in Nairobi, headed by a UNIDO Representative and a number of technical officers who focus on the implementation of the on-going Kenya country programmes and various other projects funded by multilateral funding mechanisms such as the Montréal protocol. Also, UNIDO has a large portfolio with GEF with over 90 projects in climate change mitigation focal area. This project will also benefit from some of the administrative structures established for the other UNIDO projects.

Under such context, UNIDO is well placed to implement such a programme in Kenya. With its experience, UNIDO can handle the WTE projects and take it to a higher level in the country.

[6] http://millenniumindicators.un.org/unsd/methods/m49/m49regin.htm

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

Climate Change Scenario

Kenya, like other sub-Saharan African countries, faces the uncertainty and potential risks of climate change. The country's fragile ecosystem is being put under intensive pressure arising from species migration due to habitat destruction and reduction. Already, almost 50% of the country's key biodiversity hotspots are at risk due to reduced habitat and other human induced pressures. Kenya's vulnerability to climate change is furthermore affected by, inadequate technology and information infrastructure, which pose serious hurdles to effective climate change mitigation measures.

Therefore, if not proactively addressed, climate change is envisaged to adversely affect the country's sustainable development efforts including its ability to attain the Millennium Development Goals (MDGs) by 2015 as well as the objectives set out in the Government's Vision 2030 development plan[7].

Energy Scenario

Kenya's energy sector is largely dependent on petroleum and electricity, with wood fuel providing the basic energy needs for the rural communities, urban poor, and the informal sector. In the year 2011, the total primary energy consumed was around 20.2 million tons of oil equivalent (mtoe). An analysis of this consumption shows high dependency on wood fuel and other biomass which account for 72.4% of the consumption, followed by oil at 18.5%, coal/peat at 1.2%, hydro at 1.5% and other renewable resources at 6.4%[8]. Figure 1 depicts the energy balance of Kenya.

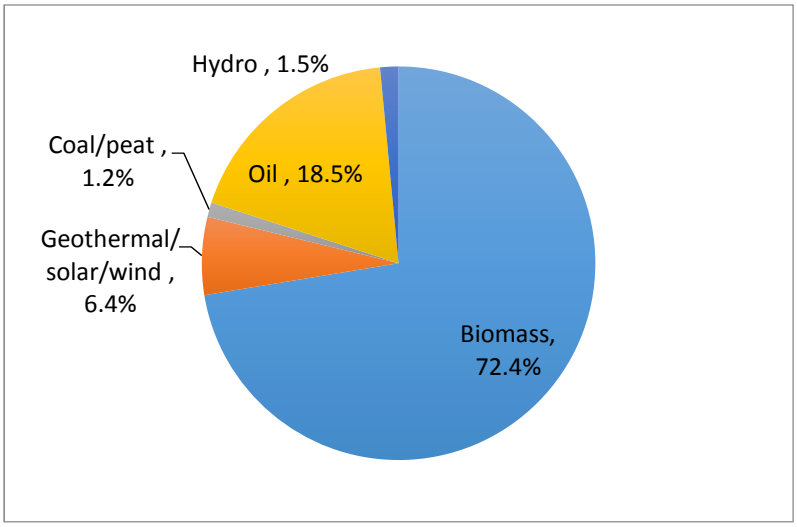


Figure 1: Energy balance of Kenya

The Government of Kenya has initiated a program "Vision 2030" to transform Kenya into a "newly industrializing, middle-income" country. However, Kenya has less than 2,000 MW of generation capacity to serve its population of over 43 million, which constrains economic growth. The energy sector is pivotal to Kenya's vision 2030, given its systemic link to almost all other sectors of the economy. In order to realize its ambition of becoming a middle-income country, the Government of Kenya has identified a strong ISID serviced by a clean and modern energy sector.

Electricity Scenario

Kenya has an electrification rate of 15% and an ambitious target to increase electricity connectivity from the current rate to at least 65% by the year 2022. Electricity demand in Kenya is increasing rapidly due to the accelerated productive investment and increasing population. Poor investments in electricity sector have widened the gap between electricity demand and supply. The demand is projected to grow to about 2,500 MW by 2015 and 15,000 MW by 2030. To meet

[7] http://kenya.um.dk/en/danida-en/nrm/climate-change/
[8] http://www.iea.org/stats/WebGraphs/KENYA4.pdf

this demand, Kenya's installed capacity should increase gradually to around 19,200 MW by 2030[9]. The current situation of limited access to electricity hampers further development of rural industrialization, including agro-industries as well as the improvement of living standards of the rural communities. The projected electricity demand from 2015-2030 is shown in table 1.

Table 1: Projected electricity demand for 2015 - 2030

Year	Installed MW	Peak MW	Annual Electricity Consumption, GWh	Growth rate
2015	3,132	2,511	15,155	21.64%
2016	3,832	2,866	17,300	14.13%
2017	4,337	3,292	19,902	14.87%
2018	5,077	3,751	22,685	13.94%
2019	5,591	4,216	25,512	12.40%
2020	6,431	4,755	28,795	12.79%
2021	7,217	5,388	32,651	13.31%
2022	8,217	6,048	36,652	12.25%
2023	8,837	6,784	41,130	12.18%
2024	9,957	7,608	46,147	12.13%
2025	11,097	8,528	51,771	12.10%
2026	13,117	9,556	58,069	12.06%
2027	13,737	10,706	65,133	12.03%
2028	15,389	11,994	73,065	12.03%
2029	17,199	13,435	81,964	12.01%
2030	19,199	15,026	91,946	11.85%
2031	21,599	16,905	103,518	12.51%

As of March 2014, the effective installed power plant capacity was only 1,767 MW. Electricity generation is dominated by hydro, geo-thermal and fossil fuel sources, making up 91% of the electricity transmitted to the national grid. Tables 2 and 3 shows Kenya's electricity generating capacity[10] and electricity generation by source respectively[11]:

Table 2: Installed electricity generating capacity

Sources of Electricity Generation		Installed Capacity (March 2014)	
		MW	%
Renewable Energy	Hydro	820	49.0
	Geothermal	261	14.9
	Wind	5	0.3
	Cogeneration	38	2.3
	Imports	NA	NA
	Sub-total	***1,124***	***66.5***
Fossil Fuels	Medium speed diesel (MSD)	535	27.0
	Gas Turbines	60	3.6
	High speed diesel (HSD) - Isolated Stations	18	1.1
	Emergency power plants	30	1.8
	Sub-total	***643***	***33.5***
Installed Capacity and Units Generation		**1,767**	**100**

[9] http://www.kplc.co.ke/img/full/bWXFzkYGyS97_National_Energy_Policy_-_Third_Draft_-_May_11_2012.pdf
[10] Draft National Energy Policy, February 2014 – Ministry of Energy & Petroleum
[11] Kenya Facts and Figures 2014, Kenya National Bureau of Statistics (KNBS)

Table 3: Electricity generation by source

Source	Electricity Generation in GWh			
	2010	2011	2012	2013
Hydro	3,224.0	3,217.2	4,015.9	4,425.0
Thermal power plant	2,201.0	2,800.5	2,200.4	2,161.7
Geo-thermal	1,442.0	1,443.7	1,515.9	1,780.9
Cogeneration	92.0	80.9	104.7	55.6
Wind	16.8	17.6	14.4	14.7
Imports	30.0	33.9	39.1	49.0
Total	**7,005.8**	**7,593.8**	**7,890.4**	**8,486.9**

Demonstration and replication of RE projects for electricity generation will make a positive impact on the reduction of carbon emission from fossil fuels generation sources.

Challenges faced by the electricity sector

The agenda of electrification in the draft of the National Energy Policy 2014[12], identified the following challenges faced by the electricity sector: a) High costs of connection, b) Scattered population settlements in the rural areas leading to long distribution lines, c) Inaccessible terrains due to underdeveloped infrastructure leading to high cost of RE projects, d) high operating costs of grids in rural areas due to low population density, e) acquisition of way leading to high compensation demand by public institutions and land owners and f) vandalism of power infrastructure.

During low hydrology, the reserve margin diminishes, which necessitates load shedding and procurement of expensive emergency power[13]. Therefore, the major challenge for Kenya is to meet its electricity demands through alternative cleaner sources in order to provide stable electricity throughout the year for the scattered population. Under the given circumstances, it would be better if electricity could be generated locally in off grid areas, with the locally available RE resources. The addition of new and alternative generating power plant is urgently required in Kenya to meet its rapidly growing electricity demands. Large-scale biogas plants using waste from slaughter houses, agro-processing and other similar wastes, present good opportunities for electricity generation owing to the abundant wastes generated on a daily basis.

Base line Scenario

Agro-industrial wastes

In Kenya, agro industrial wastes are mostly underutilized and in most cases disposed by burning, dumping or unplanned land filling. Dumping and unplanned landfilling results in methane generation and its subsequent release into the atmosphere. Methane is a stronger GHG than carbon dioxide. Hence, the avoidance of its release to the atmosphere or utilization of it holds great environmental benefits in terms of mitigating against GHG emissions and adapting to climate change. It has been estimated that industrial-scale power/cogeneration using biogas produced from agricultural residues could abate 1.6 million t CO_2e per year in 2030[14].

Currently, disposal of waste incurs cost and causes logistical difficulty. However, these organic wastes represent a potential bio resource for production of energy and bio-fertilizers[15].

A study conducted by the German International Cooperation (GIZ) during the year 2010[16] on potential power generation from biogas in Kenya, estimated the generating potential from agro-wastes as shown in Table 4 (average values). This

[12] Draft National Energy Policy, February 2014 – Ministry of Energy & Petroleum
[13]World Bank, 2011.*KENYA Scaling-Up Renewable Energy Program (SREP) Joint Development Partner Scoping Mission.* Nairobi, February 7-11
[14] http://cdkn.org/wp-content/uploads/2012/12/Kenya-Climate-Change-Action-Plan_Executive-Summary.pdf
[15]http://mahider.ilri.org/bitstream/handle/10568/10816/Project4_Biogas.pdf
[16]Fischer, E., Schmidt, T., Hora, S., Geirsdorf, J., Stinner, W., and Scholwin, F. 2010.*Agro-Industrial Biogas in Kenya: Potentials, Estimates for Tariffs, Policy and Business Recommendations*. Berlin: German International Cooperation (GIZ), 2010

study was based on the available data from a few selected industries. However, the actual country-wide potential is expected to exceed this estimate.

Table 4: Biogas Power Generation Potential from Agro Wastes in Kenya

Agricultural wastes	Power generation potential (MWe)
Sisal waste	20.0
Coffee waste	10.0
Sugar plant waste	4.1
Pineapple processing	2.4
Chicken waste	1.9
Total	**38.4**

Other potential sources include cut-flower waste. Total estimated power that could be generated from members of the Kenya Flower Council is estimated at 87 GWh/year., corresponding to an installed capacity of about 20 MW[17]. In the policy document on Feed-in-tariff policy, it was indicated that 130 MW of biogas power plants exist for immediate development in municipal waste, sisal and coffee sector among others[18].

It is thus clear that biogas potential is well in excess of 100 MW, compared to the estimated potential. The present achievements are far too little. Hence, considering the gap between the potential available and that realised, this proposed project aims at promoting WTE technologies, by focussing mainly on agro-/ and related industries. For solid wastes such as agricultural residues, etc., the possible WTE technologies are steam thermal or gasification. For the liquid effluent wastes such as wastes from animal farms and slaughter houses and other agro industries like palm oil effluents, etc., biogas technology is the most suitable one. Solar, wind and hydro technologies are location specific and expensive. In the proposed project, most of the industries concerned are in need of treating their effluent wastes.

The domestic biogas plant sector is well established in Kenya owing to various Governments, institutional and private organizational activities. Therefore, biogas technology is comparatively familiar to the people than other RE technologies. However, the existing biogas plants have a maximum installed capacity of 150 kW_{el} which is considered small-scale. Since the proposed project is focusing on agro related industries and scaling up the technology, grid access regulations, feed-in-tariffs (FiT) and policies for RE sources will be reviewed.

The Energy Act 2006 does not define specific policies for the promotion of renewable energy but sets the policy framework for the energy sector (e.g. petroleum and electricity) in general and consolidates regulations of the Electric Power Act of 1997 and the Petroleum Act of 2000. A FiT policy on electricity generation from RE sources was implemented by MoE in May 2008. The FiT policy did not specify the type of biomass sources (solid, liquid biomass; energy crops, municipal waste) or the conversion technologies (combustion, anaerobic fermentation, etc.).

With this as a base, it is quite easy to build up on the existing knowledge and technology of biogas, to go one step further. Hence, the biogas technology has been chosen among the other technologies for promoting conversion of WTE.

Baseline project

a) A large biogas facility[19] using distillery effluent operates at Agro-Chemical & Food Company (ACFC) at Muhoroni since 1997, generating 27,000 to 30,000 m^3 of biogas per day[20]. The plant underwent a major rehabilitation in the year 2010/11. ACFC is a joint venture between the Government of Kenya (56% share) through the Industrial and Commercial Development Corporation (ICDC) and the Agricultural Development Corporation (ADC) and the

[17] *Updated Rural Electrification Master Plan, 2009*
[18] Feed-in-Tariffs policy on wind, biomass, small-hydro, Geothermal, biogas and solar resource generated electricity, 2nd revision December 2012, Ministry of Energy
[19] Plant is based on Anaerobic Digester Technology supplied by UEM Inc. India
[20] Investment cost – 150 million Kenyan Shillings (data collected by UNIDO representative from the power plant owners). Major rehabilitation in year 2010/11 cost around 110 million Kenyan Shillings.

International Investment Corporation (Mehta Group 44% share). The distillery generates around 1,150 to 1,200 m^3 of waste water and all the generated distillery effluent is treated through the biogas digester[21].

The generated biogas has been used to substitute fuel oil in running two medium-size boilers. The generated sludge from the biogas plant is used mainly internally for growing of ornamental flowers and trees. The generated sludge was also tested for its manure suitability as bio-fertilizer. The result gave positive indication on manure suitability of the digested sludge. However, adjustments were recommended to incorporate nutrient contribution from other sources, before being sold as bio-fertilizer (sludge analysis report is attached as Annex I). The company intends to produce bio-fertilizer considering the above recommendation.

The main challenge faced by the ACFC is meeting the environmental regulatory requirements by the National Environment Management Authority (NEMA). The effluent treatment plant was commissioned before the implementation of Environmental Management and Coordination Act (EMCA) of 1999. This necessitates ACFC to identify more environmental friendly technology to allow for further upgrading of the existing plant. Also, there is a need for addressing the challenges of high corrosion and scale formation rate, cleaning of biogas and reduction of the high operation and maintenance costs being experienced today. In addition, the secondary stage treatment efficiency is low and hence further improvements have been identified by the company for modification[22].

b) On identifying the energy recovery potential from slaughter house waste, UNIDO, in collaboration with the United Nations Environment Programme (UNEP), Kenya Industrial Research & Development Institute (KIRDI) and Dagoretti slaughter houses association, installed a pilot plant of 10 kWe capacities using part of the wastes generated from one of the four slaughterhouses in Dagoretti abattoir cluster. 40 m^3 of biogas was produced daily which was sufficient to run the 10 kWe biogas generator for six hours.

Before installation of the power plant, the slaughter house incurred a monthly electricity bill of 20,000 KES. After installation, the electricity bill was reduced to 12,000 KES. Sludge from the digester was used as fertilizer for grass/fodder.

This pilot plant was able to demonstrate the potential of the biogas power plants in waste management and usefulness and economic potential of such wastes. This pilot plant was recognized as a model for biogas technology and stakeholders from different countries including Rwanda and Uganda visited the pilot biogas plant. Training was provided to 11 persons on the construction and operation of biogas power plants (Training of trainers).

The pilot biogas power plant was installed in 2010 and it was running in good condition until 2013. From year 2013 onwards, few issues such as digester leakage, gas burner and pump failure occurred and hence the power plant was shut down. Training was given on operation and maintenance (O&M) to the power plant staff members within initial few months of plants commissioning. Continuous capacity building was not done after that. This resulted in staff not being able to solve the technical issues faced during O&M.

Some of the important lessons learnt from the pilot biogas power plant projects are: a) Ensure availability of spare parts availability. Currently, spare parts are not easily available in the market to fix the equipment failures; b) Sustainable operation of the power plants and effective O&M. O&M activities should be carried out only by trained in-house staff.

Currently, the management is also trying to use biogas from the existing plant for heating application in the slaughter house. There is also potential of using biogas for heating application in adjacent households.

c) Few other small scale plants have been implemented in other parts of Kenya as follows:

[21] Initial treatment plant comprised of mechanical aerators and 6 lagoons (before biogas plant)
[22] Installation of more efficient and energy saving air blowers.

S. No.	Project Name	Plant Developer / operator	Installed Capacity (kW)[23]	Other Details	Lessons Learnt
1.	Sisal-cum-cattle farm in Kilifi, Kenya	Biogas Power Holding EA Ltd.[24]	150[25]	• Uses sisal waste and cow dung; • Plant is in operation since 2007 Electricity production from November 2013 to 2014 is around 110,000 kWh; • Annual O&M cost is around Kenyan Shillings 1.75 million; • Currently handles only 40% of the generated sisal waste; • Rest of the waste stored in dumping pit for distribution; • Plant for expansion to 250 kW (commissioning by December 2015) to utilize the remaining waste.	• Need for human and institutional capacity building • Training of local staff for operation and maintenance of the plants
2.	PSDA project, Kenya Plant in Keekonyokie[26]	Keekonyokie Butchers Company Limited[27]	20[28]	• Uses slaughterhouse waste; • Plant is in operation since 2007; • Climate Innovation Centre (World Bank) has supported the plant financially in year 2012 and 2014; • KIRDI and NEMA is also supporting the plant for Biogas innovation; • Absence of the project, waste was dumped in neighbouring farms and liquid waste water was let out to the nearby stream without any treatment; • Presently 100% of the generated waste is treated in the biogas plant; • Digested biogas slurry is transported using exhauster lorries to neighbouring farms for use as organic fertilizer; • Plant performance is monitored by NEMA for compliance in waste management standards.	• Corrosion of roofing materials by the biogas (hydrogen sulphide) • High costs in transporting Biogas slurry for disposal in farms • Lack of repair and maintenance of gen-set • Lack of maintenance of the biogas plant and gas piping systems • Lack of training staff in operation of the biogas plant and gen-set operation.
3.	PSDA project, Kenya Abdul Sidis Farm Plant[29]	Abdul Sidis Farm	20	GTZ supported projected.	

All the lessons learnt in the projects mention above (1, 2 and 3) will be carefully considered and included in the design of the demonstration projects.

[23] http://www.giz.de/Themen/de/dokumente/gtz2010-en-small-scale-electricity-generation-from-biomass-part-2.pdf

[24] Joint venture of Kilifi Plantations (KE) and the German companies' agriKomp GmbH and Schnell Zündstrahlmotoren AG & Co. KG. The plant was implemented through a tripartite Public Private Partnership (PPP) with GTZ (now GIZ)

[25] Initial investment cost – 40 million Kenyan Shillings

[26] GTZ supported project under Private Sector Development in Agriculture (PSDA)

[27] Keekonyoike butchers Company is a Maasai owned Livestock marketing and meat processing Investment located in Kiserian Township Kajiado county (Kenya)

[28] Initial investment cost – 7.25 million Kenyan shillings

[29] GTZ supported project under Private Sector Development in Agriculture (PSDA)

Kenya National Domestic Biogas Programme (KENDBIP)[30]

KENDBIP Phase 1 was implemented from late 2009 to the end of 2013. The overall aim of the programme was to contribute to the achievement of the Millennium Development Goals (MDGs) through the development of a commercially viable, market-oriented biogas sector and dissemination of 8,000 domestic biogas plants in rural areas of Kenya. The target was revised upwards to 11,690 plants after the first 2 successful years of implementation.

In total, 11,579 biogas plants were installed, representing 99% of the target achievement. This programme adopted a national dissemination approach, away from a defined regions approach prescribed in the initial programme implementation document. Central and Rift valley regions lead in installation of plants in phase I.

To popularize the bio-slurry usage in farms, this programme sought the collaboration of sustainable/organic agriculture institutions that were contracted through memorandums of understanding with 12 extension service providers who have been training the biogas clients' on slurry utilization.

After a year of implementation, the slurry pit was made a mandatory part of the digester to ensure all farmers have a systemic way of handling their slurry before any other subsequent process and currently around 97% of all digesters installed have been fitted with a slurry pit[31].

As household biogas digesters are very common in Kenya, the technology can be extended and modified appropriately into commercial plants. An additional know-how of the present situation would also be created under the proposed GEF project.

So far, limited developments have taken place in Kenya in the field of the commercial biogas plants sector. National Energy policy[32], identified the following barriers for commercial biogas development:

- Lack of information on the benefits and potential of biogas technology;
- Lack of Research and Development (R&D) on biogas technologies;
- High upfront costs of commercial biogas plant and equipment;
- Inadequate skilled installation contractors in Kenya;
- Lack of clear registration and regulation guidelines for biogas installation contractors;
- Lack of post installation operation and maintenance service for plant, equipment and appliances.

Apart from these identified barrier, the sector is also facing the following barriers which need to be mitigated: a) inadequate local knowledge, technical capacity and skill for sustainable implementation, O&M of biogas plants, b) lack of technical standards for biogas plants, c) lack of detailed feasibility studies for developing biogas potential d) lack of financing facility to encourage private investors.

Due to availability of biogas potential and the expectation of regulation on attractive FiT system by the Kenyan Government, the biogas sector is an interesting market for investors to develop. Furthermore, for industries where agro-residues accrue during processing, the installation of biogas plants could help satisfy the energy demand of such industry and increase their productivity. Many of these industries are located in densely populated communities, the untreated waste pollute the environment and has adverse effect on nearby inhabitants. As a result of implementing the proposed project, environment of such communities will improve, generate employments, and improve the standard of living as well as social development of the communities. Another benefit is the direct sale of electricity generated from biogas plants to bulk consumers that are not connected to the national grid. Summing up all the potential benefits from the proposed project, the proposed project will contribute to achieving sustainable development goal (SDG) 9 as well as

[30]The Kenya Biogas programme is a component of the African Biogas Partnership Programme (ABPP), funded by the Directorate General for International Cooperation (DGIS) of the Netherlands' Ministry of Foreign Affairs through two Dutch development NGO's, the Humanist Institute for Cooperation with Developing Countries (Hivos) and the Netherlands Development Organisation (SNV).

[32] Draft National Energy Policy, February 2014
http://www.kengen.co.ke/documents/National%20Energy%20Policy%20-%20Final%20Draft%20-%2027%20Feb%202014.pdf

UNIDO's ISID mandate. SDG 9 aims to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Without GEF intervention, the mentioned barriers will continue to exist and the present scenario of poor waste management and dependence on grid/fossil fuels for energy requirement will continue with little or no significant improvement. Commercial biogas generation along with heat and/or electricity generation followed by sales of excess to the grid would not be possible without enough technical knowledge, skill and confidence for successful operation of such commercial biogas power plants.

The successful construction and operation of demonstration projects built upon commercial principles will bring confidence among investors and facilitate policy changes to encourage WTE projects.

GEF intervention will be timely and appropriate to achieve the goal of utilizing available WTE potential and meeting electrification targets. GEF intervention intends to remove all remaining barriers, specifically, lack of human and institutional capacities (through the creation of the information and best practices platform), favourable business environment and scaling up commercial biogas plants.

Compared to the available potential, the present installed and planned WTE power plant capacities are far lower. It is thus clear that WTE technologies are at a very rudimentary level of penetration in Kenya. Although there is potential to establish several WTE projects, barriers still exist, which need to be removed.

The proposed project will build on the above mentioned baseline projects/activities in Kenya and will extend the baseline and focus on overcoming the barriers in Kenya. The proposed project will facilitate the wide uptake of clean energy in the agro-industries sector as part of large countrywide efforts in mitigating the anticipated climate change impacts.

The project will also supplement and make use of various existing policies and strategies such as Initial National Communication to UNFCCC, Technology Needs Assessment, Energy Act, 2006and Vision 2030, National Portfolio Formulation Document (NPFD), etc. that address the current and anticipated adverse effects of CC, including extreme events. More details on these policies and strategies are provided in section A.1.The data in electricity and energy scenarios have been arranged in a logical way that shows the increase in demand in the industrial sector.

In summary, the following point can be used as guidelines for justifying why biogas is best option for Kenya's industrial sector:

- Key issues:
  a) Wastes from agro industries are available and are either not properly disposed or under-utilized.
  b) When not properly disposed, creates environmental and health issues
  c) When under-utilized, loss of energy sources, which is a must for developing countries like Kenya
  d) When properly disposed and utilized appropriately, GHG mitigation can be effectively done.

- The government and private sector contributing to this project:
  a) Various Ministries like, MoIED, MoE, MEMR, MoF, MoALF, etc. are supporting this project through their cash and in-kind financial contributions. The ultimate aim would be to bring about an enabling environment for the WTE projects to happen in the country whenever needed. Government institutions like KIRDI are also playing key roles in this project.
  b) Private sector industries/firms are developing WTE projects for their firms with the idea of disposing of their wastes in an environmentally friendly manner and also to utilize the energy potentials from the wastes to use for their own purpose.

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:

Proposed intervention

The proposed GEF project aims at establishing the following:

a) Improved human and institutional capacity for continuous development of WTE projects
b) Improved human capacity for sustainable operation and maintenance of WTE projects
c) WTE demonstration projects on a private-public partnership (PPP) basis for a cumulative 1,856 kW_e and 1,397 kW_{th} capacity leading to scaling up of the WTE technology. This would lead to around 144,960 t CO_2e of overall emission reduction.
d) Favourable investment environment through creation of incentive scheme, leading to replication of at least 14 MW_e and 6 MW_{th} plans. This would lead to an overall emission reduction of around 1,159,680 t CO_2e.

GEF context

Under the 'business-as-usual' scenario, most of the investments in the energy sector will have to come from the Government. Given the budgetary constraints and the identified barriers, public sector investments are unlikely to substantially fund the increasing energy gap in the country, particularly using RE resources. The role of private sector which is very crucial in achieving substantial investments needed in energy sector in Kenya would be minimal.

Without GEF intervention, the utilization rate of WTE potential would be less and the initiatives taken in the sector would be inadequate. No holistic, country-wide efforts to improve the sector would take place.

GEF funding will place the Government in a better position to mobilize co-financing for the project. The 'business-as-usual' situation would limit Kenya's ability to contribute to the achievement of MDGs, especially those referring to environmental sustainability and poverty reduction. Therefore, GEF support will be instrumental for the deployment of WTE based energy systems in Kenya, supporting Government initiatives for the betterment of energy situation in the country.

In conclusion, the baseline projects and baseline scenario would not be able to bring about significant mitigation of most of the barriers that hamper the implementation of WTE projects in Kenya within a short-term. The underlying critical problems of the lack of adequate institutional capacity, supporting financial environment and good technical expertise and skills on the market would remain unsolved.

The project

The proposed project will have the following 4 Project Components (PCs):

PC 1: Capacity development and knowledge management

This project component (PC) will be implemented by UNIDO in collaboration with MoE, MoIED, MEMR and KIRDI. Training will be a major activity in this PC and will focus on awareness and capacity building on WTE in order to achieve the expected outcome of improved awareness, knowledge sharing on best practices and capacity building in the country. Through trainings, awareness on potential usage of biogas technologies in potential industries will be created. The proposed project will work with the identified government agencies to deliver the following output:

1.1.1. Information and the best practices platform (IBPP) for WTE technologies established at Kenya Industrial Research & Development Institute (KIRDI)

Under this output Information and Best Practices Platform (IBPP) for biogas technology will be established at KIRDI who has prior experience working in biogas sector in Kenya. This centre will create a database which includes all information required for developing biogas projects. It will also provide necessary training to various stakeholders such as the agro-industries, interested WTE project developers, financial institutions, engineering companies, RE/technical institutions, banks/financial institutions etc., as per their requirements.

IBPP is attached to KIRDI for reducing infrastructure development cost and operating cost as well as to ensure its sustainability. The capacity development activities at IBPP would be sustained through the following:

- A nominal fee would be charged for the training activities. This amount would be used to manage and maintain the activities of the platform.
- Well trained KIRDI staff members would be managing IBPP and hence, there would be no additional man-power cost.

Efforts will be taken to promote gender balance amongst staff of IBPP across all levels by reaching minimum 30% participation at the end of the project duration of 48 months taking into consideration the existing staff structure at KIRDI. IBPP staff will also be engaged during the entire cycle of the demonstration project. They will also be trained at the existing 10 kWe pilot plant at Dagoretti or any other operating commercial biogas plant. These trainings will focus on: a) Construction of commercial biogas plants, b) Operational arrangements of the commercial biogas plants, c) Planned and unscheduled maintenance of the industrial biogas plants and d) Troubleshooting of the commercial biogas plants.

All these trainings will ensure that IBPP staff members understand the various intricacies involved in the biogas project development. The platform will conduct periodical training even after the completion of the GEF project and will ensure that the capacity development activities are sustained. A team of international and national consultants who initially trained IBPP staff will continue their association with the platform. When the need and/or if any major/critical issues arises, these consultants would assist with the project development activities. Through the platform, WTE information will be disseminated through various dissemination tools such as leaflets or different websites. Experience sharing sessions will also take place involving engineers/project managers who have prior experience in developing similar WTE projects.

Necessary and appropriate training material for different groups of trainees will be prepared. Available guidebooks on biogas power plant development will be customized to suit the local conditions. This will benefit the potential investors. Any information regarding biogas projects can be obtained from this platform. The above arrangement will ensure the sustainability of the proposed activities in capacity development.

1.1.2. Development of human capacities in WTE for policy makers (at least 50 policy makers), project developers, agro-industries, and other stakeholders (at least 50 persons)

Without appropriate supporting policy and regulatory environment, no technology promotion can be achieved. Electricity generation by commercial biogas plants has not been implemented yet, since the feed-in-tariff for biomass does not offer specific tariffs for biogas. It is therefore, essential to engage policy makers by providing tailored training during the project period to address this challenge. The training for policy makers will focus on the reformulation and implementation process of the feed-in-tariffs and policies for biogas energy. Prior to the delivery of the training, the project will closely engage with the policy makers in understanding their present knowledge status, training needs, etc.

Specific trainings aimed at agro-industries and interested project developers will be conducted, targeting at least 50 persons. They will be educated and efforts will be taken to help them gain confidence in the technology and be equipped with necessary technical capacity for supporting, developing and implementing such projects.

In addition, trainings for various target groups such as local engineering and O&M companies will be provided (at least 50 personnel) to facilitate sustainable operation of the demonstration and replication projects. In addition, IBPP would conduct frequent trainings on O&M of biogas plants. All capacity building activities will be carried out at IBPP at KIRDI.

1.1.3. Development and strengthening of institutional capacities in the area of WTE among technical institutions (at least 50 persons from each group)

The key decision makers from different RE/technical institutions (at least 50 numbers) will be trained and equipped with necessary technical capacity for supporting, developing and implementing such projects. All the demonstration projects are on investment basis and the investors need to source their investment (co-financing) from banks and financial institutions. Therefore, efforts to create awareness and interest among banks and financial institutions for lending biogas demonstration project will be a priority. Around 50 personnel from banks, financial institutions and funding agencies will be trained in assessing, evaluating and conducting due diligence on biogas projects. Efforts will be taken to ensure that at least 20% of the training participants are women. To ensure participation of women, there could be specific outreach efforts targeting women groups and associations to raise awareness and also, there should be special consideration to the logistics of workshops/trainings (time of day, location, security, etc.).

Impact of the intervention

From the outcome of this project component, it is expected that the following barriers are removed:

Barriers / Challenges	How it is addressed
Insufficient public awareness and participation	• Creation of IBPP centre and functioning of the centre; • Training activities and information dissemination through various tools
Inadequate knowledge, technology and skill available for implementing biogas plants	Training to: • Key decision makers; • Agro-industries; • Interested project developers; • Banks/financial institutions; • RE/technical institutions; • Local engineering companies.
Inadequate local technical capacity for sustainable operation and maintenance	Training to: • Local engineering companies;. • Local O&M companies.

PC 2: Establishment of pilot agro-industrial WTE plants

This component will focus on establishing pilot agro-industrial WTE plants in Kenya. Technical assistance for project development will be facilitated through GEF grant, a part of GEF grant (USD 675,180) will also be used to provide incentives towards equipment purchase within the limits set by the principles of incremental cost. The co-financing contribution from private investors will be used for establishing the demonstration projects. The demonstration projects can also get benefitted through the soft loans that may be established under the project component 3. This is based on the fact, that for the first few plants, the investment cost is expected to be on the higher side and hence, additional incentive would ease the cost related barrier and related payback.

These demonstration projects will follow international competitive bidding practice and other standards in selecting and contracting of the equipment supplier. This would also include agreement on supply of spare parts for the O&M of WTE plants for at least 2 years. The equipment supplier would either supply or suggest ways of procuring the spare parts. Before the actual power plant operation, biogas plant operators will be trained at IBPP. These plant operators will also undergo on-the- job training at an existing biogas plant. During the plant operation, the digested residue will be

processed into organic fertilizer for sale to local farmers. It can be said that the digested sludge will be devoid of heavy metal content, plastic waste content, etc. or contain them in such quantity which makes them suitable for the land application. Under this PC, the proposed project will collaborate with MoE, MEMR, MoALF, KEBS, ERC and demonstration plant owners to deliver the following outputs:

2.1.1. Establishment of standards for medium and large scale biogas plants

At present, Kenya Bureau of Standards (KEBS), in collaboration with Energy Regulatory Commission (ERC), is working on a National standard for household and commercial biogas digesters. This standard contains regulations for entire chain of construction and operation of biogas digesters. ERC will enact regulations that will require all biogas plants to adhere to these standards. ERC is established under the Energy Act, 2006 with the mandate of regulating the energy sector. The Commission regulates the energy sector by dividing it into three sub-sectors mainly (i) Electricity, (ii) Petroleum and related products (iii) Renewable energy. The ERC regulates, and enforces the standards developed by KBS according to international standards and best practices. The following sub-sectors of RE have been regulated: (a) Solar water heating systems, (b) Improved biomass cook stoves, (c) Energy performance of appliances, (d) Impact assessment of energy labelling, (e) Energy management, (f) Photovoltaic installations, etc. These regulations focus on the value chain of Renewable Energy Technologies (RETs), in order to facilitate efficient use of RETs by enforcing Kenya Standards for renewable energy systems developed by the KBS. The commission also initiates the standards development and the codes of practices for any renewable energy activities. It has been observed that there are no standards for biogas technology presently available in Kenya. Hence, ERC and KBS will collaborate together to develop standards for biogas system based on best practices.

This project will work with KEBS and ERC and will contribute in the following ways for the early enforcement of the national standards:

- International experts' opinion on the proposed standard
- Stakeholder discussion and brainstorming sessions before enforcement

Information dissemination on the enforced standard will be carried out through various dissemination tools including website and leaflets.

2.1.2. Detailed plant design prepared for WTE demonstration plants

During the PPG stage, requests were received from private investors to provide assistance in establishing WTE and improving the capacities of some existing plants. Technical assistance will be provided to private investors to conduct detailed plant design for establishing WTE plants and increasing the capacity of existing plants. GEF resources will be used to carry out the detailed plant design; after the designs have been carried out the investors will be introduced to the financing scheme available to develop these sites.

2.1.3. WTE plants established for a cumulative capacity of around 1,856 kW_e and 1,397kW_{th}

This output aims to demonstrate WTE plants with a cumulative capacity of *1,856 kW_e and 1,397kW_{th}* in the agro-industry. Below are the selected sites in which the demonstration plant will be established. Feasibility studies for these demonstration projects were conducted during June-July 2014 (see Annex F). These plants will be designed and commissioned considering the lessons learnt from the existing biogas plants in Tanzania (as discussed in the previous section). The industries were selected based on the following criteria, (i) Expressed interest in participating in the proposed GEF project and confirmed co-financing, and (ii) Pre-feasibility study conducted during the PPG stage. The project will target the following industries as the demonstration sites:

Narrative description of demonstration sites

Migotiyo Plantations

Migotiyo plantation is a centre of agri-business with a mission to utilize best agricultural practices in production and adds value through processing, using appropriate technology while conserving the environment. Migotiyo plantation produces various agro-produce, seed, sisal, herbs and generates sisal wastes, maize leftovers, chives drops, and cow manure. Migotiyo plantation has planned to develop a biogas power plant within the plantation using sisal wastes a substrate for the biogas plant. The sisal fibre production generates a huge amount of waste material, which consists of more than 96% of vegetative waste material and process waste water. This waste material is deposited in a dump around the decorticating units and effluent seep into the nearby river, thus causing major environmental damage. However, the sisal waste contains high organic matter, and is easy to digest and produce biogas. Therefore, the plantation wants to develop an industrial biogas facility to produce biogas from sisal leaf waste for electricity generation and distribution of heat to related industries and to use the effluent residues as high quality bio-fertilizer for commercial farming. Waste availability and biogas potential in Migotiyo Plantations (taken from the feasibility study) are presented in table 5.

Table 5: Waste Availability in Migotiyo Plantations

Type of waste	Average Quantity (Ton)			Biogas potential (m^3)		
	Daily	Monthly	Yearly	Daily	Monthly	Yearly
Sisal waste	111.4	2,896	33,624	1,269	32,994	383,251

Dagoretti Slaughterhouse

Dagoretti slaughterhouse consists of 4 abattoirs. These abattoirs are among the largest contributors to land, air and water pollution in the vicinity and to the degradation of River Kabuthi, a tributary of the Nairobi River. Waste generation in the abattoirs is shown in picture 1:

Picture 1: Waste generation in Dagoretti slaughterhouse

Based on UNIDO's suggestion[33] on energy recovery and safe disposal of wastes through bio-methanation, a pilot plant of 10 kWe capacity with a portion of the wastes was installed. This plant was planned to run for up to six hours meeting the energy need of the facility. Now, it is proposed by UNIDO to upscale the pilot plant to a commercial biogas power plant to utilize waste from all the slaughter houses. Waste availability and biogas potential in Dagoretti Slaughterhouse are presented in table 6.

Table 6: Waste Availability in Dagoretti Slaughterhouse

[33] Feasibility study on implementing Biogas digester/s at the Dagoretti Abattoirs in Nairobi, Kenya, 2008

Type of Slaughterhouse waste	Average Quantity (Ton)			Biogas potential (m^3)		
	Daily	Monthly	Yearly	Daily	Monthly	Yearly
Solid waste	21	546	6,342	1,260	32,760	380,520
Waste water	25	650	7,550	75	1,950	22,650
Total	**46**	**1,196**	**13,892**	**1,335**	**34,710**	**403,170**

Farmer's Choice Slaughterhouse and pig farm

Farmer's Choice was founded in 1980, with the central purpose of selling fresh and processed pork products to all income groups in Kenya. The core business of Farmer's Choice has been the production of fresh sausages, bacon, ham and pork. Beef has also become an important supplementary product. In the mid-1980s, the company expanded into pig production, establishing a new butchery complex and slaughterhouse at Kahawa West just outside Nairobi. Waste generation in the slaughterhouse is shown in picture 2:

Picture 2: Waste generation in Farmer's choice slaughterhouse

Currently, the waste generated in the slaughterhouse is being dumped without any economic use. The management has expressed a keen interest on investing in a waste management and energy generation system through the proposed GEF project. Their heat demand is also high and they are currently using furnace oil for heat. A steam boiler can replace furnace oil 10 – 30% with biogas. So a thermal power plant was recommended for this plant instead of electricity generating plant. Waste availability and biogas potential in Farmer's Choice slaughterhouse are presented in table 7.

Table 7: Waste Availability in Farmer's Choice Slaughterhouse

Type of Slaughterhouse waste	Average Quantity (Ton)			Biogas potential (m^3)		
	Daily	Monthly	Yearly	Daily	Monthly	Yearly
Solid waste	12	312	3,624	720	18,720	217,440
Waste water	20	520	6,040	60	1,560	18,120
Total	**32**	**832**	**9,664**	**780**	**20,280**	**235,560**

In addition, Farmer's Choice has a pig farm (Upland) which generates considerable amount of solid and liquid pig manure. Waste generation in the slaughterhouse is shown in picture 3:

Picture 3: Waste generation in Farmer's Choice pig farm

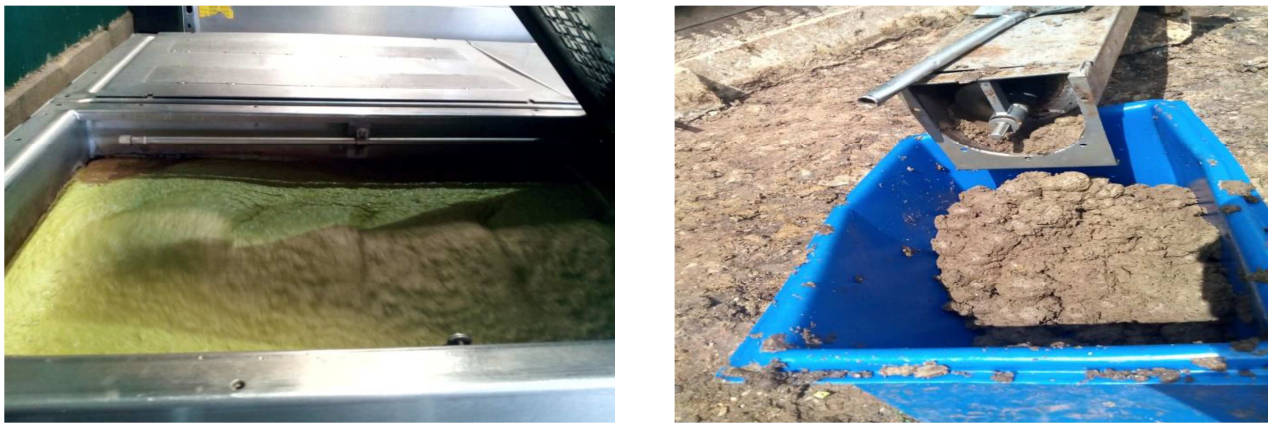
Waste availability and biogas potential in Farmer's choice pig farm are presented in table 8.

Table 8: Waste Availability in Farmer's Choice Pig farm

Type of Pig manure	Average Quantity (Ton)			Biogas potential (m^3)		
	Daily	Monthly	Yearly	Daily	Monthly	Yearly
Solid waste	32	960	11,520	1,600	48,000	576,333
Liquid	64	1,920	23,040	166	4,980	59,760
Total	**96**	**2,880**	**34,560**	**1,766**	**52,980**	**636,093**

Olivado Avocado Oil Processing Plant

The Olivado avocado oil processing plant (owned by Olivado EPZ Limited) produces a considerable amount of waste and waste water. Disposal of the waste incurs cost and causes logistical difficulty. Currently, wastes like this are often landfilled, where methane is produced and released into the atmosphere causing environmental pollution. Another major issue is the availability and the cost of grid electricity. The objective of the Olivado pilot plant is to establish a biogas plant utilizing these wastes. Waste generation in the avocado oil processing plant is shown in picture 4:



Picture 4: Waste generation in Olivado avocado oil processing plant

Waste availability and biogas potential in Olivado avocado oil processing plant are presented in table 9.

Table 9: Waste Availability in Olivado Avocado Oil Processing Plant

Type of Waste	Average Quantity (Ton)			Biogas potential (m^3)		
	Daily	Monthly	Yearly	Daily	Monthly	Yearly
Avocado waste	43	1,118	12,986	2,365	70,950	714,230

Kenya Meat Commission

A pre-feasibility-study was conducted by the German Federal Enterprise for International Cooperation (GTZ) in collaboration with the Ministry of Agriculture, in the year 2010, on the use of biogas technology for energy substitution at Kenya Meat Commission (KMC) Slaughterhouse, Athi River. According to the pre-feasibility study, the investment in a biogas plant to produce electricity for own useage does not pay back. Hence, the pre-feasibility study suggested replacement of furnace oil through biogas and tallow fat. Feasibility study conducted during July 2014 found the following waste availability and biogas potential in KMC slaughterhouse.

Table 10: Waste Availability in KMC slaughterhouse

Type of Slaughterhouse waste	Average Quantity (Ton)			Biogas potential (m^3)		
	Daily	Monthly	Yearly	Daily	Monthly	Yearly
Solid waste	17	374	4,488	1,020	22,440	269,280
Waste water	30	660	7,920	90	1,980	23,760
Total	**47**	**1,034**	**12,408**	**1,110**	**24,420**	**293,040**

The electricity and thermal energy requirements of the above industries are summarized in table 11.

Table 11: Energy requirements of the demonstration sites

S. No	Name of the industry	Electricity Consumption (kWh)			Thermal energy consumption (kWh_{th})		
		Daily	Monthly	Yearly	Daily	Monthly	Yearly
1.	Migotiyo Plantations	-	-	-	-	-	-
2.	Dagoretti Abattoirs	616	16,016	186,032	16.25	422.5	4,907
3.	Farmers choice slaughterhouse	1,968	51,168	594,336	2,400	62,400	724,800
4.	Farmers choice pig farm	2,437	73,110	877,320	293	8,790	105,480
5.	Olivado avocado oil processing plant	6,744	202,322	2,427,868	2,760	82,800	993,600
6.	Kenya meat commission	9,200	202,400	2,428,800	3,000 litre (HFO)	66,000 litre (HFO)	792,000 litre (HFO)

A list of proposed biogas-based WTE pilot sites, along with their baseline condition, estimated capacities & annual energy generation as per the feasibility study is given in table 12.

Statistical description of demonstration sites

Table 12: Baseline and project condition details for the demonstration sites

S. No.	Name of the industry	Baseline				Project						
							Electricity			Heat		
		Type of waste	Waste	Electricity	Heat	Waste	Description	Plant capacity (kW) [34]	Net energy generation (MWh)[35]	Description	Plant capacity (kW)	Net energy generation (MWh_{th})[36]
1.	Migotiyo Plantations	Sisal waste	Disposed in a dump.	Grid	Not applicable	Utilized for biogas generation	Biogas engine. Generated electricity and heat for own use. Excess power will be export to grid	1,091	8,724	Thermal energy will be used for available for heating purposes (drying of maize crops or fiber)	839	7,348
2.	Dagoretti Abattoirs (slaughter house)	Slaughter house waste	Disposed in farm land. (a part of the generated waste was used in the 10 kW plant) Waste unused for energy generation.	Grid (a part of the electricity requiremen t was also supplied by the 10 kW pilot plant)	Not applicable	Utilized for biogas generation	Biogas engine. Generated electricity for own use and the surrounding village communities. Excess power export to grid (if any)	230	632	Not applicable		
3.	Farmers Choice Slaughter house (slaughter house)	Slaughter house waste	Liquid waste treated via clarifier, multiple settling ponds prior to	Not applicable	Furnace oil	Utilized for biogas generation	Not applicable			A part of the furnace oil consumption replaced by biogas	308	269

[34] Also includes secondary thermal energy generation for biogas digester heating and other industrial use. Since this thermal energy usage is small as compared to the electricity production and usage, conservatively this is not presented here.

[35] 80% load factor and 10% parasitic electricity consumption

[36] After considering 20% loss and 60 to 65% digester heating use

S. No.	Name of the industry	Baseline				Project						
							Electricity			Heat		
		Type of waste	Waste	Electricity	Heat	Waste	Description	Plant capacity (kW) [34]	Net energy generation (MWh)[35]	Description	Plant capacity (kW)	Net energy generation (MWh_{th})[36]
			sewers. Solid waste taken for incineration. Waste unused for energy generation.									
4.	Farmers Choice pig farm (pig manure)	Pig manure	Use of an effluent treatment plant for liquid waste treatment. Solid waste spread on farms as organic fertilizer. Waste unused for energy generation.	Grid	Not applicable	Utilized for biogas generation	Biogas engine. Generated electricity for own use. Excess power export to grid (if any).	335	1,013	Not applicable		
5.	Olivado Oil Processing Plant (avocado processing)	Avocado processing waste	No treatment. Unused for energy generation.	Grid	Not applicable	Utilized for biogas generation	Biogas engine. Generated electricity and heat for own use.	200	1,015	Not applicable		
6.	Kenya Meat Commission	Slaughter house waste	Manure is collected for sale. Effluent water is disposed through drying ponds. Excess water from these ponds disposed	Not applicable	Furnace oil	Utilized for biogas generation	Not applicable			A part of the furnace oil consumption replaced by biogas	250	260

S. No.	Name of the industry	Baseline				Project						
		Type of waste	Waste	Electricity	Heat	Waste	Electricity			Heat		
							Description	Plant capacity (kW) [34]	Net energy generation (MWh)[35]	Description	Plant capacity (kW)	Net energy generation (MWh_{th})[36]
			through the local municipal sewer system. Waste unused for energy generation.									

Further chemical analysis of bio-digested sludge from other existing biogas plants was undertaken during the PPG stage. The result gave positive indication on manure suitability of the digested sludge. However, adjustments were recommended to incorporate nutrient contribution from other sources, before being sold as bio-fertilizer (see Annex I).

Aerobic post-treatment of anaerobically digested material will further reduce its phyto-toxicity and enhance the physical and chemical properties of the material[37]. Hence, it will be ensured that only the aerobically post-treated sludge will be used for fertilizer application.

The project will work with the National Environment Management Authority (NEMA) Regulatory Agency under MEMR for quarterly chemical analysis of the post-treated bio-digested sludge waste produced by the biogas plants, during its operation, for its nutrient quality and certifying its suitability for farming use.

Chemical analysis of the bio-digested slurry will be done at KEBS, University of Nairobi (School of Agriculture), or any other lab authorised by NEMA. NEMA will issue a certificate, certifying the bio-digested sludge's suitability for farm application.

Costs related to such tests will be borne by the demonstration plant owners. The demonstration plant owners, when selling the bio-digested sludge will affix NEMA's certificate on suitability as fertilizer, date of certification, etc.

MEMR will audit the demonstration plants and will check selling/distribution of certified bio-digested sludge. Any distribution of uncertified bio-digested sludge will be noted. Suitable penalty will be laid on the demonstration plant owner, including banning the distribution of sludge in that plant and cancelling the license for selling bio-digested sludge.

A tentative sludge monitoring system is shown in the figure 2.

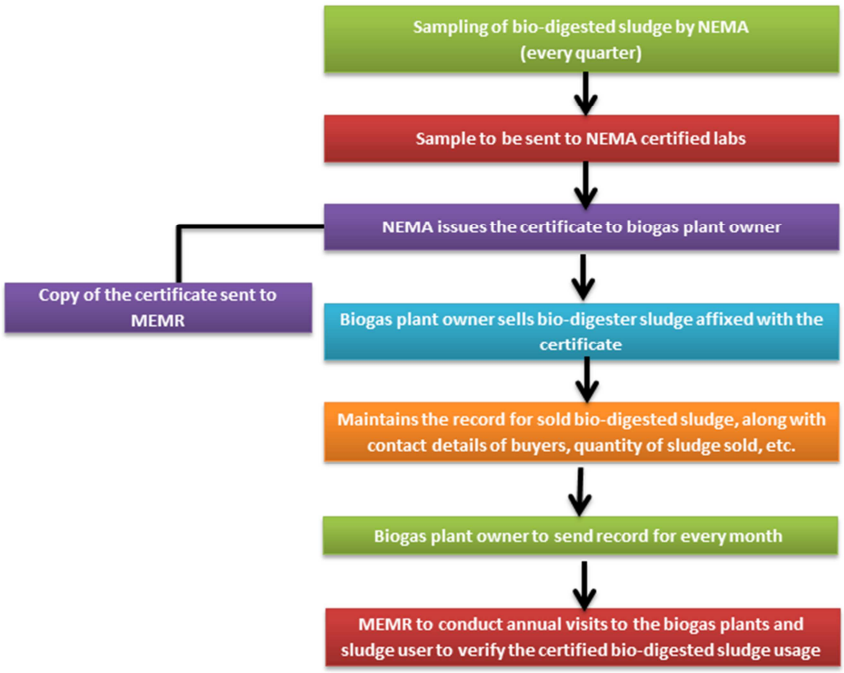


Figure 2: Sludge Monitoring System

In addition, awareness will be created among potential bio-digested sludge users on the certification from NEMA. Training will be conducted at IBPP promoting the usage of bio-digested sludge.

[37]Review paper "Anaerobic digestion of organic solid poultry slaughterhouse waste – a review"
E. Salminen 1, J. Rintala, Bioresource Technology 83 (2002) 13–26
http://josiah.berkeley.edu/2007Fall/ER200N/PolicyMemo/AnaerobicDigestionPoultrySlaughterhouse.pdf

Demonstration projects under the proposed GEF project do not involve CDM and corresponding CER benefits, since the market value for CER is low and the transaction cost for CDM project is high. These projects will only look up to GEF grant for their implementation.

Efficient biogas and gas engine technologies are not available in Kenya. Hence, they have to be imported. As a result of the demonstration projects, there will be technology transfer to Kenya. The GEF project will provide technical assistance in sourcing and preparing specifications etc., of technologies through UNIDO procurement services. However, the equipment purchase will be done by adhering to UNIDO's procurement services and rules. A number of technology know-how workshops and plant visits will also be conducted under this component.

Socio-economic baseline analysis for the community level including gender aspects will be conducted for the demonstration projects. An impact assessment study at the end will also be carried out. These studies will be conducted using GEF grant. The demonstration project owners will provide necessary support and cooperation for the conduct of these studies.

Impact of the intervention

The expected output and outcome of this component will mitigate the following barriers:

Barriers/Challenges	How it is addressed
Inadequate financing/private sector investment in WTE	Increased investments from private sector
Lack of information sharing on existing projects	Biogas demonstration projects implemented and operating. Information sharing through site visits and workshops.
Inadequate local technical capacity for sustainable operation and maintenance	Training to: • Local engineering companies; • Local O&M companies/institutions.
High costs of installing the systems	Successful demonstration will lead to: • Replication of the technology which will induce competition in the market; • Transfer of technology which will reduce the project cost.

PC 3: Scaling up investment in WTE plants

This component will be executed by UNIDO in collaboration with MoE, MoIED, MoF and the Co-operative Bank of Kenya. Discussions during the PPG stage revealed that lack of confidence in biogas technology among banks/financial institutions and consequent higher interest rate remains one of the major hurdles against biogas plant investment. The banks are ready to offer soft loans (with lower interest rate), however, they expect partial risk guarantee from Government. Hence, under this project component, efforts will be taken to establish a soft loan scheme with lower interest rate based on partial risk guarantee assured by Kenyan Government. Such a scheme will be detailed once the funds are made available during the project implementation stage.

As of now, the level of investments in biogas projects in Kenya is very low. One major reason for this is the lack of conducive environment for investments. Hence to mitigate this barrier, a specific financial incentive scheme for promoting investments in biogas projects will be created.

Output 3.1.1. Establishment and implementation of incentive systems for WTE technologies

It has to be noted that commercial biogas plants are new to Kenya and hence there should be some mechanisms to encourage project developers to invest in these technologies. With the presence of incentive facility systems along with other GEF/UNIDO's support and involvement systems, they will come forward to invest in the technology. Initial target is to provide incentives to small plants for a cumulative 6 MWe and 2 MWth and medium to large plants for a cumulative 8 MWe and 4 MWth.

Sustainability of the scheme

The Kenya Government is expected to allocate funding for enhancing RE capacity in Kenya. In addition to this, various donors are expected to support the Kenya Government in the coming years. A part of this money will be channelled to this purpose, to ensure the sustainability of the incentive scheme. Efforts will be taken to consolidate and streamline various support schemes by departments/ministries into a centralized one that will be managed by local financial institutions. Soft loan and a revolving fund scheme like will encouraged to be in place to sustain the incentive scheme for private investors.

Partners involved

The Co-operative bank of Kenya who has previously worked with RE projects in collaboration with Agence Française de Development (AFD)[38] will be the partner under PC 3. The Co-operative bank has entered into agreement with AFD towards financing the RE and Energy Efficiency projects in the country[39].

MoF will be consulted appropriately in the design and implementation of the incentive system to be sponsored by MoE and MoIED with (USD 3 million). A part of the GEF grant will be used to facilitate and create modalities of the above mentioned incentive scheme. Around USD 700,000 will be used as seed amount for the proposed incentive scheme. This will maximize the benefit of CO_2 reduction per USD spent by GEF for this project.

Complete detail of the incentive scheme is given in Annex K. It has to be however noted that, the exact modalities of the incentive scheme and involvement of various institutions would be finalised during the project implementation period after the GEF grant has been released.

In addition, MoF will also play a key role in enhancing the financial environment by offering other financial incentives like tax incentives for commercial biogas plants, recommended under the project. As of now, MoF is providing import duty exemption for domestic biogas plants construction materials. The duty on domestic biogas digester construction materials has been waivered from 25% to 0%. At the end of monitoring and evaluation, the amount of investment and energy production as a result of the proposed incentive system will be studied in detail.

Impact of the intervention

As a result of this component, it is expected that the following barriers will be addressed:

Barriers/Challenges	How it is addressed
Inadequate financing / private sector investment in WTE	• Creation and operation of incentives; • Private sector benefitted from incentives.
Lack of dedicated financing/incentives schemes to support WTE investments	

PC 4: Monitoring and Evaluation (M&E)

The Monitoring of project progress is essential for the adequate and timely delivery of results. This project component covers project monitoring and oversight by UNIDO in close coordination with MoE, MoIED and MEMR, as well as a terminal evaluation of the Project.

Initial activities under this component include the organization of an inception workshop, the definition of progress and impact indicators and the design of a detailed monitoring plan and methodology. Particular attention will be paid to gender aspects and it is anticipated that a gender analysis will be carried out during the inception phase to facilitate gender mainstreaming throughout project implementation.

[38] AFD is a financial institution and the main implementing agency of France's official development assistance to the developing countries and overseas territories.

[39] The EUR 30 Million (USD 39 Million) credit agreement signed in 2011 enabled the Bank on-lend to its customers undertaking projects targeting diversification of energy resources and transition towards renewable energy solutions

The project will be monitored from the very beginning, and a mid-term M&E will not be conducted as it is not conducted for Medium-sized projects. An independent final evaluation will be conducted three months prior to the terminal review meeting. The final evaluation will look at the impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefit goals. The final evaluation will also provide recommendations for follow-up activities.

After completion of the demonstration project and successful operation, the project performance monitoring will be conducted to study the technical, financial, environmental and socio-economic performances of the projects. A full scale project demonstration site visit and seminars will be organized and the project experiences will be disseminated to various stake holders in order to increase the replication potential of the project. Various dissemination tools such as leaflets, website, etc., will be used for effective distribution of information.

Under this component, the project will work all project stakeholders, partners and contractors to achieve the following outputs:

4.1.1. Terminal evaluation project report prepared

An independent terminal evaluation will take place three months prior to the terminal review meeting. The terminal evaluation will look at the impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefit goals. It will also provide recommendations for follow-up activities to interested stakeholders, in order to increase the development of the potential sites. The terminal project report will be made available on UNIDO's website and used for effective dissemination. National and international experts on evaluation will be engaged to carry out the evaluation using co-financing resources from UNIDO.

4.1.2. Lesson learning and information dissemination workshops

An annual report and periodical newsletter on the best practices, information on country level projects and key indicators of progress made under the project will be prepared and distributed to the key stakeholders and agencies. Annual reports will be submitted to GEF secretariat in the form of Project Implementation Reviews (PIRs).

4.1.3. Publications and websites

Methodologies / tools will be developed to use the collated information for better planning and decision making. Case studies will be prepared and presented to raise more investment in biogas projects, using the trained capacity and various financing schemes that are created.

Project implementation schedule is given in Annex E.

Local and national environmental benefits

In the absence of the biogas based energy generation, the industries will continue to pollute the surroundings with the wastes generated in the process and continue to use grid electricity and furnace oil / fossil fuel which are highly GHG intensive. At the national level, equivalent amount of GHG is mitigated.

Global environmental benefits

Direct benefits derive from the implementation of demonstration projects for approximately 1,856 kWe and 1,397 kW_{th} cumulative capacity.

Indirect benefits are obtained from the contribution of the project towards the market transformation, capacity building, institutional strengthening, technology adaptation and creating enabling environment for the investments in biogas sector. Some industries, including All Fruit Limited - a fruit processing industry - have expressed their interest to develop WTE projects.

As previously explained, there is good biogas potential in Kenya. Considering a) human and institutional capacity development, including the establishment of information and learning centre, b) establishment of incentive facility for biogas projects and c) establishment of demonstration projects for 1,856 kWe and 1,397 kW_{th}, it is conservatively assumed that at least 14 MW_e and around 6 MW_{th} biogas based plants will be replicated all over the country within a period of 10 years after the closure of the project. This will reduce the CO_2 emissions considerably and improve the energy supply situation in Kenya

Baseline for all the demonstration projects:

- For electricity generation, grid is taken as the baseline[40].
- For thermal energy generation in Kenya Meat Commission slaughterhouse, furnace oil is taken as the baseline[41].
- The annual CO_2 reduction due to avoidance of methane amounts to zero as most of the industries treat their liquid waste and solid waste before disposing. Since it is not very sure whether the existing treatment technologies result in methane generation, it is conservatively assumed to be zero.

Table 13: Emission reduction in Demonstration plants – Electricity

S. No.	Name of the industry	Type of plant	Capacity (kWe)	Annual energy generation (MWh)	Annual t CO_2e reduction	Annual CO_2 reduction due to avoidance of methane
1.	Migotiyo Plantations	Electricity	1,091	8,724	5,501	0
2.	Farmers Choice pig farm	Electricity	335	1,013	609	0
3.	Dagoretti Abattoirs	Electricity	230	632	380	0
4.	Olivado avocado oil processing plant	Electricity	200	1,015	610	0
		Total	**1,856**	**11,384**	**7,100**	**0**

Table 14: Emission reduction in Demonstration plants – Thermal energy generation

S. No.	Name of the industry	Type of plant	Capacity (kWth)	Annual energy generation (MWh_{th})	Annual t CO_2e reduction	Annual CO_2 reduction due to avoidance of methane
1.	Migotiyo Plantations	Not applicable	839	7,348	-	0
2.	Farmers Choice slaughterhouse	Furnace oil replacement	308	269	73	0
3.	Kenya meat commission	Furnace oil replacement	250	260	75	0
		Total	**1,397**	**7,877**	**148**	**0**

The established biogas plants will result in avoidance of approximately 131, 320 t CO_2e directly throughout their lifetime of 20 years. Indirectly, this will lead to avoidance of 1,159,680 t CO_2e due to replication of the pilot plants.
The overall emission reduction from the demonstration projects is estimated based on "Manual for Calculating GHG Benefits of GEF Projects: Energy Efficiency and RE Projects"[42]. The emission reduction benefits from the proposed project are summarized in table 15.

[40] Kenya's grid emission factor is taken at 0.6016 t CO_2e/MWh.
Source: http://enviroscope.iges.or.jp/modules/envirolib/view.php?docid=2136
[41] NCV of 40.4 TJ/Gg and emission factor of 77.4 t CO_2/TJ, taken from
http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf
http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf
and a density of 0.89 to 0.95. For calculation purpose, a value of 0.89 is taken.
http://www.em-ea.org/Guide%20Books/book-2/2.1%20Fuels%20and%20combustion.pdf

[42] https://www.thegef.org/gef/sites/thegef.org/files/documents/C.33.Inf_.18%20Climate%20Manual.pdf

Table 15: Emission reduction benefits of proposed project

S. No.	Type of benefit	Emission Reduction (t CO_2e)
1.	Direct reduction	144,960
2.	Indirect reduction	1,159,680

The increment of the project:

Under PC 1, the GEF funding will be used for establishing IBPP to strengthen the existing human and institutional capacity in commercial biogas technology. Under PC 2, a part of the incremental cost of demonstrating the benefits of biogas instead of carbon intensive technologies is funded from GEF resources. Under PC 3, the GEF funding will be used for the incremental element in creating the capacity based incentive scheme. As such, this will build confidence among investors and attract more investments. Also, a part of the GEF grant will be used as a seed amount in the incentive scheme. Under PC 4, the GEF resources will be used for funding the incremental cost of monitoring and independently evaluating the demonstration projects as well as other project components to ensure that the global environmental benefit objectives of the project are met.

Incremental cost for the demonstration plants is based on the following findings:

a) There is a wide gap existing in the country between the electricity demand and supply.
b) The electricity supply for industries is often unreliable forcing them to seek other power generating sources such as diesel generators.
c) Industries (including the industries where demonstration plants are being set up) operate at a lower capacity and lower operating hours due to lack of grid electricity availability.
d) Increased electricity demands are covered by diesel generators.
e) The demonstration plants have the required waste necessary to develop and operate WTE plants. Very few biogas plants exist in Kenya. Only with the involvement of GEF/UNIDO, the demonstration plant owners have come forward to invest in a technology which is new to them. If this 1,856 kWe is not developed by these proposed demonstration plants, then an equivalent amount will be generated using diesel in some other industries in Kenya. Thus, it is clear that those demonstration plants will displace equivalent amount of electricity that would be generated from diesel generators in some other industries of Kenya.
f) Investment in diesel generators is considered as the baseline cost.
g) Thermal energy requirements of Kenya Meat Commission and Farmer's choice slaughterhouse are already met through their existing furnace oil boiler. The proposed biogas plant will reduce the furnace oil consumption in this boiler. Hence the baseline cost of KMC is taken as zero.

Table 16 depicts the incremental cost for each demonstration plant[43].

Table 16: Incremental cost of demonstration projects

Plant name	Capacity	Baseline investment (USD)	Project investment (USD)	Incremental cost (USD)
Migotiyo Plantations	1,091kW 839kW_{th}	3,500,000	4,450,000	950,000
Farmers Choice Slaughter house	308 kW_{th}	0	1,572,216	1,572,216
Farmers choice pig farm	335 kW	140,000	1,725,250	1,585,250
Dagoretti Abattoirs	250 kW	110,000	1,219,000	1,109,000
Olivado Avocado Oil Processing Plant	200 kW	80,000	1,117,800	1,037,800
Kenya Meat Commissions	250 kW_{th}	0	1,276,150	1,276,150
Total		**3,830,000**	**11,360,416**	**7,530,416**

[43] For project activity technology and capacity, please refer the earlier table

As stated above in Table 16 the incremental cost, GEF bears cost of USD 765,180 only, which is about 10.2 % of the total estimated incremental cost. The total GEF resources of around 2 million will be used to mitigate CO_2 emission at a rate of USD 13.8/t CO_2 directly and around USD 1.7/t CO_2 indirectly. Table 17 shows the scenario before and after the project.

Table 17: Pre and Post Project Scenarios

Scenario before the project	Scenario after the project
Low human and institutional capacity on biogas technology	Improved human and institutional capacity
No information/learning centre for biogas technology	IBPP on biogas technology created at KIRDI
Low or no use of available wastes	Waste will be used to generate energy (electricity/thermal)
Low level of investments in industrial biogas technology	Conversion of waste to electricity and thermal energy for productive use.
Usage of fossil fuel for electricity needs	o Due to the electricity generation from biogas, equivalent amount of grid electricity is displaced in the grid. o Any excess electricity from the WTE plants will be exported to grid. Reduction of approximately 1,600 t CO_2e every year.
Usage of furnace oil/fossil fuel for thermal energy needs	Biogas based thermal energy generation replaces 51,961 litres of furnace oil in Kenya Meat Commission and Farmer's choice slaughterhouse which leads to 148 t CO_2e of emission reduction every year.

The above table clearly shows the increment of the project which can be practically realized to the fullest extent only with the GEF/UNIDO intervention. In the absence of the GEF project, the existing scenario would have improved only to the smallest extent which may have included a few WTE projects. But these efforts without any proper planning for sustainability would not have an impact similar to that of the proposed GEF project. The proposed demonstration projects are designed not only to establish the viability of biogas technology, but also to provide a framework for replication in other parts of Kenya.

Innovation

The project proposes an innovative solution for the twin problems for lack of sustainable energy and waste management by introducing biogas based energy generation from available wastes. An IBPP is created to provide continuous technical support on design and development of commercial biogas plants. They will sustain the promotional and development activities within the sector.

Also, a financial incentive system will be setup for attracting investments in WTE technology. Technical standards for medium and large scale biogas technology will be established which would increase the quality and life of the WTE plant construction. Since there is good replication potential, it is expected that, as a result of the project, more biogas projects will be established in other potential places.

Sustainability

The capacity development activities at the proposed IBPP would be sustained through the following:

- A nominal fee would be charged for the training activities. This amount will be used to manage and maintain the activities of the centre sustainably.
- Well-trained KIRDI staff members will be managing IBPP and hence, there will be no additional man-power cost.

The above arrangement will ensure the sustainability of capacity development even after the GEF project ends. Capacities of various ministries, technical/financial institutions, etc., will be built throughout the duration of the project implementation. The sustainability of the methodologies, introduced by the project, will be realized and the dissemination of the project's results to a wider range of users will be achieved.

Each demonstration project will be operated and maintained by the private investors through their own operation and maintenance (O&M) staff. Local engineering and O&M companies will be trained in O&M of WTE plants through IBPP. Also, the O&M staff of the demonstration projects will be trained by the respective suppliers. In addition regular trainings on O&M will be conducted at IBPP. Through such arrangements, the demonstration projects will continue to operate sustainably after the project implementation is over.

As mentioned earlier, the Co-operative bank has entered into an agreement with AFD to finance the RE and Energy Efficiency projects in this country[44], which can also be utilised for the proposed WTE sector. With the success of the WTE projects, the rural investment banks and other banks will eventually be interested to finance such projects. This will increase the replicability and sustainability of WTE plants in future.

Scaling up

Biogas technology will be scaled up as a result of the following:

- Successful implementation and operation of the demonstration projects: *This will lead to a boost in confidence among similar industries and private investors*
- Incentive scheme for investors of WTE projects*: Replication projects and demonstration projects can benefit through this facility*
- Financing facility from the Cooperative bank*: This will help increase the confidence of other rural investments to finance more biogas projects.*

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[45]:

Component	Risk	Proposed Mitigation Measure	Risk Level
Technical risks	Lack of human and institutional capacity is an impediment to large scale penetration of WTE technology	Training will be given to experts, operators, government agencies, etc. Capacity building and transfer of technology will mitigate the technical risk. As Kenya already has the technology for domestic biogas plants, further development on commercial biogas plants can be achieved with lesser difficulty.	Low
Financial risks	General perception that WTE investments yield low returns, hence the investors are not willing to invest.	Detailed techno-economic feasibility studies will be carried out to establish the financial viability of the demonstration projects. Moreover, financial incentives will be designed to attract investments in WTE. Increased awareness, knowledge and experiences created by successful operation of the demonstration plants are expected to enhance the stakeholders' participation.	Low
Market risks	No off-takers for the generated electricity.	The demand-supply gap is very high in Kenya and hence, there is no market risk. Off-takers for each plant will be decided during the feasibility study.	Low
Sustainable operation risk	Application of WTE technology might be in halt	The installations will be done only after conducting a proper resource assessment study in order to ensure the supply of wastes	Low

[44] The EUR 30 Million (USD 39 Million) credit agreement signed in 2011 enabled the Bank on-lend to its customers undertaking projects targeting diversification of energy resources and transition towards renewable energy solutions

[45]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

Component	Risk	Proposed Mitigation Measure	Risk Level
	by shortage of inputs	from industries.	
	Inadequate availability of trained plant operators.	Before the actual plant operation, these O&M staff will be trained at the information and best practices platform and will undergo on-the-job training in an existing biogas plant. Also, the demonstration projects' O&M staff will be trained by the respective suppliers. In addition, local engineering and O&M companies will be trained in O&M of WTE plants.	Low
Climate change risks	Floods	Biogas plant building and site office will be located on an elevated area to prevent flooding. All buildings and structures will be designed and built appropriately to avoid flooding.	Low
	Kenya' electricity mix greatly depends on hydropower (presently 50%). Due to the changing weather patterns which significantly affect the energy sector, hydropower is highly vulnerable to weather conditions and climate changes.	Utilization of wastes for electricity generation will reduce the dependency on hydropower.	Low

A.7. Coordination with other relevant GEF financed initiatives

The project will build on experiences and achievements of the following projects to ensure that they are complimentary to each other.

Removal of Barriers to Energy Conservation and Energy Efficiency in Small and Medium Scale Enterprises: This is a completed GEF-UNDP project for reduction of GHG emission in the industrial sector. It aimed at removing barriers on capacity building and financing by training of and introduction to new financial mechanisms in the energy efficiency sector respectively. The proposed project is complementary to this project, as it aims at using available wastes for energy generation by implementing WTE plants with cumulative 575 kWe and 300 kWth capacity.

Cogen for Africa (regional project): This is an on-going GEF-UNEP project. It aims at a) increasing awareness among key policy makers to promote cogeneration, b) formulating policies related to grid and rural electrification and c) supporting the establishment of dedicated regional and national institutions to provide information and services for the new and highly efficient cogenerations. The proposed project aims at creating an Information Platform which would educate the policy makers and help them gain confidence in WTE technology, as well as equip them with necessary technical capacity for supporting, developing and implementing such projects. This would lead to the creation and implementation of more policies/action plans in improving rural electrification.

Solar and Wind Energy Resource Assessment (global project): This is a completed GEF-UNEP project. The overall goal of the project was to promote the integration of wind and solar alternatives in national and regional energy planning and sector restructuring as well as in related policy making. Also, it aimed at enabling informed decision making and enhancing the ability of participating governments to attract investors' interest in RE. The proposed project complements the above project by designing and introducing financial incentives which would attract investors to WTE (renewable energy) projects.

Kenya National Domestic Biogas Programme (an initiative under the Africa Biogas Partnership Programme), 2009-2013: This programme aims at disseminating domestic biogas plants as local and sustainable energy source through development of commercially viable and market-oriented biogas sector. As household biogas digesters are very common in Kenya, the technology can be extended and modified appropriately into commercial plants. An additional know-how of the present situation would also be created under the proposed GEF project. Poverty reduction through utilization of RE sources for productive activities is a priority of UNIDO as well as the promotion of inclusive

sustainable industrial development. Therefore UNIDO's substantive branches such as Agro Business Development Branch, Business, Investment and Technology Services Branch, etc., will be actively involved in developing economic activities in beneficiary communities.

B. Additional information not addressed at PIF stage

B.1 Describe how the stakeholders will be engaged in project implementation

The proposed GEF project implementation arrangement is given below:

Implementing Agency

UNIDO is the only GEF Implementing Agency involved in this project and no specific arrangement with other GEF Agencies is sought.

Executing Partners

MoE and MoIED (along with KIRDI) will be the two main executing partners coordinating with UNIDO. Other partners include MEMR, MoALF, MoF, KEBS and Cooperative Bank of Kenya.

Project Implementation Arrangement

The project will be implemented by UNIDO in collaboration with other executing agencies and other stakeholders.

Ministry of Energy (MoE)

MoE, as a government ministry responsible for energy development will assist in creating an enabling environment for the project execution and scaling up biogas potential by advocating the right policies, programs and strategies. MoE will also be responsible for incorporating project activities in the government annual budgetary allocations so that the project financing can be complimented by the government budget for wide adoption of the technology and services.

MoE, along with MoIED, MoF, and Co-operative Bank of Kenya will be responsible for the financial incentive. There will be a contractual arrangement with UNIDO for creating the incentive facility.

Ministry of Industrialization and Enterprise Development (MoIED)

MoIED aims to facilitate the development of a robust, globally competitive, diversified industrial, enterprise and co-operative sub-sectors through the creation of an enabling environment.

Under this project, MoIED will be mainly involved in the capacity development activities, and in the establishment of the information and best practices platform (IBPP). Along with MoE, MoIED will be the main sponsor for the proposed financial incentive system.

Kenya Industrial Research & Development Institute (KIRDI)

KIRDI is a national research institute established in 1979 mandated to undertake multidisciplinary research and development in industrial and allied technologies. Under this project, KIRDI will be responsible for hosting and running the IBPP, which in return will be responsible for capacity building and advocating promotion and development of biogas technology. They will also allocate human and material resources for running IBPP sustainably. There will be contractual arrangement between UNIDO and KIRDI.

Assessment of KIRDI's capacity was carried out during the PPG stage, so as to engage them as partners and host PMU. Their existing capacities / responsibilities include the following:

a) KIRDI was the main counterpart in the establishment, Operation and maintenance of the 10 kW pilot scale WTE plant at Dagoretti abattoirs. As the main pilot site will be in Dagoretti, involving all 4 abattoirs there, KIRDI's partnership will be very important.
b) KIRDI has a separate division on "Energy and Environment".
c) The Institute has been appointed through the Ministry of Environment, Water and Natural Resources as the National Designated Entity (NDE) for Kenya under United Nations Climate Change Secretariat (UNFCCC)
d) KIRDI is responsible for full operationalization of the Climate Technology Centre and Network (CTCN) in Kenya.
e) It serves as the National Entity for the Development and Transfer of Technologies and acts as focal point for interacting with the Climate Technology Centre (CTC), UNFCCC regarding requests from Developing Country Parties about their technology needs.
f) Climate Innovation Centre: KIRDI in collaboration with Strathmore University, Price Waterhouse Coopers and Global Village Energy Partnerships (GVEP, UK) hosts the Climate Innovation Centre in Kenya, with World Bank Grant of USD 4.5 million.
g) KIRDI has developed various models of fuels efficient Gasifier Stoves for domestic use and has partnered with GIZ with funding from the Global Alliance Clean Cook Stoves (USA) to establish a National Stove Testing Centre at KIRDI.

Ministry of Agriculture, Livestock and Fishery (MoALF)

MoALF will be responsible for the establishment and operation of demonstration plant at Kenya Meat Commission. It will also support the development of biogas based energy generation in Kenyan industries.

Ministry of Finance (MoF)

Along with other ministries, MoF will be responsible for the financial incentive. Also, MoF is the deciding authority in clearing projects, which are GEF funded.

Ministry of Environment and Minerals (MEMR)

MEMR will oversee and contribute towards the capacity building activities, involve in the establishment of information and best practices platform (IBPP) and monitor the bio digested slurry and its farm usage.

Other Stakeholders

Demonstration Plant Owners

The demonstration projects will result in 1,856 kW_e and 1,397 kW_{th} biogas plants. These project promoters are responsible for mobilizing financing for investment in their plants. They will also be responsible for O&M of the plant and will operate the projects throughout their projects' life time. They will also be in charge of keeping records of the plant operations necessary for monitoring the energy generated and ultimately the GHG emission.

In addition to the above, local people and village communities, where these projects will be implemented, will have to opportunity to participate in the project. They will also take part in the consultation of background biogas resource information. Also, the demonstration projects will also closely work with utilities, like Kenya Power, for grid electricity export[46].

[46] Kenya Power is the sole agency responsible in Kenya for electric distribution and any arrangement for electric supply to the grid is the responsibility of Kenya Power.

Co-operative Bank of Kenya

The Co-operative bank of Kenya who has previously worked on renewable energy specific projects in collaboration with Agence Française de Development (AFD)[47] will be the partner under PC 3 providing incentives for WTE project developers. In collaboration with MoE, MoIED, MoF, the bank will participate in screening the projects and issuing the loans. It will also participate in monitoring the project's performance and assist the project developers along the line of project execution.

KEBS and ERC

KEBS along ERC will be responsible for the design and enforcement of technical standards for medium and large scale biogas technology. The project will collaborate with these 2 organizations for the early enforcement of the national standards.

Others

Other RE/technical institutions, financing institutions will be recipients of training on WTE technologies. This would encourage them to support development of biogas projects.

Civil Society Organizations (CSOs) and Non-Governmental Organizations (NGOs):

Relevant CSOs and NGOs, including those focusing on gender equality issues and advocating women's empowerment, such as women's associations (also see Annex J), will be invited to participate in the implementation phase of the project, and consultations will be held to confirm their roles in project execution. Regular consultations with both female and male stakeholders and local beneficiaries will ensure that the project's impact on and appropriation by the local communities can be assessed throughout project implementation.

UNIDO

UNIDO and an appointed project manager will be specifically responsible for:

- General management and monitoring of the project;
- Reporting on the project performance to the GEF;
- Procuring of international and local expertise, equipment according to UNIDO rules and regulations where applicable for delivering the planned outputs;
- Managing, supervising and monitoring the work of the international teams and ensuring that the deliverables are technically sound and consistent with the project requirements.

UNIDO will fulfill this responsibility by appointing a Project Manager and mobilizing services of its other technical, administrative and financial branches at UNIDO headquarters and the UNIDO office in Kenya. Contractual arrangements will be made with various executing entities.

Any amendments to the project will be done in accordance with the GEF policy C.39.09 and UNIDO rules and regulations.

Project Management Unit

A Project Management Unit (PMU) will be established within the KIRDI. PMU will also be the project steering committee secretariat. The PMU will consist of a National Coordinator (NC), the Project Administrative Assistant (PAA) and technical advisors. The responsibilities of PMU will be as follows:

[47] AFD is a financial institution and the main implementing agency of France's official development assistance to the developing countries and overseas territories.

- Daily management of project execution;
- Coordination of all project activities carried out by the national experts and other partners;
- Day-to-day management, monitoring and evaluation of project activities as per planned project work;
- Organization of the various seminars and training to be carried out.

Throughout the period of project execution, the PMU will receive the necessary management and monitoring support from UNIDO and the monetary support from GEF and its counterparts.

Project Steering Committee

A Project Steering Committee (PSC) will be established consisting of all relevant stakeholders (key stakeholders including MoE, MoIED, MEMR, MoALF, MoF, , KEBS, ERC, KIRDI, Cooperative Bank of Kenya, private sector representatives and UNIDO) for providing strategic guidance and review of progress in project execution. It will also facilitate co-ordination among project shareholders and maintain transparency in ensuring the ownership and to support the sustainability of the project.

PSC will be responsible for:

- Strategic guidance in line with the country needs and priorities;
- Promoting partnership among stakeholders;
- Reviewing project progress reports, including inception report;
- Provide strategic guidance for the project work plan;
- Initiating remedial action to remove impediments in the progress of project activities that were not earlier envisaged.

The committee will be chaired by, MOE. The final composition of the PSC will be defined during the project execution start-up phase. The PSC is expected to meet once a year. To ensure gender balance, the participation of both male and female will be promoted in the PSC and attention will also be paid to ensure gender responsiveness of all participants.

At the beginning of the project execution, a detailed work plan for the entire duration of the project will be developed by UNIDO in collaboration with the PMU, Government of Kenya and the international teams of experts. The working plan will be used as management and monitoring tool by PMU and will be reviewed and updated appropriately on a biannual basis. Figure 3 shows a diagram of the project implementation arrangement.

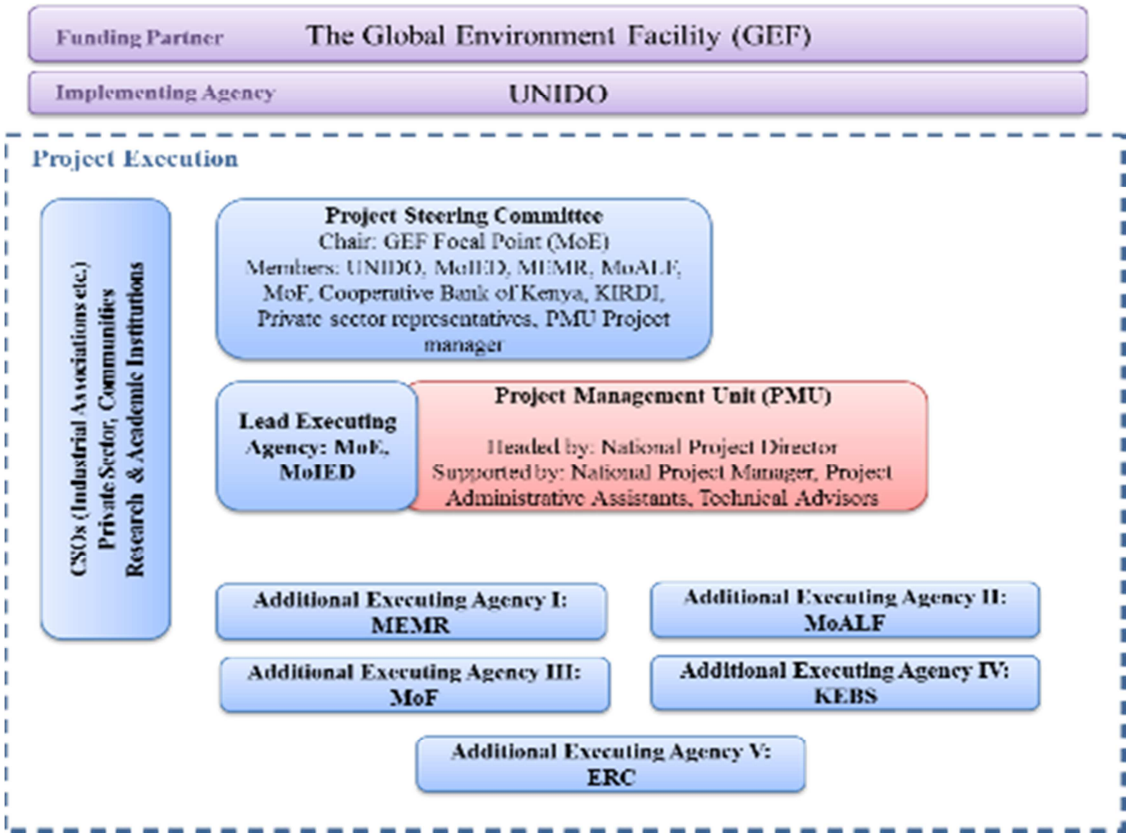


Figure 3: Diagram of project management structure

UNIDO will closely coordinate with relevant on-going and planned initiatives to ensure maximum synergies and the overall impact of Climate Change related to technical assistance in Kenya.

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):

Socio-economic benefits at national level

Through this GEF project, the use of fossil based grid electricity and furnace oil/other fossil fuel for thermal energy requirement will be considerably reduced. This will ensure reduction in the import of crude oil and savings in foreign exchange for the country (around USD 0.5 million per year)[48]. Hence, the level of the vulnerability to the fluctuation of global oil price is also reduced.

The biogas power plants established under this project will result in avoidance of approximately 144,960 tCO2eq emissions directly within the life of the project, which would otherwise result from the use of diesel generators and methane emissions from animal wastes that go to open dumping. It is expected that the market transformation will happen through the incentive system to encourage investors to develop the biogas potential, for at least cumulative of 14 MW capacity within a time span of maximum 10 years after the project duration. This will then lead to an avoidance of 1,159,680 tCO2e indirect emissions.

Socio-economic benefits at local level

The local benefits of this project include: (1) access to clean and reliable energy for the industries and population around them; (2) improved waste management leading to better environment; (3) additional income to the agro-industries through generation of own energy (4) increased electricity access and thereby improved living quality, health and education of the nearby community of the power plant sites. Also, 478 jobs will be created in various cadres as a result of the demonstration projects. Overall employment generation through the demonstration projects is given in table 18:

Table 18: Employment generation through the demonstration projects

S. No.	Name of the industry	Total no. of job generation
1.	Migotiyo Plantations	445
2.	Dagoretti Abattoirs	8
3.	Farmers choice slaughterhouse	4
4.	Farmers choice pig farm	7
5.	Olivado avocado oil processing plant	7
6.	Kenya meat commission	7
	Total	**478**

Source: Feasibility study report (Annex F)

However, it has to be noted that this is tentative. The actual number of power plant staff may vary according to the design philosophy of the selected equipment suppliers.

[48] Assuming 5% fuel production from 1 barrel of crude oil (http://www.petroleum.co.uk/refining);
1 Barrel – 0.159 kilo litres (http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy/using-the-review/Conversionfactors.html);
1 Barrel of crude oil – USD 80 (https://www.standardmedia.co.ke/m/index.php?articleID=2000139136&story_title=Falling-crude-oil-prices-tricky-for-Kenya)

Gender mainstreaming

a) Gender Mainstreaming at UNIDO

UNIDO recognizes that gender equality and the empowerment of women have a significant positive impact on sustained economic growth and inclusive industrial development, which are key drivers of poverty alleviation and social progress. Commitment of UNIDO towards gender equality and women's empowerment is demonstrated in its policy on Gender Equality and the Empowerment of Women (2015), which provides overall guidelines for establishing a gender mainstreaming strategy that:

- Ensures that a gender perspective is reflected in its programmes, policies and organizational practices;
- Advances the overall goal of gender equality and the empowerment of women, particularly the economic empowerment of women;
- Benefits from the diversity of experiences and expertise within the United Nations system to advance the internationally agreed development goals related to gender equality and the empowerment of women;
- Accelerates the Organization's efforts to achieve the goal of gender balance, in particular at decision-making levels.

At the operational level, UNIDO has developed an energy-gender guide to support gender mainstreaming of its sustainable energy programmes and initiatives at all stages of the project cycle. In addition to introduction of basic concepts and strategic approaches, it also includes tools that can be used at relevant points of the project cycle to guide the thought processes and activities. These tools include:

- gender categorization tool, which assesses how much direct impact the project will have on gender dimensions;
- gender mainstreaming check list, which summarizes key considerations which must be considered during project development;
- gender analysis tool which provides specific questions that can guide the project developer in considering gender dimensions of a project, before full gender analysis is conducted by an expert;
- gender mainstreaming the project cycle tool, which lists key activities to be considered at each step of the project cycle;
- gender indicator framework that encourages results based management by indicating potential gender dimensions and quantitative indicators for specific energy interventions.

To ensure that all projects consider gender dimensions from inception, UNIDO has also integrated a robust gender review as part of the project appraisal process both at technical and organizational level.

b) Gender dimensions of the project

This intervention in **Kenya** is expected to have limited direct influence over gender equality and/or women's empowerment in the country and therefore could be classified as a project with "**limited gender dimensions**"[49] according to the UNIDO Project Gender Categorization Tool. Nevertheless, UNIDO recognizes that all energy interventions are expected to have an impact on people and are, therefore, not gender-neutral[50]. In fact, due to diverging needs and rights regarding energy consumption and production, women and men are expected to be affected differently by the project (in terms of their rights, needs, roles, opportunities, etc.). Therefore, regardless of the project's gender category, the project aims to demonstrate good practices in mainstreaming gender aspects into **biogas projects**, wherever possible, and avoid negative impacts on women or men due to their gender, ethnicity, social status or age. **Figure 3: Gender mainstreaming the project cycle** below provides an overview of key issues that will be further considered during the gender mainstreaming of the next steps in the project cycle. Depending on the type of intervention and scope of activities, the degree of relevance of gender dimensions may vary.

[49] This would require the project to ensure at least 20% of the project outputs have clearly identified activities promoting gender equality and/ or the empowerment of women, including gender-responsive indicators and a corresponding budget OR at least one indicator in each project output refers to gender in some way. Furthermore, a gender-analysis is conducted of gender issues are included in ESIAs. Please see also "Gender Categorization Tool"

[50] ENERGIA "Turning Information into Empowerment: Strengthening Gender and Energy Networking in Africa. Leusden, 2008; Joy Clancy "Later Developers: Gender Mainstreaming in the Energy Sector", 2009

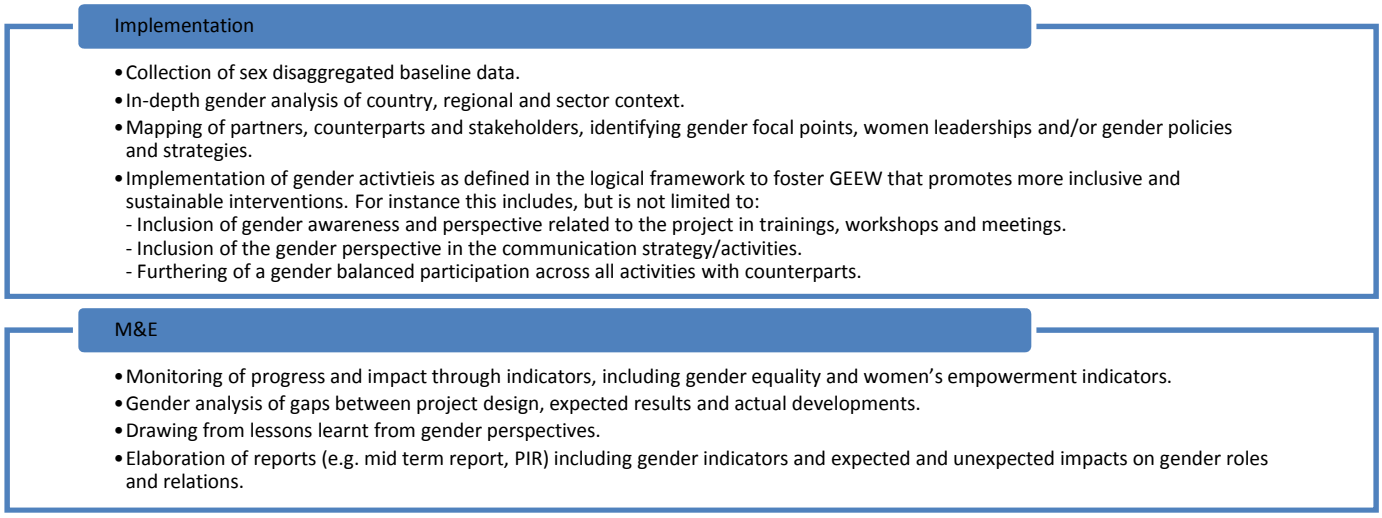


Figure 3: Key issues of gender mainstreaming the project cycle

During the PPG phase, a preliminary gender analysis of the country context has been conducted, based on which potential gender dimensions of project outcomes and outputs, as well as potential entry points for gender equality and women's empowerment (GEEW) were developed and incorporated into the project logical framework. Key gender dimensions of the project outcomes and outputs as well as potential gender-relevant indicators are provided in the logical framework in Annex J **(Selected Gender Dimensions)**.These proposed gender dimensions will be used as a guide during the implementation of the project as well as during M&E.

c) Project gender mainstreaming strategy

Guiding principle of the project will be to ensure that both women and men are provided equal opportunities to access, participate in, and benefit from the project, without compromising the technical quality of the project results.

In practical terms,

- Gender-sensitive recruitment will be practiced at all levels where possible, especially in selection of project staff. Gender responsive TORs will be used to mainstream gender in the activities of consultants and experts. In cases where the project does not have direct influence, gender-sensitive recruitment will be encouraged. Furthermore, whenever possible existing staff will be trained and their awareness raised regarding gender issues.
- All decision-making processes will consider gender dimensions. At project management level, Project Steering Committee meetings will invite observers to ensure that gender dimensions are represented. Also at the level of project activity implementation, effort will be made to consult with stakeholders focusing on gender equality and women's empowerment issues. This is especially relevant in policy review and formulation.
- To the extent possible, efforts will be made to promote participation of women in training activities, both at managerial and technical levels, as participants and trainers. This can include advertising of the events to women's technical associations, encouraging companies to send women employees, adjusting ToRs for selection of the trainers, etc.
- When data-collection or assessments are conducted as part of project implementation, gender dimensions will be considered. This can include sex-disaggregated data collection, performing gender analysis as part of ESIAs, etc.

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

Other possible RE technologies that can be implemented in Kenya for improving the electricity scenario include wind, solar, hydro, geothermal, etc. However, these technologies will not solve the waste management issues faced in agro

industries. Under such context, the only attractive alternative RET choice is biogas technology, which improves solves both the energy generation through clean sources and cost effective waste management.

The project is considered to be a cost effective intervention for GEF due to the CO_2 emission reduction potential from enhanced use of biogas technology. For a GEF contribution of around USD 2 million, this project will directly result in 1,856 kW_e and 1,397 kW_{th} additional installed capacities based on biogas technology. More importantly, the project is expected to result in the replication of several similar projects for a cumulative 14 MW_e and 6 MW_{th} capacities thus making it a high impact GEF intervention. The pilot plants established by the project will increase the local capacity in such a way that the future interventions will be increasingly cost effective.

The project is expected to save a cumulative direct GHG emission of 144,960 t CO_2e and an indirect GHG emission of 1,159,680 t CO_2e.

C. Describe the budgeted M & E plan

Project monitoring and evaluation (M&E) will be conducted in accordance with established UNIDO and GEF procedures. The M&E activities are defined by Project component 4 and the concrete activities for M&E are specified and budgeted in the M&E plan. Monitoring will be based on indicators defined in the strategic results framework given in Annex A (which details the means of verification) and the annual work plans. Monitoring and Evaluation will make use of the GEF Tracking Tool, which will be submitted to the GEF Secretariat twice during the duration of the project: at CEO Endorsement and at closure.

UNIDO, as the implementing agency, will involve the GEF Operational Focal Point and project stakeholders at all stages of project monitoring and evaluation activities in order to ensure the use of the evaluation results for further planning and implementation.

According to the Monitoring and Evaluation policy of the GEF and UNIDO, follow-up studies like Country Portfolio Evaluations and Thematic Evaluations will be initiated and conducted. All project partners and contractors are obliged to (i) make available studies, reports and other documentation related to the project; and (ii) facilitate interviews with staff involved in the project activities.

The overall objective of the M&E process is to ensure successful and quality implementation of the project by: i) tracking and reviewing the execution of project activities; ii) taking early corrective action if performance deviates significantly from the original plans; and iii) adjusting and updating project strategy and implementation plan to reflect possible changes on the ground results achieved and the corrective actions taken.

All monitoring and evaluation documents, such as periodic progress reports and terminal evaluation reports, as well as learning and knowledge sharing products, will include gender dimensions wherever adequate.

a. Monitoring

A detailed monitoring plan for tracking and reporting on project time-bound milestones and accomplishments will be prepared by UNIDO in collaboration with the established Project Management Unit (PMU) and project partners at the beginning of project implementation and then will be updated periodically. Monitoring activities will be carried out on the basis of the periodic reports developed by the PMU with the frequency aligning to the quarterly reports.

By making reference to the impact and performance indicators defined in the Project Results Framework, the monitoring plan will track, report and review the WTE project activities and accomplishments in relation to:

a. Implementation;
b. Operation and effectiveness of IBPP;
c. Conduction of various capacity building trainings and their usefulness;
d. Level of awareness and technical capacity of relevant institutions in the market and within agro-industries;
e. Implementation of incentive and soft loan facility, its operation and impacts on project implementation;
f. Replication potential of similar projects elsewhere in Kenya;
g. CO_2 emission reduction resulting from the implemented projects;
h. CO_2 emission reduction potential from other replication projects;
i. Effectiveness and usefulness of the dissemination activities such as trainings, seminars, site visits, performance reports, project website, leaflets, etc.;
j. Participation of women and the impact of the project on different beneficiary groups (e.g., change and income levels, change in competency disaggregated by sex).

b. Reporting

PMU will present a report to UNIDO every six months with detailed information on the progress of the project as per the annual implementation plan and activities that have been carried out during the period of each report. An annual report shall be submitted by PMU at the end of each project cycle year with a summary of activities carried out over the

year and will be the basis of Project Implementation Review (PIRs). The annual report will also cover the benefits gained and impacts made on the implementation of the project. In addition, the report will include the evidence to demonstrate the progress made in the achievement of the indicators highlighted in the Logical Framework.

c. Evaluation

The project will be subjected to a final evaluation. The project will be monitored from the beginning and an independent final evaluation will be conducted three months prior to the terminal review meeting. The final evaluation will look at the impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefit goals. The final evaluation will also provide recommendations for follow-up activities.

Table 16 provides the tentative budget summary for the total evaluation, which has been included in Project Component 4.

Table 16: GEF M&E budget

Activity	GEF (USD)	Co-financing (USD)	Responsible party
Monitoring of project impact indicators	80,000	35,000	• Independent M&E expert to provide feedback to PMU • PMU will submit inputs for consolidation and approval by PSC • PSC submits final inputs / reports to UNIDO PM
Measurement of GEF tracking tool specific indicators			
Periodic Monitoring Reports (will be completed through co-financing resources)		20,000	
Final evaluation		45,000	Independent M&E expert for submission to UNIDO PM
Total	**80,000**	**100,000**	

Legal Context

The Government of the Republic of Kenya agrees to apply to the present project, mutatis mutandis, the provisions of the Standard Basic Assistance Agreement between the United Nations Development Programme (UNDP) and the Government, signed and entered into force on 17th January 1991.

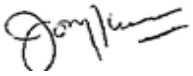
PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)

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)*
Mr. Ali Mohamed	Permanent Secretary	Ministry Of Environment And Mineral Resources	11/23/2012

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
Mr. Philippe R. Scholtès, Managing Director, Programme Development and Technical Cooperation Division - PTC, UNIDO GEF Focal Point		07/06/2015	Jossy Thomas, Industrial Development. Officer, Energy Branch, PTC, UNIDO	+43 - 1 - 26026- 3727	j.thomas@unido.org 

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).

Project Narrative		Objectively verifiable indicators				
		Indicator	**Baseline**	**Target (quantified and time-bound)**	**Source of verification**	**Risks and Assumptions**
Goal	Increased utilization of WTE plants for satisfying energy needs	1. kW_e and kW_{th} of WTE plants installed	Agro-industries depend upon fossil dominated grid electricity and furnace oil / other fossil fuel for thermal energy needs	1. At least 4 investors invest in WTE plants for a cumulative 1,856 kW_e and 1,397 kW_{th} capacity 2. Replication plants for at least 5 MW_e and around 1 MW_{th} capacity[51]	1. Physical verification of the WTE plants 2. End of project M&E report	Support from Government and private investors
Objective of the project	To promote investments in WTE technologies to increase electrification and to reduce GHG emission	1. USD investment in WTE technologies 2. tCO_2 emission reduced	Low level of investments in WTE technologies	1. At least approximately USD 6.2 million investment in 1,856 kW_e and 1,397 kW_{th} WTE projects 2. Achieve 144,960 t CO_2e of emission reduction directly (through demonstration plants) 3. Achieve 1,159,680 t CO_2e of emission reduction indirectly (through replication plants)	1. MoE / MoIED reports 2. End of project M&E report	Support from Government, Co-operative bank of Kenya and private investors
Outcome 1.1	Improved awareness, knowledge sharing on best practices and capacity building on WTE in the country	1. Creation and operation of the special centre for improving the human and institutional capacity (% of female/ male participants) 2. Number of trained personnel by the centre 3. Number of female trainers	Insufficient human and institutional capacity to develop WTE projects	1. Establish the IBPP within first six months from the start of the GEF project 2. Undertake capacity building activities to at least 50[52] beneficiaries from each group 3. To target at least 20% women participation in each group	1. Physical verification of the centre 2. KIRDI reports 3. Training reports 4. End of project reports	Continuous support from Government, training participants and KIRDI
Project Component 1: Capacity development and knowledge management						

[51] Within 10 years after the end of the project.
[52] For any training group, at least 20% women participation will be targeted.

Project Narrative		Objectively verifiable indicators				
		Indicator	**Baseline**	**Target (quantified and time-bound)**	**Source of verification**	**Risks and Assumptions**
Output 1.1.1	Information and the best practices platform (IBPP) for WTE technologies established at KIRDI	1. Business plan and annual work plans created 2. Creation and operation of the centre	Lack of one-stop technical centre on biogas	1. Business plan and annual work plan creation within first 3 months of the GEF project start 2. Creation and operation of the centre within 6 months of the GEF project start	1. Physical verification 2. Business plan and work plans - Status reports 3. End of project M&E report	Continuous support of the KIRDI and Government of Kenya
Output 1.1.2	Development of human capacities in WTE for policy makers (at least 50 policy makers), project developers, agro-industries, and other stakeholders (at least 50 persons)	1. Number of trainings organized for policy makers 2. Number of trainings organized for different target groups 3. Number of key policy makers trained (% of female/ male participants) 4. Number of persons (from other target groups) trained(% of female/ male participants) 5. Number of female trainers	Inadequate capacity among the key policy makers & project developers	1. Conduct at least 2 trainings for policy makers 2. Conduct at least 2 trainings for other target groups 3. Educate and train at least 50 policy makers on WTE potential, technology and project development 4. Train at least 50 personnel from each of the target groups[53] 5. Include at least 20%(of the total participants) women in each training	Training reports.	Support of the participating ministries, agro-industries and KIRDI
Output 1.1.3	Development and strengthening of institutional capacities in the area of WTE among technical institutions and financial institutions (at least 50 persons from each group)	1. Number of trainings organized 2. Number of persons trained (% of female/ male participants) 3. Number of female trainers	Insufficient local capacity to develop, support, operate &maintain WTE plants	1. Conduct at least 2 trainings 2. Train at least 50 personnel from different target groups[54] 3. Include at least 20%(of the total participants) women in each training	Training reports.	Support of RE/technical institutions, banks/financial institutions and KIRDI
Outcome 2.1	Increased use of	MWh of energy from	Developers does not	1. 4,720 MWh/year generated	1. Plant operation	Sustained support

[53] Target group involves: a) agro-industries, b) project developers and (c) local engineering and O&M companies
[54] Target group involves: a) RE institutions, b) Technical institutions and c) Banks & financial institutions

Project Narrative		Objectively verifiable indicators				
		Indicator	**Baseline**	**Target (quantified and time-bound)**	**Source of verification**	**Risks and Assumptions**
	biogas for energy generation	WTE technologies	trust WTE projects due to lack of knowledge and the risks perceived.	electricity from WTE plants are used in agro-industries[55] 2. 1,900 MWh/year thermal energy is used in agro-industries	records 2. End of project M&E report	of Government and private investors, banks and financial institutions
Project Component 2: Establishment of agro-industrial WTE plants						
Output 2.1.1	Establishment of standards for medium and large scale biogas power plants.	Number of standards	As of now, no standards exist for biogas power plants. KEBS & ERC are currently developing standard for domestic and commercial biogas plants	Early enforcement of the proposed standard	Government reports	Sustained support from government, KEBS and ERC
Output 2.1.2	Detailed plant design prepared for WTE plants	Project progress status	Lack of plant design reports for further project development.	Detailed plant design reports for the demonstration projects	Detailed plant design reports of each demonstration plant	Sustained support from government and agro-industry owners
Output 2.1.3	WTE plants established for a cumulative capacity of around 1,856 kW_e and 1,397 kW_{th}	MW of installed capacity	1. Inadequate commercial WTE plants 2. Agro-industries depend on (fossil-fuel dominated based) electricity and fossil fuel such as fuel oil for thermal energy needs	1,856 kW_e and 1,397 kW_{th} plants supplying electricity and thermal energy respectively	1. Physical verification of the sites 2. End of project M&E report	Agro-industries ready to invest in WTE plants
Outcome 3.1	Increased involvement of private investors in WTE projects	Number of project beneficiaries	Low interest from private investors to engage in WTE plants development	1. Install replication projects for a cumulative capacity of 14 MW_e and 6 MW_{th}	1. Physical verification of WTE plants 2. Physical verification of the plant finance documents 3. Physical	Support of MoE/MoIED, MoF and interest of private investors along with the Co-operative Bank of Kenya

[55] This may vary. The main objective is to generate electricity from these WTE plants and utilize for captive usage in industries. Any excess remaining electricity will be exported to grid. During the project stage, industry utilization and grid export will be finalized.

Project Narrative		Objectively verifiable indicators				
		Indicator	**Baseline**	**Target (quantified and time-bound)**	**Source of verification**	**Risks and Assumptions**
					verification at financing institutions / banks 4. Government reports 5. End of project report	
Project Component 3: Scaling up investment in WTE plants						
Output 3.1.1	Establishment and implementation of incentive systems for WTE technologies	1. USD incentives based on incremental cost principle to WTE projects 2. Number of project developers benefitted through the incentive facility	Inadequate financing facilities to attract investments in WTE projects	1. USD 4 million incentive facility established 2. At least 15 replication projects benefitted under the facility	1. Government reports 2. Bank Data	Support of MoE/MoIED, MoF and interest of private investors along with the Co-operative Bank of Kenya

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).

STAP comments are not applicable for MSP projects

ANNEX C: STATUS OF IMPLEMENTATION OF PROJECT PREPARATION ACTIVITIES AND THE USE OF FUNDS[56]

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

PPG Grant Approved at PIF: **$ 100,000**			
Project Preparation Activities Implemented	***GEF/LDCF/SCCF/NPIF Amount ($)***		
	Budgeted Amount	***Amount Spent To date***	***Amount Committed***
Supplemental data collection	7,000	4,904	2,096
Finalization of incentives	8,000	5,721	2,279
Identification of the institution / university and finalization of sustainable operating procedure for the information / learning platform	6,000	5,113	887
Stakeholder consultations	7,000	5,363	1,637
Selection of potential sites and carrying out the detailed feasibility studies	36,000	27,713	8,287
Preparation and finalization of full sized project document.	36,000	26,162	9,838
Total	**100,000**	**74,976**	**25,024**

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

Not applicable

ANNEX E: PROJECT IMPLEMENTATION SCHEDULE

Activity	Year 1				Year 2				Year 3				Year 4			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
PC 1 - Capacity development and knowledge management																
1.1.1 Information and the best practices platform (IBPP) for WTE technologies established at KIRDI																
a. Establishing the information and best practice platform for WTE projects at KIRDI																
b. Business plan and annual work plans of the centre are implemented successfully																
c. Training to IBPP staff on operation and management of the platform																
d. Creation of database and information required for developing biogas projects at the centre																
e. Preparation of training materials for different trainees to be trained at the centre																
f. Available guidebooks on biogas technologies and power plant development will be customised for adapting to the local conditions																
g. Public announcement and media campaign to publicize the services of IBPP																
h. Preparation of leaflets and website for biogas information dissemination through the IBPP																
1.1.2 Development of human capacities in WTE for policy makers, project developers, agro-industries, and other stakeholders.																
a. Assessment of capacity of policy makers																
b. Training to at least 50 policy makers on biogas project development																
c. Assessment of capacity requirement of other target groups																
d. Training to at least 50 agro-industries and interested project developers for project implementation																
e. Training to at least 50 personnel from local engineering and O&M companies in O&M of biogas plants																
1.1.3 Development and strengthening of institutional capacities in the area of WTE among technical institutions and financial institutions																
a. Assessment of capacity requirement of different target groups																
b. Training to at least 50 personnel from different RE/technical institutions in developing biogas projects																

Activity	Year 1				Year 2				Year 3				Year 4			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
c. Training to at least 50 personnel from banks, financial institutions and funding agencies in assessing the biogas projects																
PC 2 - Establishment of pilot agro-industrial WTE plants																
2.1.1 Establishment of standards for medium and large scale biogas power plants																
a. Assessment of the draft standard by International expert																
b. Stakeholder discussion and brainstorming sessions on the proposed standard																
c. National standards in place																
d. Information dissemination on the enforced standard through various tools such as website, leaflets, etc.																
2.1.2 Detailed plant designs prepared for participating demonstration projects																
a. Detailed plant designs for the demonstration sites																
2.1.3 WTE plants established for a cumulative capacity of around 1,856 kW_e and 1,397 kW_{th}																
a. Arranging the necessary licenses, permits and contracts for the biogas plants																
b. Study on insurance required for the biogas plants during construction and operation																
c. Preparing bidding document for biogas plants																
d. Launching the bid document, bidding, evaluating and selecting contractor for biogas plants																
e. Finalization of biogas plants O&M plan																
f. Financial closures																
g. Construction and commissioning of the biogas plants																
h. Conducting expert inspection during construction and commissioning by Owner's Engineers																
i. Monitoring, testing and reporting on WTE plants performance																
j. Conducting full scale demonstration site visit and seminar																
k. Disseminating the information through leaflets and website																
l. No. of technology know-how workshops conducted																
m. No. of field visits to biogas plants																
PC 3 - Creation of favourable investment environment																
3.1 Eestablishment and implementation of incentive systems for WTE technologies																
a. Recommendations on the modalities and procedures of the incentive scheme																

Activity	Year 1				Year 2				Year 3				Year 4			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
b. Establishment and operation of the incentive scheme																
c. Raising awareness among the stakeholders on the availability of incentives through seminars and road shows																
d. Liaising with MoF for other financial incentives like tax incentives for commercial biogas plants																
PC 4 - Monitoring and Evaluation (M&E)																
4.1.1 Mid-term M & E report prepared																
a. Preparation of TORs & recruitment of evaluation consultant																
b. Conduct of mid-term evaluation and preparation of M&E report																
4.1.2 End of project M & E report prepared																
a. Preparation of TORs & recruitment of evaluation consultant																
b. Conduct of final evaluation and preparation of M&E report																
4.3 Lessons learning and information dissemination workshops																
a. Conduct of information disseminations workshops																
4.4. Publications and websites																
a. Disseminating the information through leaflets and website																
Project Management																
a. Establishment of Project Management Unit																
b. Development of a detailed activity plan and schedule																
c. Conduct of National workshop on gender mainstreaming																
d. Establishment of Project Steering Committee																
e. Periodic convening of PSC meeting																
f. Implementation of biogas projects																
g. Reporting																
h. Day-to-day coordination, management and monitoring of all project activities																

LIST OF ATTACHMENTS

1. ANNEX F- Feasibility studies report
2. ANNEX G- Itemized budget
3. ANNEX H- Co-financing letters
4. ANNEX I - Sludge analysis report
5. ANNEX J- Gender analysis on Kenya
5. ANNEX K- WTE Incentive scheme