Project Document

Government of Egypt

United Nations Development Programme
Global Environment Facility

Bioenergy for Sustainable Rural Development
PIMS 2284

The objective of this project is to remove the technical, institutional, information, financial, and other market barriers to the increasing use of biomass energy in promoting sustainable rural development in Egypt and in reducing the negative global and local environmental impacts associated with the use of fossil fuels and the environmentally not sound management of the agricultural and solid waste. This is envisaged to be achieved by (i) testing the technical and, in particular, the economic and financial feasibility of selected bioenergy technologies on the basis of new business and financing models, and developing further the financial, institutional and market strategies for their large-scale replication; (ii) supporting the development and adoption of an enabling policy framework to implement and leverage financing for the recommended strategies; iii) building the capacity of the supply side to market, finance and deliver rural bioenergy services; and iv) institutionalizing the support provided by the project to facilitate sustainable growth of the market after the end of the project.

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United Nations Development Programme
Country: EGYPT Project Document

UNDAF Outcome(s): Regional human development disparities are reduced, including reducing the gender gap, and environmental sustainability improved

Expected CP Outcome(s): Sustainable Management of environment and natural resource incorporated into poverty reduction strategies/key national development frameworks and sector strategies

(Those that are linked to the project and extracted from the CPAP)

Expected CPAP Output(s): Access to cleaner energy services and low - emissions technology including renewable energy, energy efficiency and/or advance fossil fuel technologies promoted

(Those that will result from the project and extracted from the CPAP)

Implementing partner: Egyptian Environmental Affairs Agency (EEAA)

Responsible Parties:

Brief Description

The objective of this project is to remove the technical, institutional, information, financial, and other market barriers to the increasing use of biomass energy in promoting sustainable rural development in Egypt and in reducing the negative global and local environmental impacts associated with the use of fossil fuels and the environmentally not sound management of the agricultural and solid waste. This is envisaged to be achieved by (i) testing the technical and, in particular, the economic and financial feasibility of selected bioenergy technologies on the basis of new business and financing models, and developing further the financial, institutional and market strategies for their large-scale replication; (ii) supporting the development and adoption of an enabling policy framework to implement and leverage financing for the recommended strategies; iii) building the capacity of the supply side to market, finance and deliver rural bioenergy services; and iv) institutionalizing the support provided by the project to facilitate sustainable growth of the market after the end of the project.

Programme Period:	2007-2011
CPAP Programme Component:	Energy and environment for sustainable development
Project Title:	Bio-energy for Sustainable Rural Development
Atlas Award ID:	00045899
Start date:	September 2008
End Date:	September 2013
PAC Meeting Date	4 August 2003

YYYY AWP budget:	
Total resources required	
Total allocated resources:	5,160,000
• Regular	150,000
• Other:	
o GEF	3,000,000
o Private Sector	250,000
o Government	1,760,000
Unfunded budget:	
In-kind Contributions	

Agreed by: H.E. Amb. Menha Bakhoum, Deputy Assistant Foreign Minister & Director of International Cooperation, Ministry of Foreign Affairs

Signature: Date: 19/11/2008

Agreed by: Dr. Mawaheb Aboul Azm, Chief Executive Officer, Egyptian Environmental Affairs Agency (EEAA)

Signature: Date:

Agreed by: Mr. Mounir Tabet, Country Director
United Nations Development Programme (UNDP)

Signature: Date:

ACRONYMS

BET	Biomass Energy Technology
BDF	Bioenergy Development Fund
BSP	Bioenergy Service Provider
CEO	GEF Chief Executive Officer
CO	UNDP Country Office
CO_2	Carbon dioxide
EE	Energy Efficiency
EEAA	Egyptian Environmental Affairs Agency
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
HQ	UNDP Headquarters
LE	Egyptian Pound
LPG	Liquid Petroleum Gas
LRU	Local Rural Units
MDG	UN Millennium Development Goals
MISR	Municipal Initiatives for Strategic Recovery Project
M&E	Monitoring and Evaluation
MoE	Ministry of Environment
MYFF	Multi-year Funding Framework
NGO	Non-Governmental Organisation
QPR	Quarterly Progress Report
PDF	Project Development Facility
PIR	Project Implementation Review
PMU	Project Management Unit
PMT	Project Management Team
PSC	Project Steering Committee
RCU	UNDP Regional Co-ordination Unit
SFD	Social Fund for Development
SRF	Strategic Results Framework
TPR	Tripartite Review
TTR	Terminal Tripartite Review
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change

SECTION I: ELABORATION OF THE NARRATIVE

Part I: Situation Analysis

General Country Background

1. The Arab Republic of Egypt forms the northeast corner of Africa and spreads over into Asia, and embraces a total area of almost one million square kilometers. The country is divided geographically into four major provinces: the Nile Valley and the Delta, Western Desert, Eastern Desert and Sinai Peninsula. The total land area of Egypt is about 998,000 square kilometers, about 3 per cent of which is cultivated, 1.5 per cent is considered as permanent cropland (covered with trees, shrubs, etc) and woodlands. 0.5 per cent is used for public utilities (roads, bridges, etc) and buildings, and the remaining 95 per cent is classified as other land (desert and semi-desert areas, hills, sand dunes, etc).

2. Egypt forms a part of the great desert belt that stretches eastwards from the Atlantic across the whole of north Africa and further through Arabia. Like all other lands lying within this belt, Egypt is characterized by a warm and almost rainless climate. The air temperature in Egypt frequently rises to over 40 degrees Celcius in the daytime during the summer and seldom falls as low as zero degree C even during the coldest nights of winter. The average rainfall over the country is only about 10 mm a year. Egypt has plenty of sunshine. The sunshine hours count over 3400 hours per year in the north and 3900 hours in the south. The average annual solar energy received varies between 1900 and 2600 kWh per square meter and year, from the northern to the southern parts of the country. Relatively strong wind regime prevails mainly along the Red Sea coast, with an annual average wind speed along the northern parts of the coast between 18 and 36 km/h (i.e. with a power flux of about 150 to 1000 watt/square meter). Winds with lower velocities (14 to 20 km/h) are encountered along the Mediterranean coast.

3. Egypt is divided into 26 governorates, four of which are urban (Cairo, Alexandria, Port Said and Suez Governorates). According to the Local Administrative Law, each of these governorates is divided into a number of centers or districts " *Marakez*" (the plural of " Markaz"). Each Markaz comprises a main town, which serves as its capital and a number of Local Rural Units (LRUs). Each LRU is composed of a number of villages, one of which serves as the "mother" village or administrative centre of the LRU. Each of these villages has a number of hamlets or satellites. According to official statistics, there are 214 cities and towns in Egypt, 175 Markaz, 4463 villages and 27415 hamelts and satellites.

4. According to the latest census (2006), the population of Egypt is estimated at 76.5 million including Egyptians living abroad, of which 42.6 per cent live in urban areas, and at an overall growth rate of 37% over the 1996 figure. For the country as a whole, the population density is about 1153-persons per square kilometer of inhabited area. Cairo Governorate is the most densely populated governorate followed by Giza, Kalyubia and Alexandria.

5. Egypt's economy is estimated to have grown by 4.0 per cent annually in the period of 1991-2000 and it has continued to fluctuate around this figure in the following years, but jumped to 6.8 per cent in 2005/2006 fiscal year. A policy of economic liberalism since 1970s and the introduction of major structural reforms in 1990s resulted in deregulation, opening many sectors to foreign operators, restructuring public sector companies and encouraging privatization. The main constraints to economic development are the low and stagnant domestic savings, the significant and persistent trade deficit due to stagnation in earnings

from traditional exports, and slippages in the implementation of structural reforms and financial sector privatization and trade liberalization. The economy continues to be vulnerable to external shocks as a result of its considerable dependence on international private and official resource transfers, tourism, Suez Canal revenues and exports of oil and gas. In addition, the country's export earnings are derived mainly from products and services with limited growth potential.

6. Egypt's GDP in 2006 was US$ 107 billion, of which 15 per cent came from agriculture, 36 per cent from industry, and 49 per cent from services sector (World Development Report, 2008). The per capita income (GNI/capita) in that year was $ 1350, ranking Egypt as a middle-income (lower middle-income) country according to the World Bank.

7. In the UNDP's Human Development Report, the Human Development Index (HDI) of Egypt in 2005 was 0.702 ranking Egypt as number 112 among 177 countries (UNDP, Human Development Report 2007). Considerable differences exist, however, between different governorates and within the governorates themselves, in particular between rural and urban areas. The 2004 National Human Development Report (UNDP, 2004) indicates that the urban governorates have the highest HDI. Assuit and Fayoum Governorates have the lowest HDI.

8. A UNDP study on subjective poverty and social capital in Egypt (UNDP, 2003) estimated the average per capita low absolute (objective) poverty line at L.E. 1116 per annum. The corresponding upper poverty line was set at L.E. 1574. Based on people's perception of poverty, the estimated subjective poverty line was L.E. 1723. Accordingly, in 2002, 20.4 per cent of the Egyptian population was classified to live in absolute poverty, i.e. they could not obtain their basic food and non-food needs. Using the upper poverty line, overall poverty in Egypt rises to 43.8 per cent. Absolute poverty is mostly observed in rural areas, especially in Upper Egypt (34.9 per cent of the population in rural areas are absolutely poor, compared to 19.2 per cent in urban areas). In Lower Egypt, the incidence of absolute poverty is lower (16.6 per cent in rural areas and 9.8 per cent in urban areas).

Energy Situation

9. The main energy resources available in Egypt are oil, natural gas, hydropower and other renewable sources of energy, coal and non-commercial sources of energy. The proven recoverable oil reserves in Egypt were counted as 3.7 billion barrels (507 million tons) in 2005, whereas the proven recoverable natural gas reserves were estimated at 1900 billion cubic meters (about 1581 Mtoe). Egypt's share of these resources is about two-thirds, while the remaining share is owned by international companies contracted for the exploration and production of oil and natural gas. In addition to oil and natural gas, Egypt has a small amount of coal reserves (24 million tons). About 90 per cent of the Nile's hydro potential has been exploited to generate about 15 billion kWh of electricity per year. Other renewable sources of energy, especially solar and wind energy have good potential in Egypt, but their overall contribution is still very limited. Biomass, especially crop residues and dung, is used in rural areas as a non-commercial fuel for some household applications. Table 1 and Table 2 provide the statistics on the development of energy production and consumption in Egypt .

Table 1. Primary Energy Production

	2000	2001	2002	2003	2004	2005	2006
Oil (million tons)	37.8	35.2	34.8	35.6	33.8	32.2	32.1
Natural gas (billion cu.m.)	18.3	24.6	26.7	30.0	33.1	38.4	41.3
Coal (million tons)	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Electricity (billion kWh)	79.9	80.7	86.1	92.2	98.4	101	108.4
Thermal & others (%)	81.0%	81.9%	83.5%	85.8%	86.4%	87.5%	88.3%
Hydro (%)	19.0%	18.1%	16.5%	14.2%	13.6%	12.5%	11.7%

Table 2. Final Energy Consumption (million toe)

	2000	2001	2002	2003	2004
Oil	20.9	21.6	22.4	22.4	22.5
Natural gas	6.2	7.8	8.6	9.8	10.6
Coal	0.7	0.7	0.8	0.8	0.8
Electricity	5.5	5.6	6.3	6.5	7.2
Biomass	1.4	1.5	1.2	1.2	1.3
Total	34.7	37.2	39.3	40.7	42.4

10. The average per capita energy consumption in 2004 was 850 kgoe. But it should be noted that this average conceals marked differences in consumption between urban and rural areas on the one hand and within these areas themselves on the other. About 30 per cent of the energy was used by industry, 24 by transport sector, 33 by households and services and 12 percent by non-energy uses.

11. Electricity generation in Egypt was 108.4 billion kWh in 2006, about 12 per cent of which was generated by hydropower, and the remaining 88 per cent by thermal power plants. About 35 per cent of electricity is used by industry, 37 per cent by residential and commercial sectors, 4 per cent by agriculture and 24 per cent by public utilities. The average per capita electricity consumption in 2006 was 1290 kWh.

Energy Policy

12. In general, the Government's energy strategy considers the energy and power sectors as an engine of growth and as such adequate priority has been given to the development of these sectors. The goal is to secure sufficient and affordable energy supplies to meet the requirements of all segments of the economy, improve sector efficiency and optimize both domestic utilization of the country's energy resources and energy export. Because of the abundant gas reserves, the objective is also to develop the utilization of gas in order to reduce oil consumption and to become self-sufficient in oil supply.

13. The energy sector faces a number of challenges, however, that must be addressed to maximize the sector's contribution to the development process. First, the large capital investments required to secure adequate and reliable supply of energy to meet the demand continue to increase in line with economic growth and the expanding population. Secondly, prices of liquid petroleum fuels, natural gas and electricity had been kept stagnant over a long period, despite increase in production costs. The result has been low cost recovery and deteriorating financial performance of the entities responsible for energy production and

distribution. Furthermore, subsidized energy prices are not really promoting efficient energy use and can also distort prices in the manufacturing sector.

14. On the other hand, in Egypt, as well as in other developing countries, the tariff reform for the poorer and weaker sections of the society has to be designed not only on the basis of full cost recovery, but has also to factor in equity considerations so that the costs of meeting the basic energy needs of the disadvantaged and most vulnerable groups of the population do not exceed their capacity to pay. The inevitability of some cross-subsidization for the provision of lifeline-subsidized rates of electricity to selected disadvantaged groups is this still foreseen or there is a need to find other means of support for this part of the population.

15. The Government has started to take steps to tackle the listed energy sector constraints. In line with the recent momentum in overall economic reforms, energy prices are sought to be rationalized to better reflect the cost of supply. Prices of petroleum products, natural gas and electricity have been raised and there are prospects of further adjustments to achieve higher cost recovery, including the approval of 5% annual tariff adjustments up to 2009/2010. Since 2004, rates have gone up with 5% per year and will continue to do so until 2010.

16. In order to meet the rising demand for electricity, the Egyptian Electricity Holding Company (EEHC) is planning to increase its current installed capacity of 11 GW by another 12 GW by the year 2012. To achieve this, the Government's current policy is to open up generation and distribution to private participation, while still maintaining the transmission network as a public monopoly. The BOOT scheme has already been introduced and under this arrangement, there are currently three international independent private power (IPP) operators.

17. The Government of Egypt is also pursuing a strategy to diversify its energy source through the development of new and renewable energy resources. The updated renewable energy strategy targets to supply 3% of electricity generation by the year 2010, mainly from solar and wind energy, with additional contributions of other renewable energy applications such as solar water heating in both domestic and industrial sector, water pumping and desalination by wind, photovoltaic rural electrification in remote areas and biomass applications.

18. The feed-in rates for Independent Power Producers (IPPs) have been set as dollar-designated rates at 0.09 LE/kWh in 1999. Because of the depreciation of the Egyptian Pound over the last years, the rate in local currency is now approximately 0.14 LE/kWh. However, higher rates are paid in exceptional situations. Wind generated power receives 0.17 LE/kWh (as a combination of a formal feed-in tariff + additional incentive).

19. These policy measures are expected to slowly start to reverse the decline in sector performance and enhance private investor interests, which are key to the long-term development of the energy sector, including the increasing use of renewable energy

Rural Energy

20. The energy consumption patterns and energy mix used in rural areas of Egypt have changed considerably over the past three decades. With expansion of rural electrification, there has been a marked shift from the use of kerosene to electricity for lighting. About 92.4 per cent of households in rural areas are currently connected to the electricity grid, while the remaining 7.6 per cent (about 522,000 households, typically in more remote satellite villages)

still use kerosene and LPG lamps for lighting. The per capita electricity consumption in rural areas varies considerably from 90 kWh/year to 760 kWh/year (the higher values are encountered in villages near urban areas). Brown and black outs, however, are common and the capacity of the grid is many rural areas are adequate to serve only the needs of lighting and some electronic equipment.

21. There has also been a marked shift from the use of agricultural residues and dung cakes for cooking, baking and water heating to the use of kerosene and LPG cylinders (butane gas). About 55 per cent of households use LPG cylinders; about 69 per cent use kerosene and about 17 per cent use agricultural residues.

22. The recent surveys carried out in 1700 households in rural areas of Assuit Governorate and 1500 households in Fayoum have indicated that in average 2-3 LPG cylinders and 20-25 litres of kerosene is used per month for cooking and water heating in each household. The amount of agricultural residues used is about 50 bundles (about 150 kg) per household each month for cooking and baking.

23. The level of subsidization of households is still considerable, ranging from about 33% for kerosene up to 60% for diesel and LPG. An overview of the price levels of different fossil fuels used in rural areas is provided in Table 4 below.

Table 4 Price levels of selected fossil fuels in 2005

	Price (LE/unit)	**LHV (MJ/unit)**	**Price (LE/GJ)**
Diesel fuel (l)	0.55	36.8	14,9
unsubsidised	*1.44*		*39,1*
Kerosene (l)	0.80	36.6	21,9
village observations	1.00		*27,4*
unsubsidised	*1.20*		*32,8*
LPG (kg)	0.63	47.3	13,2
village observations	*0.88*[3]		*18,5*
unsubsidised	*1.50*		*31,7*

[3]Actual prices depend on availability and can go up to 1.0 LE/kg or more in remote areas.

24. LPG is normally sold in 8 kg cylinders with an official price of L.E. 5.0 each. The transportation costs, however, can significantly increase the final costs to the consumers reaching LE 10-15 per cylinder.

25. Agricultural residues are mainly used for baking and cooking, collected either free from the fields or, in some cases, brought separately. Typical fuels are stalk and cobs of maize, cotton stalk and dried cow dung.

26. **Maize stalk:** Families that do not grow maize themselves often buy stalk per cart or camel load. Depending on the season, a cart of approx 10 m3 (bulk) of air-dry maize stalk costs 50-70 LE. At a bulk density of 1 t/m3, the price per tons is approximately 50-70 LE/m3. Maize cobs are not usually trade and no price level could be established.

27. **Cotton stalk:** The stalk of cotton is removed from the land after the harvest of the cotton, as measure of pest control. In the areas visited, most of the stalk is used for cooking energy and therefore little or none is disposed by burning in the field. Price levels are assumed to be similar to that of maize stalk.

28. **Cow dung:** Cakes of dung and straw are prepared and left to dry in the sun. The cakes are commonly used for baking. Dung cakes are not commonly traded so no price level has been established.

29. The mentioned fuels are typically used in traditional stoves and furnaces with estimated efficiency of 10 per cent only. In the case of the use of fossil fuels, farmers commonly resort to burning crop residues in the fields, resulting in a vast loss of energy besides causing direct local negative impacts on human health and environment. A study by the World Bank (2003) estimated that local damage costs due to the burning of agricultural residues in Egypt were approximately L.E. 0.7 billion ($ 150 million in 1999/2000.

30. Uncontrolled burning of crop residues leads to massive air pollution during the harvesting seasons, in particular in October and November. Enormous amounts of residues, especially from the harvested rice crop are set alight in order to clear the lands. The result is a massive "black cloud" that suffocates the inhabitants of nearby urban areas.

31. **Densified fuels:** Densification is a physical process whereby materials such as biomass are compacted under high pressure into a uniform shape (i.e. briquettes or pellets). The density of the material increases enormously; from bulk densities of 100-200 kg per m3 to massive densities of around 1.2 kg/l. Densification introduces large benefits for logistics (transport and storage), use of the biomass (e.g. in hearths or fixed bed gasifiers), and hygienisation (seeds and insects are killed in the process). Due to the somewhat lower moisture content in comparison to the raw material, the calorific value may be somewhat higher (16-17 MJ/kg). The main drawback is the energy use of the process (around 100 kWhe/tonne).

32. **Densification (briquetting)** is seen as one of the means of combating the environmental problems related to the uncontrolled burning of crop residues. The briquettes can be stored and distributed as a household fuel. Based on order-of magnitude estimates of investments and operational costs, the production costs per tons of briquettes are estimated at 140-160 LE/t.

33. **Charcoal** is a very common type of biofuel in many developing countries. In general it is an urban fuel, produced in rural areas: the high energy density (about 28 MJ/kg) makes it more suitable for transportation over long distances.

34. Most charcoal is produced in the traditional way, where a pile of woody biomass is stacked, lit, and covered to shut of the flow of oxygen to the process. It is possible, however, to produce charcoal also from certain agro-residues such as straws and stalks, albeit not directly.

35. One possible route is to carbonize densified residues, resulting in uniformly shaped carbon briquettes. A second way is to directly carbonize the residue, and then make briquettes using a binder (such as sugar cane molasses). A cheap and reliable technology is agglomeration, where uniform round charcoal balls of 3-4 cm are formed in a type of cement mill. A pilot test with this technology was done in Fayoum several years ago.

36. Charcoal from agro residues is most commonly a replacement for traditional charcoal and thus the largest demand can usually be found in urban areas. For finding energy solutions for rural areas, the application would be less suitable. However, it could offer a solution to environmental problems related to the uncontrolled combustion of agricultural residues, and it

could provide additional income to rural families supplying the raw materials. In that respect, it could be considered a possible means of large-scale valorization of unused biomass residues.

37. Based on order-of magnitude estimates of investments and operational costs, the production costs of carbonized briquettes (capital intensive) and agglo-briquettes (more labour intensive) in Egypt are estimated to be at 900-1,100 LE/t .

38. **Ethanol based fuels:** A recent development, especially in Africa, is the use of ethanol based fuels for cooking. Ethanol (ethyl alcohol) is a liquid fuel that can be produced by biochemical conversion of sugar or starch holding products. It has an energy density of 22 MJ/l. It can be used directly in a simple burner for cooking; alternatively, it can be first jellified to make it more safely to use.

39. Ethanol is produced at large scale in several countries, especially Brazil and USA where it is used as an automotive fuel. It can be produced most efficiently near large sugar plants, as these produce a large amount of molasses, a suitable raw material. Production cost strongly depend on the alternative value of the molasses, but is generally in the order 250-300 USD/m3 (1.4-1.8 LE/l).

40. **Anaerobic digestion:** Anaerobic digestion is the process of microbiological decomposition of (wet) biomass into methane and carbon dioxide (biogas). It takes place in strict absence of oxygen, and usually requires a (very) watery environment.

41. Although anaerobic digestion can be used for a range of applications (e.g. wastewater treatment, processing of municipal organic wastes), the most relevant for rural areas is digestion of animal dung. Such digester systems are available for use in households (upward from several heads of livestock), but also for larger communities (dozens of heads of livestock) and farms (hundreds to thousands of heads). The digested effluent is a very suitable (and valuable) fertilizer for agriculture.

42. The gas produced can either be used directly for cooking or water heating or, in larger plants, for electricity generation.

43. **Combustion with steam cycle:** In combustion systems, fuels are directly and completely burned. The flue gases can be used for the production of hot water or steam; the latter can be expanded through a turbine, producing electricity. The process is well-proven and reliable and installations for most types of biomass fuels are commercially available. Combustion systems are available upward from a few hundred kWe although for smaller systems (up to several MWe) the efficiency may be limited. Such smaller systems are generally best suitable for CHP applications (Combined Heat and Power), i.e. where there is a significant demand for process heat. On the other hand, specific investment costs have been rapidly decreasing over the past decade due to the increasing number of suppliers from Newly Industrialized Countries in Asia and South America.

44. **Gasification** in a thermo-chemical process whereby a fuel (e.g. biomass) is converted into a combustible producer gas. The gas contains carbon monoxide (CO), hydrogen (H2) and methane (CH4), and the inert gases nitrogen (N2) and carbon dioxide (CO2). The gas has a Net Calorific Value of around 4.5 - 6 MJ/Nm3. The producer gas can be used in conventional

gas appliances (e.g. boilers) or gas engines. Gasifier systems are available upward from several kWe but larger (multi megawatt) systems are not commonplace.

45. Suppliers from India and China are known to supply very cost-effective gasifier systems, but their suitability for different fuels and their performance are generally limited and needs to be explored further. Also, there are no known suppliers of large (multi-megawatt) systems in these countries, so larger systems would need to be supplied by European or American suppliers, which will add to the costs. Furthermore gasification has several important drawbacks, such as its limited fuel flexibility, operational problems related to fuel ash, gas cleaning, emission control, and the required level of knowledge and know-how for operation.

46. **Plant oils:** Plant oils, such as jatropha oil, can be used as a diesel replacement in a modified diesel engine. The oil can be produced by pressing the oil from the seeds of the jatropha tree, a bush that can be grown under harsh circumstances, withstanding long periods of drought. The plant is grown as a hedge in rural areas in several West African countries, where the pressed seed oil provides a source of income or fuel for rural families.

47. In Egypt, an experiment has been recently started with the production of jatropha oil as a feedstock for biodiesel. Although no operational data is available yet, the owners claim to be able to produce the biodiesel for less than 330 EUR/t (almost 400 USD/t or 2,300 LE/t), which would set the price of the crude jatropha oil at around 250-300 USD/t (about 1,400-1,800 LE/t, approx. 20% above the unsubsidised diesel cost). When produced at a smaller scale, production cost can go up quickly to about 600 USD/t or more.

48. Table 5 gives an overview of the estimated costs of different biofuels, in comparison to the cost of the presently used fuels.

Table 5 Cost comparison of selected biofuels and their current alternatives (2005).

Fuel	Cost (LE/unit)	Cost (LE/MJ)	Current alternative	Unsubsidised cost alternative (LE/MJ)
Briquettes (t)	150	8.8	stalks	4.7[1]
Charcoal (t)	1,000	35.7	Wood charcoal	-
Ethanol (l)	1,600	72.7	kerosene	32.8
Jatropha (l)	1,600	44.4	Diesel	39.1

[1] Based on the off-season price level, i.e. 70 LE/t.

49. From the table it can be concluded that:

- Ethanol is far from competitive with unsubsidised kerosene;
- Jatropha oil (when produced on large scale) is nearly competitive with unsubsidised diesel. In the long run, when diesel subsidies are reduced, jatropha oil may become a cost-effective replacement fuel albeit only when produced at sufficiently low costs.
- Briquettes from agro-residue are not competitive with their nearest alternative. Around 35% of the costs, however, consist of raw material costs, if measures against open air combustion of agro-residues come in place, prices may go down considerably.

- Charcoal from agro residues could provide a solution for the problem of open air combustion and generate income for the rural population. Its competitiveness, however, will depend on the price levels of charcoal in urban areas.

50. The applicability and cost-effectiveness of anaerobic digestion of animal manure, and combustion and gasification of agro-residues were subjects to a more detailed feasibility study during the project preparatory phase, the key conclusions of which are briefly discussed below:

51. **Family scale anaerobic digestion:** Family scale anaerobic digestion (biogas) systems in the range of 6-12 m3 usually require the manure of about 4 to 10 heads of livestock. In addition, excrements from the family latrine can be added (should there not be social or cultural barriers to that) and certain organic residues (co-substrates). The output of the digester is a combustible biogas which can be used for cooking.

52. The digester effluent can be used as a fertiliser and will have a higher nutrient value than the original animal manure that has entered digester. This is due to the conversion of nitrogen compounds into a form, where they are better accessible for plants. In addition, during the digestion process pathogens and seeds are killed, providing a good means of hygienisation of the feedstock.

53. Three most common types of systems that can generally be found in the market are: 1) Chinese fixed dome, 2) Indian floating drum and 3) Polyethylene bags. While the first two systems typically have lifetime of 15-20 years and investment costs in the range of LE 500 (USD 90) per $m^{3,}$ the polyethene bags are much cheaper, but also less durable with certain parts requiring replacement every 2-3 years. For the purpose of this project, a more detailed feasibility analysis was conducted for an 8 m3 biogas plant of an Indian floating drum type.

54. The results of the feasibility study for an 8 m^3 system with investment costs of LE 4,000 indicated a 14% IRR for the investment and simple payback of 6.1 years. It should be noted, however, that the results are sensitive to the estimated value of the fertilizers and the value of the fuel the biogas is substituting, namely whether it is LPG, kerosene or a mix of them and what is considered as the real or perceived value added for the reduced need for transporting kerosene or LPG over the distances, which sometimes can add significantly to the final price of these fuels. During consultations of the PDF B phase, a somewhat lower price of LE 3,500 for a similar system was also quoted.

55. In general the analysis indicated, however, that under favorable conditions the family scale biogas plants can provide an economically feasible alternative for kerosene and LPG even with the current subsidized fuel prices. By creating a more level playing field for biogas with an additional subsidy comparable to those provided for LPG or kerosene or by gradually removing the subsidies from these fuels, the economics can be further improved.

56. **Community scale anaerobic digestion:** Although there are different technologies available for larger scale digestion, community digester system can be very similar to household systems. They will then have more or less the same performance characteristics (manure input, gas yield and fertilizer production per m3 of digester content) as the smaller systems. The typical investment needs for a digester of 130 m^3 would be LE 52,800 (USD 9,200). A diesel genset of 12 MWe would add another LE 41,800 (USD 7,300).

57. The biogas that is produced can be utilized in different ways:

- It can be used to generate electricity in small (grid connected or stand-alone) units. The gas can be temporarily stored, so that the system, when properly dimensioned, can supply peak loads;
- The gas can be distributed among a number of users. This will require some type of a distribution grid and a minimum gas pressure, with which to distribute. Furthermore, there would be a need for a metering and billing system. Due to the relatively small system size and the complexity of the operation, this option is disregarded at present;
- The gas can be supplied as a replacement fuel to shaft driven applications, such as a pumping stations, which can be found all over in Egypt, or a mill.

58. As the basis for the calculations done for this project, two cases were studied: i) a system producing gas as a substitute for diesel in applications such as pumping stations or mills driven directly by a diesel motor and ii) for producing electricity. In both cases, the livestock holders supply the required manure and can receive part of the fertilizer in return. Where applicable, manure can also be bought from parties at a rate that will reflect the benefits.

59. The analysis of the option producing biogas as a substitute for diesel resulted in an IRR of 8% and simple payback of 8.6 years. With an unsubsidized diesel price or by providing a similar subsidy for biogas, the IRR would jump to 30% with a simple payback of 3 years.

60. In the case electricity production, the investment on gas diesel can not be considered feasible, if the electricity needs to be sold to the grid with the current feed-in tariffs of up to LE 0.17 / kWh. Should there be a possibility, however, to charge a higher commercial tariff of LE 0.51 / kWh directly from the targeted customers, the indicators are similar to the direct use of gas, namely 7% IRR and a simple payback period of 9.1 years. This can be the case, for instance, in remote areas where diesel generation is the only alternative and diesel prices are high due to the long transport distances.

61. **Farmscale anaerobic digestion:** Especially when larger amounts of materials are available for digestion, it may be beneficial to increase the temperature to the mesophylic range (35-40 ^{o}C) in order increase the speed of digestion and reduce the related retention time to 30-40 days compared to the retention time of a typical household system of 50-60 days, which is working on a lower temperature. The advantage is the possibility to considerably decrease the required reactor volume.

62. For the large scale digestion of animal manure, the most common type of reactor is the continuously stirred tank reactor (CSTR). The CSTR consists of a large digestion tank (usually starting at several hundreds m3), which is stirred with a propeller stirring device. The continuous mixing of the digester contents maximizes the contact between methane producing bacteria and feedstock. The produced methane is collected under a plastic foil on the top of the digester tank, which may also serve as temporary gas storage.

63. In the financial analysis, this option was considered economically feasible, if the manure used as the feedstock for the biogas plant has no alternative value and the electricity can be sold directly to the customers at the higher commercial sector tariff of LE 0.51/kWh, comparable to the situation with the community scale plant.

64. **Biomass gasification**: There are several gasification technologies, of which the most commonly used are:

- Fixed bed gasifiers (updraft / downdraft). Coarse fuel particles enter the gasifier from the top, and move down under the influence of gravity. The air is inserted from the top (downdraft) or bottom (updraft). Updraft gasifiers are least sensitive to fuel quality (morphology, ash content, moisture content) but the producer gas contains large amounts of tar and ash. Downdraft gasifiers produce cleaner gas but are sensitive to fuel quality (morphology, ash content, moisture content). Fixed bed gasifiers are most suitable for smaller applications (updraft up to several MWe).
- Fluidised bed gasifiers (bubling / circulating bed), in which small fuel particles react in a fluidised sand bed. These gasifiers are more flexible with respect to fuel properties and quality but they are more complex and require a higher level of automation. Fluidised bed gasification is usually applied for somewhat larger systems (upward from several hundred kWe).
- Electricity production can take place in an internal combustion engine (spark plug). In larger (multi-megaWatt) systems, gas can be combusted in a gas turbine.

65. Gasification is not a straightforward technology. Even when a gasifier is well designed for the available fuel, there is a host of operational problems that can occur. Common problems that are frequently encountered are the following:

- Ash slagging. Depending on the ash content and ash melting behaviour, ash slagging can lead to congestions.
- Fuel bridging. In fixed bed gasifiers, the slow movement of the fuel bed can lead to the formation of fuel bridges inside the gasifier, which prevents the supply of fuel and disrupts the process.
- Grate breakdown. With some gasifiers, high temperatures in the combustion zone are know to lead to frequent breakdowns of the grate.

66. Other site selection and environmental related considerations in selecting a gasification system are:

- In order to operate a gasifier for extended periods of time, there should be sufficient biomass resources available nearby. Especially when the feedstock is not produced centrally and continuously, there will be need for a considerable logistical system and large scale storage. When crop residues are produced during one particular season, each kilotonne of (baled) agro residue will require storage of 3-4,000 m3. Storage needs for a 500 kWe gasifier will then require storage in the order of 10,000 m3.
- Operating a gasifier requires a dedicated team of well trained operators with a technical background. Gasifiers need constant attention if they are required to operate continuously. Operators should be able to recognise and handle occurring problems and interruptions and do small maintenance themselves.
- In order to operate at full capacity during a large number of hours per year, the gasifier system will need to be grid connected. Preferably, there should be an arrangement with one or more large commercial users for supply of electricity, in order to increase the returns from grid supply.

- Control of carbon monoxide (CO) emissions: Because of the high carbon monoxide content of the producer gas, and the fact that there is always some slip in the gas engine, CO content of the exhaust gases may surpass emission limits;
- Control of contaminated scrubbing water: many gasifier systems, especially from India, apply wet scrubbing for the cleaning and cooling of the producer gas. The effluents contain high levels of tar and will need to be cleaned and recycled in order to prevent environmental contamination.

67. Of utmost importance is a proper match between fuel type and gasifier. Not all residues are equally suitable for all types of gasifiers. Materials with high ash contents and very low ash melting points (e.g. different types of straw) may cause problems with congestion of fixed bed gasifiers. Furthermore, depending on the morphology and type of gasifier, extensive fuel pre-treatment may be required (drying, milling, briquetting).

68. There are several important steps perceding and following the actual gasification process itself:

- Fuel preparation. Each type of gasifier has specific fuel requirements, with respect to morphology (size and shape), moisture content, composition etc. Moreover, gasifiers are sensitive to the consistency of fuel quality. Certain forms of fuel preparation is required in most cases.
- Gas cleaning and cooling. When the producer gas is to be applied in a gas engine, it will need to be of sufficient quality with respect to tar and particulate matter. As all conventional gasifiers produce these substances, a certain form of gas cleaning will always be required. Furthermore, the gas needs to be cooled down to reduce its volume.

69. The efficiency of a gasification system is determined by the efficiency of the gasifier and that of the gas engine. For the gasifier, an efficiency of 70% can be assumed, for the gas engine 25-30%. The combined efficiency is thus 21% maximum (fuel to gross electricity). The overall energy efficiency of the plant can be slightly higher if the heat from the gas cooling and the gas engine can be applied usefully. Apart from the efficiency, the plant will consume a certain mount of electricity for its operation (e.g. for fuel preparation, fans, motors etc).

70. Small gasifiers (up to several hundreds of kiloWatts) can be rather simple, with low levels of automation. Such systems are supplied be a range of (especially Indian and Chinese) manufacturers, at low investment costs. Larger systems (Multi-Megawatt) systems are supplied by European suppliers, are much more automated but also much more expensive.

71. The results of the pre-feasibility study conducted during the project preparatory phase for a 500 kWe system of Indian type with total investment costs of LE 2,500,000 (USD 436,000) indicated a 16% IRR with a simple pay back period of 5.8 years. The assumptions used in the calculation included fuel price of LE 50 per ton at the gate of the plant, electricity tariff of LE 0.34 per kWh by direct sale to the consumer and an operation of 5,000 hours per year.

72. As in the previous case, the results of the feasibility study are obviously sensitive to the assumptions used. If, for instance, through the Government supported programs to manage agricultural waste, fuel can be received at reduced price of LE 10 per ton, the IRR would

increase to 21%. On the other hand, the reduction of the electricity sales price down to LE 0.25 per kWh would reduce the IRR down to 5-6%.

73. Given the above, it is clear that the gasification plants using the agricultural waste currently burnt in the fields would require some preferential conditions for their financially feasible introduction, which may include support in the following key areas separately or as a combination:

- support for the fuel collection, pre-treatment and/or transportation reducing the fuel price at the gate;
- premium feed-in tariff into the grid or a possibility for direct consumer connection and sale of electricity at the rate comparable to the current commercial consumer tariffs (or using the electricity for own use, if the plant is integrated with the other production facilities; and/or
- separate, initial capital support and/or an add-on for the price of electricity produced and sold.

74. Given the seriousness of the problem with the current practice of burning crop residues in the field, obtaining the type of support elaborated above is considered as a realistic option, but requires further negotiations on the basis of concrete investment plants and sources of financing. The ongoing EEAA initiatives to reduce open burning of agricultural waste by supporting the business development in rural areas to promote the collection and alternative processing of this waste are expected to also contribute to this effort. The Ministry of Environment, in collaboration of several entities and governorates, is embarking on several initiatives to locally manufacture and distribute automatic, semi-automatic and manual rice straw compressors among farmers. The Ministry of Environment has provided different modalities of grants and loans with total investments of about LE 44 million to enable compression and collection of rice straw for various uses.

75. **Biomass combustion:** Combustion of biomass with conventional steam cycle for energy generation is well proven and commercially available technology. Although its relevance for rural development is less pronounced, large scale combustion of biomass may offer a solution for the environmental problems caused by the uncontrolled combustion of agricultural residues. Particularly at larger scales (upward from several MWe), fuel-to-energy efficiencies are considerable and specific investment costs go down. For state-of-the-art combustion systems of around 40 MWe, over-all efficiencies can be as high as 35%. Smaller systems have lower efficiencies: systems of around of 5 MWe have efficiencies in the order of 25%. When process heat is supplied, the electric efficiency will be somewhat lower.

76. In order to operate to their full extent (8,000 hours per year), the combustion plants need to be connected to the national grid and will supply all its energy to the grid.

77. Other specific features of (large scale) combustion are:

- High fuel flexibility. Well developed plants can handle different types of fuel, including (combinations of) rice straw, maize residues and other agricultural residues, but also fossil fuels such as natural gas;
- High level of automation.
- High reliability and therefore high availability (in the order of 8000 h/a).

78. The main drawback of large scale installations is the logistics of the fuel supply. Large plants require large amounts of fuel, which usually needs to be collected in a large area. The larger the power plant, the larger the fuel need, and thus the larger the transport distances. Constructing the plant as near a large agricultural area as possible could minimize the transport distances.

79. When fuel is produced during a short period of time (e.g. during harvest time), large amounts of biomass will need to be stored for year-round plant operations. This could be minimized by implementing an installation with a high level of fuel flexibility. If such a system can utilize different residues harvested in different seasons, the required storage of each residue can be limited. In addition, in periods of low fuel availability, a fossil fuel could be (co-)combusted.

80. Utilization of residual heat for productive purposes can considerably improve the energy efficiency and economics of a power plant. The nature of such heat demand should preferably be large (multi-megawatt), continuous throughout the year, and low temperature (e.g. for drying). Such heat demands are usually found in industry.

81. The results of a preliminary pre-feasibility analysis conducted for a medium (5 MWe) and larger scale (40 MWe) plant by using the investment and operating costs and other operational characteristics of straw combustion plants operating in UK and Denmark as a basis for calculations and by assuming the fuel price of LE 50 per ton and an electricity feed-in tariff of LE 0,17 per kWh, indicated that at least under these conditions the introduction of combustion plants does not look financially feasible. Whether the financial feasibility of these kind of combustion plants can be improved up to the level needed by measures able to reduce the investment costs or by leveraging additional public support already discussed in the context of the gasification technologies, will be subject to further consultations and studies during the project implementation phase. Some preliminary interest for investing into these kind of plants has been shown by some private investors, but under current framework conditions no real progress has been made yet.

82. By building on the **conclusions** of the studies reflected above, the initial focus of the project's market development activities is expected to be on the following markets and technologies:

- improving the access to sustainable energy services for those rural communities that have currently problems with energy supply, thereby promoting their socio–economic development with the focus on: i) family scale 6-12 m^3 biogas plants (anaerobic digestion of manure) for providing gas for cooking and water heating and ii) larger community (100-150 m^3) and, as applicable, more effective (in terms of the required digestion time) farm scale digesters, with an option for electricity generation, where the required conditions for that seem to exist; and
- supporting the Government efforts to reduce the open burning of agricultural waste (crop residues), with the initial focus on the opportunities provided by small scale combustion or gasification.

83. Semi-industrial or industrial plants for digestion will also be considered, which in certain cases can be more promising with respect to efficiency and ecology. For this purpose, more advanced, state of the art technology will also be evaluated.

Early Experiences and Lessons Learnt

84. As mentioned before, the traditional biomass fuels are typically used in simple stoves and furnaces with efficiency of around 10% or less. In order to improve this low efficiency, some small-scale projects have been implemented by local NGOs, through the GEF Small Grant Program, to increase the efficiency of traditional open fire ovens (including a revolving fund mechanism) and to increase the efficiency of charcoal production. NREA has been supporting a project on briquetting crop residues.

85. About 850 small biogas units (family type) have been installed since the 1970s, through grants offered by donors and the Ministry of Agriculture, to serve as "demonstration" units. About 90% of the plants were of the Indian type, with a floating gas storage drum; the remaining 10% are based on Chinese models with fixed domes. An evaluation carried out by DANIDA in 2000 concluded that about 50% of the biogas plants were not operating (and since then the percentage has increased) and most of the remaining plants did not produce the amount of gas that they should have been producing.

86. In most cases, it was concluded that the main reason for such a grave history has been that the plants were installed with significant donor support, but without adequate technical backstopping after that to address the problems occurring during further operation, to support the regular maintenance of the plants and to optimize the gas production. As a result of the plants not operating up to the expectations and promises made, the owners got dissatisfied and in many case abandoned the plants, although with proper maintenance and technical follow-up they could still be in operation. An illustrative example is that after studying the performance of some of the still operating plants and making recommendations for their improved operation, the gas production could be raised in some cases immediately by 5-6 fold.

87. In some cases, the problem was that the plants were constructed close to urban centers with easy access to butane gas and kerosene, further accelerating the abandoning of the biogas systems, if some problems started to occur. The few plants that were constructed in remote areas have been successful and are still operating (e.g. those of New Basaisa in Sinai).

88. The situation described above reveals the problems with the "traditional" technical demonstration approach financed primarily by grants, rather than trying to build up and introduce more business and financing models that can sustain and support further market also after project is over.

89. A more successful model has been introduced by some local NGOs, which have been constructing and selling family scale biogas plants in selected rural areas through a revolving fund mechanism. The lack of resources, however, have not allowed the expansion of this program.

90. In the area of gasification, the EEAA, supported by the Government of China, has facilitated the construction of two gasification demonstration plants, which are currently supplying 50 households each with gas by using rice straw as fuel.

91. A brief discussion on the general barriers to the promotion of bioenergy technologies (BETs) for productive rural energy use follows:

Barriers to the promotion of bioenergy technologies (BETs)

92. The GEF's experience to date has shown that the barriers being removed generally relate to five market characteristics: policy; finance; business skills; information; and technology. As identified in the second Climate Change Program Study (CCPS2, 2004) as well as in the new draft programming framework for GEF-4, the removal of market barriers relating to these qualities "can form the basis for a market development strategy that is applicable to all of GEF's Operational Programs as well as being replicable, sustainable, and cost-effective". The following section is discussing how these "five pillars" apply for the current situation in the bioenergy market in Egypt, followed up by a section of "Project Strategy" describing in further detail the proposed support strategy of this project to overcome these barriers.

93. **Policy:** Despite the policy framework, which in general is favorable for increasing the share of renewable energy in country's energy balance, the Government and the related donor efforts (including GEF) have until now focused primarily on the power sector, including large scale wind and solar thermal power. The opportunities of smaller, decentralized bioenergy technologies (BETs) have consequently gained less attention. A related barrier is the current fossil fuel subsidies, providing an uneven playing field for competing BETs, which do not have access to similar support.

94. As discussed in further detail in the draft project document, some positive steps in the area of increasing the prices of the main energy commodities to better reflect the actual market prices have already been taken and this trend is expected to continue. In parallel and especially over the transition period, however, there is a need for a more aggressive, enabling policy to promote or at least provide a level playing field for BETs, the establishment and adoption of which policy framework is also one of the key targets of this project.

95. On the institutional side, there is lack of national-level coordination among different agencies carrying out activities related to BETs. In comparison with many other energy systems, development of bioenergy calls for decentralized approaches involving many stakeholders and requiring considerable resources. Such activities should be carried out by different institutions at different levels with proper coordination and interaction mechanisms in place.

96. **Finance:** While there are some wealthier families in the rural areas that could be able to finance the family scale bioenergy plants promoted under this project also by cash, the majority of the rural population depends on access to longer term financing options. Also, making such financing options available keeping the monthly financing cost of the new BET plants lower than the monthly spending of the targeted beneficiaries on competing kerosine, diesel, LPG or electricity is likely to make the overall investment for BETs more attractive and eventually allowing longer payback periods than for paying the cost in cash upfront.

97. On the basis of the pre-feasibility studies conducted during the project preparatory phase, it was concluded that in selected market areas the BETs can be economically feasible even in the current, quite challenging market environment with subsidized fossil fuel and electricity prices , but the non-availability of suitable long term credits is still posing a barrier to financing BETs. While the goal should be to keep the monthly spending of the targeted beneficiaries on BETs (including the loan service) lower than their current spending on the competing energy sources, with the financing options requiring a payback period of under 5 years this is seldom possible. The calculated lifetime of most new BETs promoted under this

project is 15 years and the required payback typically between 5-10 years rather than under 5 years.

98. There are basically two ways of addressing this barrier: 1) to lower the initial capital costs (and accordingly the size of the loan) with an appropriately sized capital subsidy, which can be phased out when the market develops further or 2) to facilitate the establishment of new, concessional lending schemes (e.g. longer term revolving funds), which allow longer payback periods than the ones currently in the market. In the first case and on the basis of the pre-feasibility analysis conducted during the project preparatory phase, the level of required investment support in the current market environment of Egypt to effectively support the initial market development phase of BETs has been estimated to be in the range of 20-40%, which is comparable with the experiences from other countries. For further details, see Section IV, Part III ("Possible Implementation and Financing Arrangements of the Proposed Bionenergy Plants").

99. In the case of family scale biogas plants, the revolving fund model has already shown some success in Egypt, but in order to expand this idea and to leverage additional resources for that, there is a need for some cost sharing over the initial transition and learning period to address, among others, the financing barriers discussed above.

100. **Business Skills:** Despite some successful initiatives of the local NGOs to promote BETs at the local level in the frame of available donor support, there is no adequate capacity within the existing institutions yet for the widespread promotion of such technologies at a larger scale. For facilitating sustainable development of the market, there is a need for entities, which have the required technical, marketing and financial skills to promote the investments into BETs on a maximum cost recovery basis. Their capacity needs to be built for leveraging financing for the investments and for their own operations from different public, semi-commercial or commercial sources and facilitate the actual construction of the plants at the adequate level of technical quality with associated after sale and technical support services, thereby securing continuing positive experience with the technology and sustained market growth. This aspect, in particular, is something, which has been missing from many earlier grant financed demonstration projects.

101. **Information:** Despite some demonstrations, the use of modern BETs is still relatively new in Egypt with the associated lack of experience and trust on their performance, which especially in the case of biogas has been strengthened by the negative experiences with some early demonstration projects. As such, there are still needs to prove the operational and financial feasibility of the new BETs both to the targeted private and public sector stakeholders in order to leverage stronger political support and financing for their further replication. This is not only to do with the technical performance of the plant itself, but the whole chain of supplying the plant with required fuel, the viability of the proposed business models and financing arrangements etc.

102. **Technology:** As discussed in the earlier chapters, the types of BETs promoted under this project have been widely implemented in other countries, but some additional technical assistance is expected to be needed to study and secure their proper operation and applicability for Egyptian conditions and the envisaged type of the fuels used. There are also no standards and quality control requirements for new BETs yet, which would need to be introduced in a due course.

PART II STRATEGY

Project Goal, Objective, Outcomes and Outputs/Activities

103. The project intervention is presented according to the logical framework approach. The essence of this approach is that outputs are clustered by outcomes, which together will achieve the project objective under the overall project goal. The envisaged project components following this approach are briefly discussed below, with further details in the Logframe Matrix in section II, "Strategic Results Framework and GEF Increment".

104. The goal[1] of the project is to facilitate and accelerate the market development for new bioenergy technologies (BET) in Egypt, thereby promoting sustainable socio-economic development of the rural communities in Egypt and reducing the negative global and local environmental impacts associated with the use of fossil fuels and the environmentally not sound management of the agricultural waste.

105. The objective[2] of the project is to remove the technical, institutional, information, financial, and market barriers to developing the BET market in Egypt by (i) testing the feasibility and building the public confidence on BET systems and on the new business and financing models to facilitate their broader adoption, and on the basis of those models showing success, developing further the financial, institutional and market strategies for their large-scale replication; (ii) supporting the development and adoption of an enabling policy framework to implement and leverage financing for the recommended strategies; iii) building the capacity of the supply side to do marketing, finance and deliver rural bioenergy services; and iv) institutionalizing the support provided by the project to facilitate sustainable growth of the market after the end of the project.

106. In order to facilitate sustainable market transformation, there is a need for parallel, mutually supportive measures that can create a sustainable demand through an enabling policy framework and other promotional measures, which are building the confidence of the market on the new technologies, and on the other side meeting this demand by building the capacity of commercially oriented and professional supply chain able to offer high quality products and services, combined with the access to affordable and sustainable financing mechanisms. The components described in further detail below are aiming at facilitating this process. For community mobilisation, the project is looking for close co-operation with the UNDP-MISR project and the participatory planning tools used by that.

107. Through the implementation of the planned investments projects, the project is going to monitor and collect experiences from the different type and size of bioenergy applications, including family, community and farm scale, thereby exploring further the opportunities also for semi-industrial or industrial plants. For this purpose and in line with the recommendations coming out from the GEF Council review, more advanced technologies also from other countries will be evaluated in addition to the proposed lower costs technologies from China and India.

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[1] by building on the definition of the project goal as "the overall result to which the project will contribute, along with various other, external interventions".

[2] by building on the definition of the project objective as "the overall resul t that the project itself will achieve, independent of other interventions i.e. what the project is accountable for delivering"

Project Outcomes and Outputs

Outcome 1: New business and financing models successfully introduced and tested by using appropriate technical solutions and demonstrating the possibility to construct and operate bioenergy systems on a cost recovery basis under a supportive and enabling policy and financing environment.

108. On the basis of the pre-feasibility studies conducted during the project preparatory phase, the initial focus of the project will be on two market areas, which have been identified as the priorities of the Government and thereby also able to leverage the maximum political support, which for the development of the bioenergy technologies at this early market development phase in Egypt is still seen as essential.

109. **The first market area** will be those rural communities, which at the moment have inadequate access to energy and/or for which more cost-.effective alternatives could be provided to promote their socio-economic development. By building on the efforts of both UNDP and the Government of Egypt to support these communities, the proposed GEF project will support the introduction of family and community scale biogas plants, from which the gas can either be used for cooking or other household needs (thereby substituting the current use of kerosine, LPG or ineffective use of traditional biomass fuels), or in the case of community plants, for producing electricity. Another option with the community plants is to produce gas for shaft-driven applications such as pumping stations, mills etc. In both latter cases, the community biogas plants would substitute the use of diesel oil.

110. The first projects are envisaged to be implemented in four rural clusters (small villages), of 500 households each, in four Governorates: Assuit, Fayoum, South Sinai and Matruh. Assuit and Fayoum have the lowest human development index in Egypt and the highest unemployment rate. The project will be open to consider also other areas, however, where communities express interest and contribute to the project activities and where opportunities arise for co-funding. Such a case exist, for instance, with one private oil company, which has expressed interest to work in specific governorates in the vicinity of their field operations

111. The rural areas in Assuit and Fayoum Governorates have also been identified by the UNDP MISR project (Municipal Initiative for Strategic Recovery), jointly funded by the Government of Egypt and different donors, among the most impoverished areas requiring immediate attention. The MISR project plans to support the rural community development by a participatory approach across 10 governorates (comprising over 1,500 villages). During the first phase in 2004-05, a development plan was prepared for 10 villages. The Government of Egypt has allocated LE 15 million to finance the implementation of priority projects in these first 10 villages, complemented by LE 5 million from UNDP and other donors. Meanwhile, the Government, the World Bank and UNDP have negotiated and are preparing to sign a MoU to have US$ 150 million (from the WB loan) to implement the developed plans in 5 of the targeted governorates over the next 4 years.

112. In the plans prepared so far, adequate access to energy (beside water supply, sanitation and social services such as health clinics, educational institutions etc. requiring access to reliable energy supply) has been reported as one of key priorities for development, which opens an opportunity to introduce also biomass based energy production technologies instead of diesel or other conventional energy sources considered in the baseline. The coupling of

bioenergy systems with these efforts will add value to the overall package by improving the energy supply and at the same time provide new job and income opportunities. In the case of successful pilot initiatives, the technologies can be replicated in other villages, thereby the GEF project benefiting the MISR Programme at the national level and vice versa

113. By complementing, among others, the support provided by the MISR project, the proposed UNDP/GEF project is seeking to channel its support through selected local NGOs (or other community driven entities) and the private sector and seeks gradually build their capacity to become professional "Bioenergy Service Providers" (BSPs) with the required marketing, technical and financial engineering skills to continue the development of the BET market on a self-sustaining basis after the project is over.

114. Beside the TA component to support the establishment and capacity building of the BSPs, a financial contribution from the GEF is requested for the establishment of a pilot "Bioenergy Development Fund" (BDF), which can support the BSPs during the early market development phase. This support can be gradually removed, when the market is maturing and/or complementary and supportive longer-term policies will become into place.

115. The operations and the financial support provided by the BDF will be co-ordinated with the financing opportunities of the Social Fund for Development and/or other similar entities that share the goals of the project to develop the local SMEs and to support environmentally sustainable projects. For further details about the scheme and its funding criteria, see Section IV, Part V "Description of the Bioenergy Development Fund (BDF)".

116. **The second market area** will be those rural areas, in which massive amounts of crop residues, in particular rice straw and husk, but also other residues, are currently burnt in the fields, thereby producing significant amount of local air pollution affecting seriously also the urban centers such as Cairo. Reducing this air pollution is currently considered as one of the top priorities of the Government in the environmental field.

117. In this market area, the project seeks to complement the efforts of the Government of Egypt to promote the collection of this waste from the fields and use for energy production.

118. In accordance with the implementation and financing strategy for the first market area, the UNDP/GEF will complement the support provided by the local UNDP office and the Government of Egypt by directing its support to building the capacity of selected local commercial or "semi-commercial" entities, which after the project can continue to market and offer their services for professional construction and operation of biomass energy plants on a self sustaining, cost-recovery basis.

119. Through successful demonstration of the management, implementation and financing mechanisms used for facilitating the construction of these first plants, the project seeks to leverage broader policy and, as applicable, financial or fiscal support, for their large scale replication. For further details, see Outcome 2.

120. The specific outputs under this component include:

- An updated market analysis and finalized plans and operational criteria for the project's capacity building and financial support strategy.
- The initial awareness raising and marketing activities successfully finalized

- The Bioenergy Development Fund (BDF) successfully established and launched.
- The BET systems installed as per the project annual and final targets.

Outcome 2 An enabling policy framework, effectively promoting rural bioenergy development adopted.

121. This component includes activities needed to make the key decision and policy makers aware of the benefits of the bioenergy technologies promoted and to support the development and adoption of a coherent, enabling policy and institutional environment at the national and regional level to support the project to reach its ultimate goal to facilitate and accelerate the market development for new bioenergy technologies (BETs) in Egypt.

122. The key areas to be addresses in that respect include:

- Whenever feasible, considering bioenergy technologies as the first alternative, when supporting rural communities to improve their access to energy instead of diesel, kerosene or LPG and for managing the agricultural waste instead of the current open field burning
- Creating a level playing field for bioenergy in the frame of Government's current tariff policy;
- Developing and adopting appropriate and with other initiatives co-ordinated financial and fiscal incentive mechanisms to facilitate sustainable development of bioenergy technologies (connected with efforts to promote sustainable socio-economic development of rural communities and improved agricultural waste management)
- Facilitating the development and adoption of an adequate legal and regulatory framework for technical standards, quality control and, as needed, business relations between the commercial or semi-commercial bioenergy service providers and their customers.

123. The project will enter to and continue the dialogue with the key policy and decisions makers to promote the goals and objectives listed above with the aim to facilitate the adoption of the required changes in the end of the project on the basis of their national economic and social benefits. For that, however, concrete and tested technical solutions and institutional and financing models need to be provided, which is supported by component 1 of this project.

124. The specific outputs under this component include:

- An updated study on the technical, economic and financial feasibility of the different bioenergy technologies to contribute to meeting the rural energy needs and to reduce the open burning of agricultural residues in the field (by building on the initial assessment conducted during the project preparatory phase)
- Enhanced awareness of and established policy dialogue with the key stakeholders and decision makers on the on the results of the study and the socio-economic benefits of BET systems.
- A draft policy paper highlighting the barriers and recommending improvements for the current policy framework for the promotion of rural bioenergy systems. Continuing dialogue with the key policy makers to promote the project goals and objectives

- Continuing consultations, promotional events, high level meetings and other measures to facilitate the adoption of the recommendations made.

125. For reaching the outcome 2 and the specific outputs under that, the project will co-operate closely with the "National Sustainable Energy Policy Reform" component of the UNDP/Spain MDG Achievement Fund project, expected to start in early 200

Outcome 3 Enhanced capacity of the local supply chain to market and deliver sustainable rural bioenergy products and services, including financing.

126. The purpose of this component is to build the capacity of the supply chain to secure the good technical quality of products and services offered to the market, thereby promoting its sustainable growth as well as to support the required marketing activities of the envisaged "Bioenergy Service Providers".

127. It will be closely integrated with the first pilot initiatives, institutional and financing arrangements implemented under component 1. By building on the financial and fiscal incentives and other support that can be leveraged by the project, and which can continue to support the BET market development in Egypt after that, this component will also support the establishment of and leveraging financing for the applicable new financing mechanisms, to which the targeted customer can either have an access directly or through the BSPs.

128. The training under this component will be designed and developed keeping in view the needs and background of the beneficiaries of the project. The technical modules targeting the manufacturers and technicians will focus primarily on the technical quality of manufacturing and construction of the systems as well as for the required maintenance and operation support. The second training module will be on business skills: marketing, finance, accounting, and project development. This training and technical backstopping will help and build the capacity of the enterprises, NGO's and/or community-based organizations that are involved in the implementation of the first pilot projects under component 1 to expand and continue their activities after the project is over as well as to encourage and build the capacity of eventual new service providers seeking to enter the market. Beyond the project, the experiences gained from training will also help to design future training and capacity building needs.

129. Reaching the outcome of component 3 will be further supported by developing applicable quality standards and certification schemes, including both products and the related construction, installation and follow-up maintenance services, so as to ensure that the targeted beneficiaries have a satisfactory experience with the technology. Certification and quality assurance will contribute to trouble free use of BETs and can subsequently increase consumer confidence in the technology. At the beginning, this is envisaged to be introduced as a voluntary scheme, but can later, along with the developing market, adopted as a mandatory scheme and a prerequisite also for having access to the TA and financing mechanisms promoted under the project. The trained BSPs may also be granted the right to use some sort of quality logo in their promotion.

130. Finally, the activities under this component will be targeted towards enhancing the awareness of the general public in rural areas about the benefits and opportunities provided by the modern BETs, thereby complementing the marketing efforts of the BSPs. These campaigns can include TV, radio and printed media information campaigns, events leaflets

and booklets drawing also materials from the first pilot projects implemented under component 1.

131. The specific outputs under this component include:

- An updated survey and evaluation of the existing (or potential future) market players and their capacity to produce rural biomass energy related products and services;
- Channels and opportunities for information exchange, networking, match making missions and conditions for different local and foreign entities to explore opportunities for co-operation created
- A manual for the development and financing of rural bioenergy projects in Egypt;
- An information and marketing package tailored for the targeted co-financing sources to support the BSPs and related awareness raising/match making;
- Draft technical standards and certification system (to be adopted either as a voluntary or as a mandatory quality control scheme – see outcome 2).
- Trained and, as applicable, certified product and service providers, including manufacturers, technicians etc.
- A joint public awareness raising and marketing campaign with supply side product or service providers for the targeted customers

Outcome 4 Institutionalization of the support provided by the project, including monitoring, learning, adaptive feedback and evaluation.

132. By building on the outcomes, outputs and lessons learnt from the activities implemented under components 1, 2, 3 and on the identified further support needs identified during the implementation of the project, the purpose of this component is to ensure adequate feedback for project's adpative management and that the required further support can be institutionalized and made available to support sustainable growth of the BET market also after the project. While the required actions at the policy side were addressed already under component 2, this component will focus on the required ongoing monitoring and evaluation of the impact of the project implementation as well as further capacity building, market promotion, supply chain strengthening by taking into experiences and lessons learnt during the implementation. Furthermore, by compilation and dissemination of the project results and lessons learnt, it will serve the replication of the activities that have demonstrated success not only in Egypt, but also in other countries.

133. The specific outputs under this component include:

- An updated baseline study, against which the impact of the project can be measured;
- Project mid-term evaluation and other required reviews, including annual reports from continuing monitoring and evaluation of all the investment projects facilitated by the project;
- Including rural biomass energy increasingly into the curricula of the relevant academic and other educational institutions;
- A Biomass Energy Association or another entity continue to serve as a focal point for further promotional activities of bioenergy technologiues on a self sustaining basis;

- As applicable, further elaboration, resource mobilization for and continuation of the required financial support mechanisms, including, as applicable, carbon financing;
- Final project report and associated promotional material and events, inluding dissemination and presenting project results not only in Egypt, but also in other countries through participation in seminars, workshops and other possible channels;
- Final project evaluation.

Project Indicators, Risks and Assumptions

134. Key indicators of the project's success are:

(a) The first pilot bioenergy systems constructed and operated by the professional and trained private or public entities on a profitable and sustainable basis;

(b) Over 90% customer satisfaction on the services provided by the first pilot project;

(c) An enabling policy framework for promoting sustainable rural biomass energy created, including, with other public support[3] co-ordinated financial and fiscal incentives to create a level playing field for bioenergy compared to other conventional energy sources such as diesel, kerosene, LPG and grid-electricity;

(d) Adoption of adequate product standards and quality control mechanisms;

(e) Availability of good quality (certified as applicable) and cost-effective products and services in the market to construct and operate the type of BET systems promoted by the project;

(f) Institutionalization of the support provided so as to facilitate continuing promotion of BET systems also after the project.

135. To reach this goal, it is critical that the first pilot projects do not work only technically OK, but can also can demonstrate the economic and financial feasibility of the technologies to be promoted. Furthermore, it is assumed that through the public awareness raising and advocacy work conducted during the implementation of the project, the different key stakeholders, including the Government of Egypt and its underlying agencies, can be encouraged to undertake more aggressive measures to promote the BET market in Egypt.

136. The project can be considered to face two categories of risks: external (policy related) and internal risks (risks inherent to the project implementation itself).

137. The main external risk is that the enabling policy framework for promoting biomass energy technologies does not develop at the desired speed and, in particular, that the low, subsidized fossil fuel and electricity prices continue to be major barriers to enhanced utilization of biomass energy. While the current subsidies can obviously not be removed overnight, the projects seeks to facilitate that at least for the transition period adequate financial and fiscal incentives and other public support can be made available to create a level playing field for bioenergy to compete.

138. The last few years have indicated some positive development and the environmental aspects are gaining increasing attention. The National Action Plan for Egypt calls for better

[3] such as ongoing or planned Government support programs for rural development and improved agricultural waste management

management of agricultural residues and municipal solid wastes and for reducing GHG emissions. The exploitation of renewable energy resources (including biomass energy) is also encouraged in the Government's Renewable Energy Strategy. The Government has launched specific programs to reduce the open burning of agricultural waste and the subsidies on electricity and fossil fuels are sought to be gradually removed with a decision already taken to increase the electricity tariffs by 5% annually.

139. The general investment climate in Egypt can be considered as another external risk. In that respect, it can be noted that the investment environment in Egypt is improving. The power sector has already removed obstacle for private sector participation (three BOOT plants have already been established) and facilities are also given for small power generation and distribution. The prospects for investment are therefore improved – reforms, although gradual, are continuing.

140. The main internal risks are:

141. *The risk of poor co-operation between project stakeholders*: To be successful, the project needs input and co-operation from several main ministries and other institutions, as well as their serious commitment to continue the promotion of the biomass energy technologies. The project will mitigate this risk by establishing a Project Steering Committee (PSC) as a main body to co-ordinate the project activities with other ongoing activities, as well as to discuss and propose legal and regulatory interventions to promote the use of biomass as an energy source.

142. *The risk of inadequate project implementation*: In a project of this complexity a top quality project management is absolutely essential for its success. Besides the experience and good knowledge of biomass energy activities in general, the qualifications of the project management should include a proven track record and experience on promoting and managing projects of a similar size and complexity and have, in particular, experience on marketing and financing new renewable energy technologies on a sustainable basis. These risks will be minimized by taking them into account while defining the Terms of Reference for the project manager and the other project personnel.

143. *The risk of cost overrun and time delays of the first pilot projects (completion risk)*: This risk will be minimized by careful selection of contractors and adequate terms and conditions of the contracts to secure timely provision of the services needed.

144. *The risk of use of inappropriate technologies (technology risk)*: This risk is minimized by careful selection of BET systems that are suitable for the chosen locations, and for the energy demands of the community. The project implementers should be highly experienced and bring together expertise to overcome this risk. In addition the hardware will be required to be supplied according to carefully formulated standards, and the construction of the pilot BET systems must be carried out according to the established specifications. The operation and monitoring of the BET systems must be kept under close scrutiny at the beginning, until well trained operators take over.

145. *The risk of non-participation of the local communities:* This risk can be mitigated through empowerment of village committees and their participation at all stages of the project implementation. Adequate awareness raising about the socio-economic benefits of BET systems should help to reduce this risk.

146. The *sensitivity of the financial feasibility of the projects* to the estimated value of the residues of the anaerobic digestion as fertilizers as well as to the risks related to the availability and price of the feedstock for both anaerobic disgestion and for possible larger biomass gasification or combustion plants. These risks are to primarily addressed by adequate market analysis before making the investment decision as well as by longer term fuel supply contracts for larger bioenergy plants.

147. *The risk of non-payment of the final beneficiaries for the services*: This risk can be reduced by making sure that adequate contractual arrangements are in place with the end users, by awareness raising on the importance of the "fee-for-service" model in creating new job opportunities and in improving the living conditions of the villages in general, etc. A mechanism for cost recovery should be in place from the start.

148. The confidence building, in general, is seen as the most important aspect for the success of the project and consequently due attention on this issue needs to be paid.

Expected global, national and local benefits

149. On a global level, the project will facilitate a "carbon neutral" path for sustainable development. The anticipated global environmental benefits are: a) GHG emission reduction by substituting fossil fuel use with bioenergy; and b) eventual additional GHG emission reduction gains achieved by environmentally more sound management of agricultural residues, animal dung and MSW.

150. Given the great uncertainties associated with estimates for the second category of emissions, the global benefits of this project have been calculated only on the basis of the amount of fossil fuel use that can be substituted with bioenergy.

151. The cumulative direct GHG emission reduction achieved by the bioenergy projects, whose implementation is directly facilitated by the proposed UNDP/GEF project has been estimated at 192 ktons of CO2 over the next 20 years and the cumulative, GHG reduction potential including both direct and direct post project GHG reduction at 2,3 million tons of CO2 by assuming a 20 % annual growth of the market after the end of the project.

152. The main national and local benefits are expected to be:

- Providing an alternative energy source to rural population producing costs savings compared to competing energy sources;
- Economic costs savings at the national level and reduced dependency and expenditures on imported energy;
- Reduced local pollution produced by conventional energy sources and reduced, uncontrolled burning or agricultural waste in the fields;
- The higher nutrient value of the effluent of the biogas digesters compared to the original animal manure, when used as a fertilizer and the associated possibilities for an additional revenue stream when selling this effluent;.
- Health benefits associated with the killing of the pathogens and seeds during the digestion process; and
- General socioeconomic development of the rural communities (being a key element of Egypt's Development Policy and Plan 2002/2017) and enhanced employment

opportunities in manufacturing and providing the required services for bioenergy technologies and development of the country's SME sector;.

Project Rationale and GEF Policy Conformity

153. The project aims at opening up a market for the development and dissemination of bioenergy technologies in Egypt to promote sustainable rural development and to reduce GHG emissions. As a part of the last, August 2006 work programme approved under GEF-3, this project was prepared to be consistent with the goals and guidelines of the GEF operational Programme 6 " *Promoting the adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs"* under the Strategic Priority # 4 "Productive Uses of Renewable Energy". Under GEF-4, the project would have contributed to reaching the objectives of the CC Strategic Program 4: "Promoting Sustainable Energy Production from Biomass".

Country Ownership: Country eligibility and country drivenness

154. According to the Instrument for the Establishment of the Restructured Global Environment Facility, Egypt qualifies for GEF financing on the following grounds:

- It has ratified the United Nations Framework Convention on Climate Change on 05 December 1994; and

- It receives development assistance from UNDP's core resources.

155. The proposed project is in line with target of Egypt's Renewable Energy Strategy, namely that renewable energies should supply 3% of energy production by the year 2010. The project is also supporting Egypt's efforts to reduce GHG emissions and to manage agricultural residues and MSW in an environmentally sound way, as set in Egypt's National Environmental Action Plan 2002/2017. Egypt is also committed to the implementation of the Millennium Development Goals (MDGs). While energy is not explicitly one of the MDGs, energy services play a number of direct and indirect roles in achieving several of the MDGs. Access to energy services facilitates socio-economic development in rural areas, creates employment, improves health and human development and ultimately leads to alleviation of poverty.

156. The project complies with the United Nations Development Assistance Framework (UNDAF) (2007-2011) as well as the new UNDP Country Programme (2007-2011) in Egypt under Outcome 3 on reducing regional disparity and promoting environmental sustainability. The project also serves UNDP's Multi-Year Funding Framework (MYFF) Core Result on the increase to access of energy services and cleaner fuels in rural areas. In addition, the project is in line with UNDP Egypt's MYFF (2007-2011), Goal 3 on energy and environment for sustainable development and Outcome 8, namely sustainable management of environment and natural resources incorporated into poverty reduction strategies/key national development framework's and sector strategies. The project supports UNDP CO efforts to link Egypt to GEF and will foster the country's linkages with United Nations Framework Convention on Climate Change. In this connection, UNDP CO has committed US$ 150,000 from TRAC resources to support the implementation of the proposed biomass energy project activities.

Sustainability (including financial sustainability)

157. The economic and financial feasibility of the different biomass energy technologies was studied during the PDF B phase of the project and the results have been summarized in Section IV, Part VI of the the project document. A general conclusion of the studies was that while in selected market areas and under otherwise favorable conditions the BETs can be economically justified even in the current, quite challenging market environment with subsidized fossil fuel and electricity prices, several financial barriers remain, which are sought to be removed by the proposed project.

158. In order to facilitate sustainable market transformation, there is a need for parallel, mutually supporting measures that can create a sustainable demand through an enabling policy framework and other promotional measures, which are building the confidence of the market on the new technologies, and, on the other side, meeting this demand by building the capacity of commercially oriented and professional supply chain able to offer high quality products and services, combined with the access to affordable and sustainable financing mechanisms. Awareness raising and confidence building in general on the proposed technical, institutional and financial measures is seen as critical for ensuring the sustainability of the project. Sometimes results on the practical side are needed, before the necessary changes at the policy level can be effectively promoted and implemented. Through this project, this process is sought to be facilitated.

159. In the project design, the lessons leant from earlier attempts to promote bioenergy technologies in Egypt and elsewhere have been taken into account, which highlight the need for introducing applicable cost recovery mechanisms from the very beginning as well as the often underestimated monitoring and technical backstopping needs after the plant has been constructed and commissioned. As such, facilitating this continuing technical backstopping by training and promoting the establishment of a network of professional local "Bioenergy Service Providers" (BSPs) as well as by promoting business and financing models that take the continuing technical backstopping needs and financial sustainability aspects into account from the very beginning, the project seeks to avoid some of the earlier mistakes that have been made in introducing bioenergy technologies in Egypt. Additional technical support will be provided by an international expert team, which is expected to support and follow up the project implementation and, through the on-the-job training and otherwise, gradually build the capacity of the participating local entities to carry on with the market development, after the project is over.

160. By building on the successful implementation of the first pilot projects, the project will work and continue the dialogue with key decision and policy makers so as facilitate the development and adoption of a more supportive policy framework to provide a more level playing field for bioenergy technologies compared to competing energy sources. The capital incentives used for initiating the market and for creating adequate market volume are sought to be gradually reduced, when the market develops further. By this, the project seeks to support a process that is also getting less dependent on external donor support.

161. In supporting the Government of Egypt to design and adopt enabling policies for BET, including, as applicable adequate financial and fiscal incentives, the project will take into account international experiences of such policies highlighting the need for such incentives to be transparent, predictable and long term enough. The common lesson learnt in supporting not only bioenergy technologies, but also other renewable energy is that frequently changing

and unpredictable incentive schemes are rather discouraging than encouraging the market growth and the related efforts to raise capital for the required investments.

162. Finally, the sustainability aspects are addressed under component 4 of the project with the aim to institutionalize the further support needs.

Replicability

163. The replication potential of the project is discussed in further detail in Section IV, Part VII, indicating that over 63 000 family scale, 3 800 community scale and close to 70 farm scale biogas plants as well as over 1,500 gasification plants (or combustion plants with corresponding capacity, if gasification does not prove to be yet technically mature enough) could be introduced in Egypt resulting an annual GHG reduction potential of close to 1,7 million tons of CO_2

164. Energy demand will undoubtedly increase at a fast rate in rural areas of Egypt striving for development and improvement of living conditions. The replication of the results of this project depends on its successful implementation. The following elements are of primary importance:

- Technical assistance activities that are intended to lay the necessary foundation of a supportive framework for the development and marketing of BET systems;
- Awareness raising activities and demonstration of the socio-economic benefits of BET systems, in particular for sustainable rural development;
- Implementation of selected pilot activities to support public awareness and capacity building activities and to gain experience on appropriate service delivery models and thereby reduce the risks of the implementation of similar projects in other areas;
- Close monitoring and evaluation of the project implementation and results, thereby providing lessons learned for future action; and
- Institutionalisation of the project support, as elaborated in further detail under Outcome 4 of the project.

165. The project will facilitate continuing contacts and co-operation between the different stakeholder groups at the national and international level by organizing seminars, workshops and other public events, thereby bringing the project proponents, the policy makers and the potential investors / other donors together. The results of the project, if successful, are expected to provide some useful experiences and models for replication not only in Egypt, but also in other countries.

PART III PROJECT MANAGEMENT ARRANGEMENTS

166. The following chapter is summarizing the project management arrangments. For further details about the role, key duties and responsibilities of the different entities and persons engaged in project management, see section IV, Part IV "Terms of Reference" and Part V " Description of the Bioenergy Development Fund (BDF)".

167. The executing agency of the project will be the Egyptian Environmental Affairs Agency (EEAA) following the UNDP national execution arrangements. In executing the project, the EEAA will have the responsibility to ensure the liaison and co-ordination with the other ministries and public administration bodies and the agencies and authorities under them,

which are having a stake in the project. As a part of this, the EEAA shall convene a Project Steering Committee (PSC) to supervise, advise and co-ordinate the implementation of the project. The EEAA will also assign a Project Director, who as a representative of the Government of Egypt will be responsible for ensuring that the project is executed in accordance with the project document and the UNDP guidelines for nationally executed projects.

168. The Project Steering Committee (PSC) will be chaired by the Project Director or EEAA CEO, if different. Its members will include a representative from each of the key ministries or other entities involved in the project, including a representative of UNDP. Other members can be invited by the decision of the PSC on as needed basis, however by taking care that the PSC remains operational by its size. The final list of the PSC members will be completed at the outset of project operations and presented in the Inception Report. The project manager will participate as a non-voting member in the PSC meetings. To effectively support the project, the PSC should meet at least twice a year.

169. When and as needed, the meetings of the PSC can be extended to Technical Advisory Group meetings. The TAG will function largely as a roster of national experts providing inputs on project outputs on a demand driven basis. While the TAG can meet periodically as a group, in most instances individual experts or smaller working groups of experts will be consulted.

170. The day-to-day management and reporting of the project progress will be under the responsibility of a full time project manager selected jointly by the executing agency and UNDP, in consultation with the UNDP/GEF Regional Co-ordination Unit.

171. The project manager will be supported by an administrative assistant, by project's international technical adviser(s)[4] as well by the national experts taking the lead in the implementation of the specific technical assistance components of the project. Links with relevant institutions in other countries that have already gained significant experience in biomass energy use, such as in India and China, will be established. Experts from these as well as from other developing or developed countries advanced in biomass energy use will be involved to share their experiences in biomass energy utilization, to advise the project implementation and to promote both "south-south" and "north-south" co-operation and networking in general.

172. The management of the proposed Bioenergy Development Fund (BDF) will be entrusted with the selected financial intermediate according to the agreed terms. The selection of this financial intermediate will be finalized at the outset of project operations by building on the initial consultations with few candidate banks during the project preparatory phase and on the basis of the best offer received during the final negotiations. The operation of the BDF will be supervised by the Project Steering Committee.

173. UNDP country office in Cairo will be responsible for monitoring and ensuring proper use of UNDP-GEF funds to all assigned activities, timely reporting of implementation progress as well as undertaking of mandatory and non-mandatory evaluations.

174. The actual construction and operation of the biomass energy plants are sought to be organized on a commercial or semi-commercial basis to be managed by local NGOs or other

[4] See the draft Terms of Reference in Section IV; Part IV for further details.

experiences private or public sector entities, with initial support provided by the project. Although with the first projects, the experts funded by the project are expected to be heavily involved both in the preparation as well as in supervising the construction and early operation, the project activities during further implementation are expected to have a gradual shift towards more general advisory and monitoring type of functions and continuing the advocacy work in general.

175. For successfully reaching the stated objective and outcomes of the project, it also essential that the progress with different project components will be closely monitored both by the key local stakeholders and authorities as well as by project's international technical advisors, starting with the finalization of the detailed, component specific work plans and implementation arrangements and continuing through the project's implementation phase. The purpose of this is to identify possible risks to successful completion of the project and to facilitate adaptive management and early corrective action, when needed.

176. In order to accord proper acknowledgement to GEF for providing funding, a GEF logo should appear on all relevant GEF project publications, including any hardware purchased with GEF funds. Any citation on publications regarding projects funded by GEF should also accord proper acknowledgement to GEF. The UNDP logo should be more prominent-and separated from GEF logo, if possible, as UN visibility is important for security purposes.

Stakeholder Involvement

See Section IV, Part III "Stakeholder Involvement Plan".

PART IV: MONITORING AND EVALUATION PLAN

177. Project monitoring and evaluation will be conducted in accordance with established UNDP and GEF procedures. The Logical Framework Matrix in Section II provides performance and impact indicators for project implementation along with their corresponding means of verification. These will form the basis, on which the project's Monitoring and Evaluation Plan will be built.

178. The following sections outline the principle components of the Monitoring and Evaluation Plan and indicative cost estimates related to M&E activities. The project's Monitoring and Evaluation Plan will be presented and finalized at the Project's Inception Report following a collective fine-tuning of indicators, means of verification, and the full definition of project staff's M&E responsibilities.

Monitoring and Reporting

Project Inception Phase

179. A Project Inception Workshop will be conducted with the full project team, relevant government counterparts, co-financing partners, the UNDP-CO and representation from the UNDP-GEF Regional Coordinating Unit, as well as UNDP-GEF (HQs) as appropriate.

180. A fundamental objective of this Inception Workshop will be to assist the project team to understand and take ownership of the project's goals and objectives, as well as finalize preparation of the project's first annual work plan on the basis of the project's logframe matrix. This will include reviewing the logframe (indicators, means of verification,

assumptions), imparting additional detail as needed, and on the basis of this exercise finalize the Annual Work Plan (AWP) with precise and measurable performance indicators, and in a manner consistent with the expected outcomes of the project.

181. Additionally, the purpose and objective of the Inception Workshop (IW) will be to: (i) introduce project staff with the UNDP-GEF expanded team which will support the project during its implementation, namely the CO and responsible Regional Coordinating Unit staff; (ii) detail the roles, support services and complementary responsibilities of UNDP-CO and RCU staff vis a vis the project team; (iii) provide a detailed overview of UNDP-GEF reporting and monitoring and evaluation (M&E) requirements, with particular emphasis on the Annual Project Implementation Reviews (PIRs) and related documentation, the Annual Project Report (APR), Tripartite Review Meetings, as well as mid-term and final evaluations. Equally, the IW will provide an opportunity to inform the project team on UNDP project related budgetary planning, budget reviews, and mandatory budget rephasings.

182. The IW will also provide an opportunity for all parties to understand their roles, functions, and responsibilities within the project's decision-making structures, including reporting and communication lines, and conflict resolution mechanisms. The Terms of Reference for project staff and decision-making structures will be discussed again, as needed, in order to clarify for all each parties responsibilities during the project's implementation phase.

Monitoring responsibilities and events

183. A detailed schedule of project review meetings will be developed by the project management, in consultation with project implementation partners and stakeholder representatives, and incorporated in the Project Inception Report. Such a schedule will include: (i) tentative time frames for Tripartite Reviews, Steering Committee Meetings, (or relevant advisory and/or coordination mechanisms) and (ii) project related Monitoring and Evaluation activities.

184. *Day to day monitoring* of implementation progress will be the responsibility of the Project Coordinator, Director or CTA (depending on the established project structure) based on the project's Annual Workplan and its indicators. The Project Team will inform the UNDP-CO of any delays or difficulties faced during implementation so that the appropriate support or corrective measures can be adopted in a timely and remedial fashion.

185. The project management team will fine-tune the progress and performance/impact indicators of the project in consultation with the full project team at the Inception Workshop with support from UNDP-CO and assisted by the UNDP-GEF Regional Coordinating Unit. Specific targets for the first year implementation progress indicators together with their means of verification will be developed at this Workshop. These will be used to assess whether implementation is proceeding at the intended pace and in the right direction and will form part of the Annual Workplan. The local implementing agencies will also take part in the Inception Workshop, in which a common vision of overall project goals will be established. Targets and indicators for subsequent years would be defined annually as a part of the internal evaluation and planning processes undertaken by the project team.

186. Measurement of impact indicators related to global benefits will occur according to the schedules defined in the Inception Workshop and tentatively outlined in the indicative Impact Measurement Template at the end of this Annex. The measurement of these will be facilitated

by subcontracts or retainers with relevant institutions or through specific studies that are to form part of the projects activities (e.g. measurement of carbon benefits or through surveys for capacity building efforts).

187. *Periodic monitoring* of implementation progress will be undertaken by the UNDP-CO through quarterly meetings with the project proponent, or more frequently as deemed necessary. This will allow parties to take stock and to troubleshoot any problems pertaining to the project in a timely fashion to ensure smooth implementation of project activities.

188. UNDP Country Offices and UNDP-GEF RCUs, as appropriate, will conduct yearly visits to projects that have field sites, or more often based on an agreed upon scheduled to be detailed in the project's Inception Report / Annual Workplan to assess project progress. Any other member of the Steering Committee can also accompany, as decided by the PSC. A Field Visit Report will be prepared by the CO and circulated no less than one month after the visit to the project team, all PSC members, and UNDP-GEF.

189. *Annual Monitoring* will occur through the **Tripartite Review (TPR).** This is the highest policy-level meeting of the parties directly involved in the implementation of the project. The project will be subject to Tripartite Review (TPR) at least once every year. The first such meeting will be held within the first twelve months from the start of full implementation. The project proponent will prepare an Annual Project Report/Project Implementation Review (APR/PIR) and submit it to UNDP-CO and the UNDP-GEF regional office at least two weeks prior to the TPR for review and comments.

190. The APR/PIR will be used as one of the basic documents for discussions in the TPR meeting. The project proponent will present the APR/PIR to the TPR, highlighting policy issues and recommendations for the decision of the TPR participants. The project proponent also informs the participants of any agreement reached by stakeholders during the APR/PIR preparation on how to resolve operational issues. Separate reviews of each project component may also be conducted if necessary.

191. *The Terminal Tripartite Review (TPR)* is held in the last month of project operations. The project proponent is responsible for preparing the Terminal Report and submitting it to UNDP-CO and RBAS-GEF's Regional Coordinating Unit. It shall be prepared in draft at least two months in advance of the TTR in order to allow review, and will serve as the basis for discussions in the TTR. The terminal tripartite review considers the implementation of the project as a whole, paying particular attention to whether the project has achieved its stated objectives and contributed to the broader environmental objective. It decides whether any actions are still necessary, particularly in relation to sustainability of project results, and acts as a vehicle through which lessons learnt can be captured to feed into other projects under implementation or formulation.

192. The TPR has the authority to suspend disbursement if project performance benchmarks are not met. Benchmarks will be developed at the Inception Workshop, based on the performance and impact indicators defined in the projects logical framework matrix.

Project Monitoring Reporting

193. The Project Coordinator, in conjunction with the UNDP-GEF extended team, will be responsible for the preparation and submission of the following reports that form part of the monitoring process. Items (a) through (f) are mandatory and strictly related to monitoring,

while (g) through (h) have a broader function and the frequency and nature is project specific to be defined throughout implementation.

(a) Inception Report (IR)

194. A Project Inception Report will be prepared immediately following the Inception Workshop. It will include a detailed First Year/ Annual Work Plan divided in quarterly time-frames detailing the activities and progress indicators that will guide implementation during the first year of the project. This Work Plan would include the dates of specific field visits, support missions from the UNDP-CO or the Regional Coordinating Unit (RCU) or consultants, as well as time-frames for meetings of the project's decision making structures. The Report will also include a detailed project budget for the first full year of implementation, prepared on the basis of the Annual Work Plan, and including any monitoring and evaluation requirements to effectively measure project performance during the targeted 12 months time-frame.

195. The Inception Report will include a more detailed narrative on the institutional roles, responsibilities, coordinating actions and feedback mechanisms of project related partners. In addition, a section will be included on progress to date on project establishment and start-up activities and an update of any changed external conditions that may effect project implementation.

196. After finalized, the report will be circulated to the project counterparts who will be given a period of one calendar month in which to respond with comments or queries. Prior to this circulation of the IR, the UNDP Country Office and UNDP-GEF's Regional Coordinating Unit will review the document.

(b) Annual Project Report (APR)

197. The APR is a UNDP requirement and part of UNDP's Country Office central oversight, monitoring and project management. It is a self -assessment report by project management to the CO and provides input to the country office reporting process and the ROAR, as well as forming a key input to the Tripartite Project Review. An APR will be prepared on an annual basis prior to the Tripartite Project Review, to reflect progress achieved in meeting the project's Annual Work Plan and assess performance of the project in contributing to intended outcomes through outputs and partnership work.

198. The format of the APR is flexible but should include the following:

- An analysis of project performance over the reporting period, including outputs produced and, where possible, information on the status of the outcome;
- The constraints experienced in the progress towards results and the reasons for these;
- The three (at most) major constraints to achievement of results;
- AWP, CAE and other expenditure reports (ERP generated);
- Lessons learned;
- Clear recommendations for future orientation in addressing key problems in lack of progress

(c) Project Implementation Review (PIR)

199. The PIR is an annual monitoring process mandated by the GEF. It has become an essential management and monitoring tool for project managers and offers the main vehicle for extracting lessons from ongoing projects. Once the project has been under implementation for a year, a Project Implementation Report must be completed by the CO together with the project team. The PIR is typically prepared immediately after the end of the GEF's financial year (June) and ideally prior to the TPR. The PIR should then be discussed in the TPR so that the result would be a PIR that has been agreed upon by the project, the executing agency, UNDP CO and the concerned RC.

200. The individual PIRs are collected, reviewed and analysed by the RCs prior to sending them to the focal area clusters at the UNDP/GEF headquarters. The focal area clusters supported by the UNDP/GEF M&E Unit analyze the PIRs by focal area, theme and region for common issues/results and lessons. The TAs and PTAs play a key role in this consolidating analysis.

201. The focal area PIRs are then discussed in the GEF Interagency Focal Area Task Forces in or around November each year and consolidated reports by focal area are collated by the GEF Independent M&E Unit based on the Task Force findings.

202. The GEF M&E Unit provides the scope and content of the PIR. In light of the similarities of both APR and PIR, UNDP/GEF has prepared a harmonized format for reference, which is available from UNDP/GEF's M&E Unit.

(d) Quarterly Progress Reports

203. Short reports outlining main updates in project progress will be provided quarterly to the local UNDP Country Office and the UNDP-GEF regional office by the project team.

(e) Periodic Thematic Reports

204. As and when called for by UNDP, UNDP-GEF or the Implementing Partner, the project team will prepare Specific Thematic Reports, focusing on specific issues or areas of activity. The request for a Thematic Report will be provided to the project team in written form by UNDP and will clearly state the issue or activities that need to be reported on. These reports can be used as a form of lessons learnt exercise, specific oversight in key areas, or as troubleshooting exercises to evaluate and overcome obstacles and difficulties encountered. UNDP is requested to minimize its requests for Thematic Reports, and when such are necessary will allow reasonable timeframes for their preparation by the project team.

(f) Project Terminal Report

205. During the last three months of the project the project team will prepare the Project Terminal Report. This comprehensive report will summarize all activities, achievements and outputs of the Project, lessons learnt, objectives met, or not achieved, structures and systems implemented, etc. and will be the definitive statement of the Project's activities during its lifetime. It will also lay out recommendations for any further steps that may need to be taken to ensure sustainability and replicability of the Project's activities.

(g) Technical Reports (project specific- optional)

206. Technical Reports are detailed documents covering specific areas of analysis or scientific specializations within the overall project. As part of the Inception Report, the project team will prepare a draft Reports List, detailing the technical reports that are expected to be prepared on key areas of activity during the course of the Project, and tentative due dates. Where necessary this Reports List will be revised and updated, and included in subsequent APRs. Technical Reports may also be prepared by external consultants and should be comprehensive, specialized analyses of clearly defined areas of research within the framework of the project and its sites. These technical reports will represent, as appropriate, the project's substantive contribution to specific areas, and will be used in efforts to disseminate relevant information and best practices at local, national and international levels.

(h) Project Publications (project specific- optional)

207. Project Publications will form a key method of crystallizing and disseminating the results and achievements of the Project. These publications may be scientific or informational texts on the activities and achievements of the Project, in the form of journal articles, multimedia publications, etc. These publications can be based on Technical Reports, depending upon the relevance, scientific worth, etc. of these Reports, or may be summaries or compilations of a series of Technical Reports and other research. The project team will determine if any of the Technical Reports merit formal publication, and will also (in consultation with UNDP, the government and other relevant stakeholder groups) plan and produce these Publications in a consistent and recognizable format. Project resources will need to be defined and allocated for these activities as appropriate and in a manner commensurate with the project's budget.

Independent Evaluation

208. The project will be subjected to at least two independent external evaluations as follows:

Mid-term Evaluation

209. An independent Mid-Term Evaluation will be undertaken at the end of the second year of implementation. The Mid-Term Evaluation will determine progress being made towards the achievement of outcomes and will identify course correction if needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. The organization, terms of reference and timing of the mid-term evaluation will be decided after consultation between the parties to the project document. The Terms of Reference for this Mid-term evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit and UNDP-GEF.

Final Evaluation

210. An independent Final Evaluation will take place three months prior to the terminal tripartite review meeting, and will focus on the same issues as the mid-term evaluation. The final evaluation will also look at impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental goals.

The Final Evaluation should also provide recommendations for follow-up activities. The Terms of Reference for this evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit and UNDP-GEF.

Audit Clause

211. The Government will provide the Resident Representative with certified periodic financial statements, and with an annual audit of the financial statements relating to the status of UNDP (including GEF) funds according to the established procedures set out in the Programming and Finance manuals. The Audit will be conducted by a legally recognized independent auditor.

Learning and Knowledge Sharing

212. Results from the project will be disseminated within and beyond the project intervention zone through a number of existing information sharing networks and forums. In addition:

- The project will participate, as relevant and appropriate, in UNDP/GEF sponsored networks, organized for Senior Personnel working on projects that share common characteristics.

- The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks, which may be of benefit to project implementation though lessons learned.

213. The project will identify, analyze, and share lessons learned that might be beneficial in the design and implementation of similar future projects. Identify and analyzing lessons learned is an on- going process, and the need to communicate such lessons as one of the project's central contributions is a requirement to be delivered not less frequently than once every 12 months. UNDP/GEF shall provide a format and assist the project team in categorizing, documenting and reporting on lessons learned. To this end a percentage of project resources will need to be allocated for these activities.

Table G-1 : Indicative Monitoring and Evaluation Work plan and corresponding Budget

Type of M&E activity	Responsible Parties	Budget US$ *Excluding project team Staff time*	Time frame
Inception Workshop	EEAA Project Manager (PM) UNDP CO UNDP GEF	5,000	Within first two months of project start up
Inception Report	EEAA Project Manager UNDP CO ITA, as needed	15,000	Immediately following IW
Measurement of Means of Verification for Project Purpose Indicators (incl. an updated baseline study)	Project Manager will oversee the hiring of specific studies and institutions, and delegate responsibilities to relevant team members	To be finalized at the outset of project operations for the inception workshop and report. Indicative cost: 30,000	Start, mid and end of project

Measurement of Means of Verification for Project Progress and Performance (measured on an annual basis)	Oversight by Project GEF Technical Advisor and Project Manager. Measurements by regional field officers and local IAs	To be determined as part of the Annual Work Plan's preparation. Indicative cost: 10,000 per year for four years	Annually prior to APR/PIR and to the definition of annual work plans
APR and PIR	Project Manager UNDP-CO UNDP-GEF	None	Annually
Annual meetings	Government Counterparts UNDP CO Project Manager UNDP-GEF Regional Coordinating Unit	None	Every year, upon receipt of APR
Project Management Board	EEAA UNDP CO Project Manager		
Steering Committee Meetings	EEAA Project Manager UNDP CO	None	Following Project IW and subsequently at least once a year
Periodic status reports	Project team	5,000	To be determined by Project team and UNDP CO at the outset project operations
Technical reports	Project team Hired consultants as needed	20,000	To be determined by Project Team and UNDP-CO during implementation
Mid-term External Evaluation and other interim evaluations	Project team UNDP- CO UNDP-GEF Regional Coordinating Unit External Consultants (i.e. evaluation team)	20,000	At the mid-point of project implementation. Additional component specific evaluations on as needed basis
Final External Evaluation	Project team, UNDP-CO UNDP-GEF Regional Coordinating Unit External Consultants (i.e. evaluation team)	30,000	At the end of project implementation
Terminal Report	Project team UNDP-CO External Consultant	None	At least one month before the end of the project
Lessons learned	Project team UNDP-GEF Regional Coordinating Unit (suggested formats for documenting best practices, etc)	15,000 (average 3,000 per year)	Yearly
Audit	UNDP-CO Project team	5,000 (average $1,000 per year)	Yearly
Visits to field sites (UNDP staff travel costs to be charged to IA fees)	UNDP Country Office UNDP-GEF Regional Coordinating Unit (as appropriate) Government representatives	15,000 (average one visit per year)	Yearly
TOTAL INDICATIVE COST *Excluding project team staff time and UNDP staff and travel expenses*		US$ 200,000	

PART V: LEGAL CONTEXT

This Project Document shall be the instrument referred to as such in Article I of the Standard Basic Assistance Agreement between the Government of Egypt and the United Nations Development Programme, signed by the parties on 19 January 1987. The host country-implementing agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the government co-operating agency described in that Agreement

The UNDP Resident Representative in Egypt is authorized to effect in writing the following types of revision to this Project Document, provided that he/she has verified the agreement thereto by the UNDP-GEF Unit and is assured that the other signatories to the Project Document have no objection to the proposed changes:

- Revision of, or addition to, any of the annexes to the Project Document;
- Revisions which do not involve significant changes in the immediate objectives, outputs or activities of the project, but are caused by the rearrangement of the inputs already agreed to or by cost increases due to inflation;
- Mandatory annual revisions which re-phase the delivery of agreed project inputs or increased expert or other costs due to inflation or take into account agency expenditure flexibility; and
- Inclusion of additional annexes and attachments only as set out here in the Project Document.

SECTION II: STRATEGIC RESULTS FRAMEWORK AND GEF INCREMENT

Part I: Incremental Cost Analysis

Global Environmental Objective
The global environmental objective of the project is the reduction of GHG emissions by enhancing the market for bioenergy in meeting the energy needs of the rural population and by reducing the non-productive, open burning of agricultural waste in the fields.

Baseline
The baseline scenario is meeting the rural energy needs primarily by extending the grid or using diesel generators for electricity and supply of butane gas and kerosene for cooking and heating and the continuing, extensive burning of agricultural waste in the fields.

Alternative (Project) Case
In the alternative scenario, rural energy needs are increasingly met by modern bioenergy technologies. Gas for domestic use will be provided by biogas plants, which can be community or household plants, depending on the situation. Electricity will be increasingly provided by generators connected to community or farm scale biogas plants or to biomass combustion or gasification plants. The open burning of agricultural waste is reduced and the residues are used for energy generation, thereby replacing the use of fossil fuels.

The GHG reduction impact of the project has been estimated as follows:

- The direct GHG reduction from the additional BET systems, the construction of which will be facilitated by the proposed project during its duration, has been estimated at 192 ktons of CO_2 over a 20 year calculation period
- The estimated cumulative CO_2 reduction (direct, direct post-project and indirect) from the expected market development facilitated by the project has been estimated at 2.3 million tons of CO_2 by 2025.
- The estimated GHG reduction potential for the amount of agricultural waste that realistically could be collected and utilized for energy use has been estimated at 1.7 million tons of CO_2 per year or 33.4 million tons over a calculation period of 20 years

As for the domestic benefits, the BET systems can improve the access of rural communities to sustainable energy, which is essential to foster their socio-economic development. There are also additional health benefits from improved management of agricultural waste and reduced local air pollution as well a possibility to produce higher value organic fertilizers as a side product of biogas production.

Systems Boundary
For estimating the GHG reduction potential of the project, only the direct GHG emissions resulting from burning the fuels have been taken into account.

The indirect emissions from fuel production and transportation activities as well as the net impact of other GHGs such as methane have not been considered due to the high uncertainties associated with these calculations.

Table II-1 Summary of the Incremental Cost Analysis

Outcome 1: New business and financing models successfully introduced and tested by using appropriate technical solutions	**Baseline:** Lack of confidence and the absence of sustainable and replicable models for implementation and financing of the targeted bioenergy technologies.	**Alternative:** Demonstration of the technical and financial feasibility and concerete implementation and financing mechanisms to facilitate the market development of the targeted bioenergy technologies.	**GEF Increment:** Technical assistance + financing. Estimated GEF costs: USD 1,820,000 **Estimated global benefits:** • 192 ktons of CO2 over a 20 year calculation as direct GHG reduction impact of the BET systems constructed during the project implementation.
Outcome 2: An enabling policy framework, effectively promoting rural bioenergy development adopted.	**Baseline:** Absence of an enabling policy framework, effectively promoting rural bioenergy development	**Alternative:** An enabling policy framework, effectively promoting rural bioenergy development in place.	**GEF Increment:** Technical assistance + the project working as a catalyst and platform to advocate and facilitate the required poli cy changes. Estimated GEF costs: USD 160,000 **Estimated global benefits:** Indirect, connected with the successful outcome of the other project components.
Outcome 3: Enhanced capacity of the local supply chain to market and deliver sustainable rural bioenergy products and services, including financing.	**Baseline:** Inadequate capacity of the local supply chain to market and deliver sustainable rural bioenergy products and services, including financing..	**Alternative:** Enhanced capacity of the local supply chain to market and deliver sustainable rural bioenergy products and services, leading to the sustainable market growth.	**GEF Increment:** Technical assistance + cost sharing of selected pilot projects. Estimated GEF costs: USD 460,000 **Estimated global benefits:** Indirect, connected with the successful outcome of other project components.
Outcome 4: Institutionalization of the support provided by the project, including monitoring, learning, adaptive feedback and evaluation.	**Baseline:** Inadequate information for adaptive management and project's final results and lessons learnt not captured and institutionalized for further market promotion.	**Alternative:** Adequate information for adaptative management. Project's final results and lessons learnt captured and institutionalized for further market promotion.	**GEF Increment:** Technical assistance. Estimated GEF costs: USD 260,000 **Estimated global benefits:** Indirect, connected with the successful outcome of other project components.
Project management	N/A	N/A	**GEF Increment:** Estimated GEF costs: USD 300,000
Total:	The energy needs of the targeted rural areas met or to be met by kerosene, LPG and fossil fuel based electricity generation.	Sustainable market growth of the bioenergy technologies, as per the specific targets of the projects (see the logrframe)	**GEF Increment:** Technical assistance + project financing. Estimated GEF costs: USD 3,000,000 **Estimated global benefits:** • 192 ktons of CO2 over a 20 year calculation as direct GHG reduct ion impact components. • 2.3 million tons of CO2 as the estimated cumulative CO2 reduction (direct, direct post-project and indirect) from market development by 2025

Part II: Logical Framework Analysis

Project Goal: To facilitate and accelerate the market development of new bioenergy technologies (BET) in Egypt, thereby promoting the sustainable socio -economic development of the rural communities in Egypt and reducing the negative global and local environmental impacts associated with the use of fossi l fuels and the environmentally not sound management of the agricultural and solid waste.					
Project Strategy	**Indicator**	**Baseline**	**Target**	**Sources of verification**	**Risks and Assumptions**
Objective of the project: To remove the technical, institutional, information, financial, and market barriers to developing the bioenergy technology (BET) market in Egypt	The level of confidence on modern BET as means to contribute to rural energy needs. The market growth of BET The level of supportive framework conditions in place sustaining the market growth after the end of the GEF project.	Low level of confidence No market growth of BET Inadequate public support to the initiate and sustain the BET market growth	High level of confidence Average annual 20% market growth at the end of the project, as compared to the previous year. Supportive policy, including required financial and fiscal incentives in place to sustain the market growth.	Final project evaluation and the related stakeholder consultations.	The political will to effectively promote bioenergy as an alternative or complementary energy source to LPG, kerosine and diesel.
Outcome 1: New business and financing models successfully introduced using appropriate technical solutions and demonstrating the possibility to construct and operate BET systems on a cost recovery basis under a supportive and enabling policy and financing environment.	The level of confidence on modern BET and the implementation mechanisms promoted. The operational and financial data of the systems installed. The level of customer satisfaction.	Low level of awareness and confidence - only some family scale systems installed – lack of success stories on a broader scale.	At least 1000 family scale, 10 community scale and 2 farm scale biogas systems constructed and commissioned by the end of the project. For gasification and/or combustion plants, at least 4 MW of installed new capacity reached by the end of the project. Over 90% of the customers satisfied with the new systems	Project reports Project midterm and final evaluation, including related surveys.	The targeted beneficiaries accept the proposed technologies, implementation and financing arrangements.
Output 1.1 An updated market analysis and finalized plans and	Finalized, updated market analysis, plans and operational	The market analysis plans and operational criteria for the	See the indicator.	Project reports	Approval of the project by the GEF

operational criteria for the project's capacity building and financial support strategy.	criteria for the project's capacity building and financial support strategy.	project's capacity building and financial support strategy to be finalized.			
Output 1.2 The initial awareness raising and marketing with the targeted clients successfully finalized (for replication the awareness raising and marketing under Outcome 3).	Number of applications received	Lack of awareness of the existing opporytunities with bioenergy	The applications for support to reach the first year targets, i.e 50 family scale biogas plants and 2 community scale biogas plants received	Project reports	The targeted beneficiaries accept the proposed technologies, implementation and financing arrangements.
Output 1.3 The Bioenergy Development Fund successfully announced and launched.	Number of and approved	No financial support facility or scheme exist to support BETs	The applications for support to reach the first year targets, i.e 50 family scale biogas plants and 2 community scale biogas plants approved.	Project reports	See above.
Output 1.4 The BET systems installed as per the project annual and final targets.	Number of systems constructed.	No systems constructed	The first pilot bioenergy systems constructed and operated by professional "Bioenergy Service Providers" on the basis of maximum cost recovery by the end of the first 18 months of project implementation Others as per the project's annual and final targets.	Project reports	See above
Outcome 2 An enabling policy framework, effectively promoting rural bioenergy development adopted.	The content of the policy actions, legal and regulatory changes adopted.	Subsidized fossil fuel and electricity prices. Lack of supportive policies to create a level playing field for BETs. Lack of adequate product	An enabling policy framework for promoting sustainable rural biomass energy adopted, including: • Recognition of the BET and other renewable systems in official Gov't documents as the first option to be studied and considered for meeting rural	Project reports and official Government documents	The political will to effectively promote bioenergy as an alternative or complementary energy source to LPG, kerosine and diesel exist, including the provision of adequate financial and

		standards and quality control mechanisms	energy needs, whenever technically and economically feasible • A level playing field for BET systems to compete with subsidized fossil fuels created and, as applicable, introduction of eventual additional financial or fiscal incentives to support BETs on the basis of their socio-economic and environmental benefits • A supportive regulatory framework for managing the relations between the bioenergy service providers and the customers; • Adoption of adequate product standards and quality control mechanisms.		fiscal incentives.
Output 2.1 An updated study on the technical, economic and financial feasbility of the different bioenergy technologies for contributing to sustainable management of agricultural waste and its use for productive energy generation putrposes.	The status of the study	No updated assessment available	The study finalized by the end of the first year of the project.	Project reports	
Output 2.2 Enhanced awareness of and established policy dialogue with the key stakeholders and decision makers on the	The PR material produced The list and output of consultations held.	Inadequate awareness and attention on the socio-economic benefits of BET systems.	The initial PR package finalized Initial meetings and consultations with the key stake-holders finalized by the first 12 months	Project reports	Consistency with the overall Government strategies and development priorities

results of the study and the socio-economic benefits of BET systems.			of the project. Enhanced awareness of the general public through programs and articles in public media, workshops etc.		
Output 2.3 A draft policy paper highlighting the barriers and recommending improvements for the current policy framework for the development of the rural bio-energy market.	The status of the document	No comprehensive proposal on the steps to be taken for creating an enabling policy framework for biomass energy.	The draft policy paper finalized by the end of the first 18 months from the project start.	Project reports	See above
Output 2.4 Continuing consultations, promotional events, high-level meetings and other measures to facilitate the adoption of the recommendations.	The status and level of policy dialogue	Inadequate attention on the legal and regulatory changes needed to effectively promote BETs.	The required activities to facilitate the adoption of the recommended policy changes finalized by the end of the second year of the project.	Project reports	See above
Outcome 3 Enhanced capacity of the local supply chain to market and deliver sustainable rural bioenergy products and services, including financing.	The number of identified and trained "Bionergy Service Providers" (BSPs) capacitated to continue to operate on a self-sustaining basis after the end of the project. The level of follow-up activities of the trained BSPs.	Inadequate capacity of the supply chain to effectively market and deliver products and services for rural bioenergy development.	At least 20 new local entities to serve as BSPs identified and their capacity built by the end of the first 18 months. The follow-up activities and business of the trained BSPs show an increasing trend, leveraging financing from a variety of sources.	Market surveys and monitoring reports Project mid-term and final evaluation	Adequate demand for rural bioenergy services can be created through the project. Interest of the targeted stakeholders to extend or expand their business in the bioenergy field.
Output 3.1 An updated survey and evaluation of the existing (or potential future) market players and their capacity to produce rural biomass energy related products and services.	The status of the survey.	No updated survey exists.	An updated survey and capacity evaluation finalized by the end of the first 6 months of the project.	Project reports	Enough entities with initial capacity and interest to grow into professional BSPs exist.

Output 3.2 Channels and opportunities for information exchange, networking, match making missions and conditions for different local and foreign entities to explore opportunities for co-operation created	Number of contacts facilitated	Good channels and opportunities for networking and matchmaking between the local supply side actors and potential foreign partners missing.	Project web site established including links to relevant information. At least one international, bioenergy workshop in Egypt and 5 matchmaking missions facilitated by the project.	Project reports	See above
Output 3.3 A manual for the development and financing of rural bioenergy projects in Egypt	The status of manual	No manual available	Finalized manual in Arabic and in English for developing and financing of rural bioenergy projects in Egypt.	Project reports	See above
Output 3.4 An information and marketing package tailored for the targeted co-financing sources to support the BSPs and related awareness raising / match making finalized	The availability of the information and marketing package. The number of meeting and financial matchmaking events organized	No consolidated information about BET systems to potential financing institutions available.	Information and marketing package about BET systems to potential financing institutions finalized. Contacts created between the BSPs and with at least 5 new promising co-financing sources in addition to the BDF.	Project reports	See above
Output 3.5 Draft technical standards and certification system (to be adopted either as a voluntary or as a mandatory quality control scheme – see outcome 2).	The status of the technical standards/ requirements and a certification system	No technical standards or certification system in place	Technical standards or requirements and a certification system developed and adopted (see also outcome 2) both for hardware and for service providers in the distribution chain.	Project reports	Adequate market volume to justify the certification system.
Output 3.6 Trained and, as applicable, certified product and service providers, including manufacturers, technicians etc.	Number and type of people trained Verified results of the training through a certification scheme	Lack of information and capacity in the supply chain to effectively market and deliver their products and services.	At least 100 people trained and, as applicable, certified from the supply chain in order to build up their technical, management and marketing, plant operation and maintenance and/or financial engineering skills	Project reports	Interest and motivation of the targeted stakeholders for training can be created through perspective business opportunities, the introduction of the certification system or by

			(the scope of training depending on the target group)		other means.
Output 3.7 A joint public awareness raising and marketing campaign with supply side product or service providers for the targeted customers	The number of customers reached by the marketing campaigns Optional: Number of partnerships created and, as applicable, the amount of cost-sharing received.	No comprehensive marketing campaigns implemented.	Over 50% percent of the targeted clients (the specific amount t.b.d) are acknowledging the information delivered through the marketing campaigns.	Market surveys	Interest of the targeted product and service providers to join the campaign.
<u>Outcome 4</u> Institutionalization of the support provided by the project, including monitoring, learning, adaptive feedback and evaluation.	An entity continuing the bioenergy market promotion after the project established and its funding secured The level of information available for adaptive management, for measuring the impact and for effective replication/ expansion of the project activities.	Discontinuing support at the end of the project. Inadequate information for measuring the impact and for adaptive management.	An entity continuing the bioenergy market promotion after the project established and its funding secured Required information available during the implementation of the project for adaptive management, for measuring the impact and for effective replication/ expansion of the project activities.	Project final evaluation Annual project reports	Successful completion of the prior project activities
Output 4.1 An updated baseline study, against which the impact of the project can be measured.	Status of the report.	Inadequate or outdated baseline information.	Finalized, updated baseline study.	Project reports	Selection of the right tools and methodologies for the baseline study and for monitoring the project impact.
Output 4.2 Project mid-term evaluation and other required reviews, including annual reports from continuing monitoring and evaluation of all the investment projects facilitated by the project	Status of the reports	Inadequate information for adaptive management.	Finalized mid-term evaluation and adequate management response to address the MTE observations and recommendations.	Project reports	Adequate monitoring, reporting and filing of the key documents to facilitate external reviews and evaluations.
Output 4.3 Adding the topic	The level of inclusion of	Bioenergy inadequately	Rural biomass energy increasingly	Project reports and final	See above

of rural biomass energy increasingly into the curricula of the relevant academic and other educational instititutions	bioenergy into the relevant curriculas	covered by the current curriculas	included into the curricula of the relevant academic and other educational institutions	evaluation	
Output 4.4 A Biomass Energy Association or another applicable entity continue to serve as a focal point for further promotional activities on a self-sustaining basis.	The existence and continuing effective operation of a bioenergy focal point after the project	No focal point for rural bioenergy available after the project	A rural bioenergy focal point established and continue its effective operation also after the project	Final evaluation	See above
Output 4.5 As needed, further elaboration and financing leveraged for applicable financial support mechanisms to continue the promotion of bioenergy, including, as applicable, carbon financing	The continuing availability of the required financial support, when needed.	The existing financing barriers continue to slow down the rural bioenergy development	Established financial support mechanisms continue to attract financing for bio-energy projects at the end of the project as per the market development targets set at the project objective level.	Final evaluation	See above
Output 4.6 Final project report consolidating the results and lesson learnt from the implementation of the different project components and recommendations for the required next steps.	Status of the final report	No consolidation of the results and lessons learnt.	Final project report consolidating the results and lesson learnt from the implementation of the different project component and recommendations for the required next steps.	Project reports and final evaluation	Continuing monitoring and reporting of the impact of the pilot projects by using the rights tools and methodologies as well as the experiences and lessons learnt during their implementation.
Output 4.7 Final project evaluation.	Status of the FE	No FE	Final evaluation finalized as per the specific UNDP and GEF requirements	Project reports	Adequate monitoring, reporting and filing of the key documents to facilitate external reviews and evaluations.

SECTION III: TOTAL PROJECT BUDGET, FINANCING AND WORK PLAN

The total costs of the proposed project have been estimated at USD 15,390,000 (without the PDF and unconfirmed cofinancing), of which total the GEF is requested to cover the incremental costs of USD 3,000,000 to share the technical assistance cost, project management and initial bioenergy technology (BET) market development costs, demonstrating the use of new technologies, business and financing models.

Out of the requested USD 3,000,000, the technical assistance activities will account for USD 1,800,000 consisting of the required awareness raising, stakeholder involvement, training, travel, local and international expert support, project management costs and the project monitoring and evaluation. This is complemented by a financial leveraging support package of USD 1,200,000.

The GEF financial leveraging support package will consist of resources, which can be used as loans or applicable credit enhancement instruments to support new or existing "Bioenergy Service Providers" (BSPs) to obtain financing for the targeted BET investments from different public and private entities. The further negotiations after the project entering into the work program have already leveraged an additional USD 1,760,000 from the Government of Egypt to support bioenergy, and which resources will be used together with the GEF funds to establish a pilot Bioenergy Development Fund (BDF) with the initial capital of close to USD 3,000,000. The draft operational criterial of the Fund are presented in Section IV, Part V.

Complementary financing is expected to be provided by ongoing rural development programs such as the UNDP-MISR initiative. In addition, UNDP Country Programme is directly contributing to the proposed GEF project with USD 150,000.

The performance and impact of the BDF will be closely monitored and the design fine-tuned, if needed. When the market matures, the GEF support can be gradually phased out and, as applicable, replaced with a broader Government program and incentive policy to support bio-energy by building on the financial support models demonstrated.

Table III-1, Project Financing

Outcome	Total USD	Baseline USD	GEF Incremental USD
Outcome 1: New business and financing models successfully introduced and tested	6,310,000	MSEA/EEAA: 2,790,000 MISR: 1,450,000 Others: 250,000 Total: 4,490,000	TA: 620,000 BDF: 1,200,000 Total: 1,820,000
Outcome 2: An enabling policy framework, effectively promoting rural bioenergy development adopted.	510,000	Spanish MDG-F: 350,000	160,000
Outcome 3: Enhanced capacity of the local supply chain to market and deliver sustainable rural bioenergy products and services, including financing.	6,890,000 (+ 100,000 not confirmed)	MSEA/EEAA: 6,430,000 NREA: 100,000[5] (not confirmed)	460,000
Outcome 4: Institutionalization of the support provided by the project, including monitoring, learning, adaptive feedback and evaluation.	330,000	UNDP: 70,000	260,000
Project Management	1,350,000	UNDP: 250,000 MSEA/EEAA: 800,000	300,000
GRAND TOTAL (with confirmed cofinancing)	**15,390,000**	**12,390,000**	**3,000,000**

[5] Estimated value of the in-kind cost-sharing of the NREA testing facilities.

Table III-2 Summary of Cofinancing [6]

Name of Co-financier (source)	Classification	Type	Amount	Description	Status*
Outcome 1:					
MSEA/EEAA	Government	Cash	USD: 1,760,000	MSEA/EEAA contribution in the capitalisation of the BDF	Confirmed
MSEA/EEAA	Government	In-kind and parallel	Activities: LE 5.69 million (USD 1,030,000) Management: LE 0.55 million (USD 100,000) Total: USD 1,130,000	MSEA/EEAA contribution for testing the small scale biomass gasification	Confirmed
MISR-Project (GoE, UNDP, Gov. of Netherlands, Gov't of Canada)	Mixed	In-kind & Parallel	Activities: USD 1,450,000 Management: USD 150,000	Funding for participatory planning at the community level + cost sharing of the bioenergy investments	Confirmed
Centurion Petroleum Corporation	Private	Cash	USD 250,000	Cost-sharing of investments	Confirmed
Outcome 2:					
Spanish MDG Fund	Bilateral	Parallel	Activities: USD 350,000 Management: USD 20,000	Support for energy policy reform to promote energy efficiency and renewable energy	Confirmed
Outcome 3:					
MSEA/EEAA	Government	In-kind & Parallel	Activities: LE 35,600,000 (USD: 6,430,000) Management: LE 3,500,000 (USD 630,000) Total: USD 7,060,000	EEAA activities to support the collection and compression of agricultural waste (Outcome 3)	Confirmed
NREA	Government	In-kind	USD 100,000	NREA laboratories for testing (Outcome 3)	An estimate - not confirmed
Outcome 4:					
UNDP	Agency	Cash	USD 70,000 (+ USD 80,000 for management)	Institutionalization of the results and required follow-upn and cost sharing of the project management costs	Confirmed
Sub-Total Co-financing (w/out Management)			**USD 11,340,000 + USD 100,000**		Confirmed Not confirmed

[6] In all the tables, for converting Egyptian Pounds into USD an exchange rate of 1 US$ = LE 5.54 has been used (as of Nov. 14, 2007)

Table III-3 Summary of Cofinancing of Program Management

Name of Co-financier (source)	Classification	Type	Amount	Description
MSEA/EEAA	Government	In-kind & parallel	LE 0.55 million (USD 100,000)	MSEA/EEAA management costs for testing the small scale biomass gasification
MISR-Project (GoE, UNDP, Gov. of Netherlands, Gov't of Canada)	Mixed	parallel	USD 150,000	MISR program management costs, as it applies for bioenergy related activities
Spanish MDG Fund	Bilateral	parallel	USD 20,000	Management of the energy policy reform component
MSEA/EEAA	Government	Parallel and In-kind	LE 3,500,000 (USD 630,000)	Management of the Rice Straw Compactor Support Program
MSEA/EEAA	Government	In-kind	USD 70,000	Project Director and other EEAA staff + related information dissemination, hosting of meetings etc.
UNDP	Agency	Cash	USD 80,000	Project Mgmt Office and Communication Cost-sharing
Sub-Total Co-financing for Management			**USD 1,050,000**	

Table III-3 Total Project Workplan and Budget in Atlas

Award ID:	00045899
Award Title:	Egypt – Bioenergy for Sustainable Rural Development
Business Unit:	EGY10
Project Title:	Egypt - Bioenergy for Sustainable Rural Development
Project ID and Pims number	00054347-Pims number 2284
Implementing Partner (Executing Agency)	Egyptian Environmental Affairs Agency (EEAA)

GEF Outcome/ Atlas Activity	Responsible Party/ Implementing Agent	Fund ID	Donor Name	Atlas Budgetary Account Code	ATLAS Budget Description	Amount Year 1 (USD)	Amount Year 2 (USD)	Amount Year 3 (USD)	Amount Year 4 (USD)	Amount Year 5 (USD)	Total (USD)	See Budget Note:
Outcome 1	**EEAA**	**62000**	**GEF**	71200	International Consultants Sht Term	10,000	20,000	25,000	20,000	15,000	90,000	
				71300	Local Consultants Sht Term	20,000	50,000	50,000	50,000	40,000	210,000	
				71400	Contractual services – Ind.	20,000	30,000	30,000	30,000	20,000	130,000	
				71600	Travel	3,000	5,000	10,000	8,000	4,000	30,000	1)
				72100	Contractual services - companies	20,000	20,000	20,000	20,000	20,000	100,000	9)
				72200	Equipment	30,000	4,000	2,000	2,000	2,000	40,000	2)
				72600	Grants	150,000	250,000	300,000	250,000	250,000	1,200,000	7)
				74200	Printing and publication costs	5,000	6,000	7,000	6,000	6,000	30,000	3)
				74500	Miscellaneous	2,000	2,000	2,000	2,000	2,000	10,000	4)
					sub-total GEF	**260,000**	**387,000**	**446,000**	**388,000**	**359,000**	**1,840,000**	
		62040	**Gov't**	72600	Grants	150,000	500,000	500,000	350,000	260,000	1,760,000	8)
					Sub-total Gov't	**150,000**	**500,000**	**500,000**	**350,000**	**260,000**	**1,760,000**	
			Private Sector	72600	Grants	50,000	50,000	50,000	50,000	50,000	250,000	8)
					Sub-total private sector	50,000	50,000	50,000	50,000	50,000	**250,000**	
					TOTAL OUTCOME 1	**460,000**	**937,000**	**996,000**	**788,000**	**669,000**	**3,850,000**	
Outcome 2	**EEAA**	**62000**	**GEF**	71400	Contractual services – Ind.	5,000	17,000	34,000	25,000	24,000	105,000	
				71600	Travel	2,000	2,000	2,000	2,000	2,000	10,000	1)
				72100	Contractual services - companies	5,000	10,000	10,000	5,000		30,000	9)
				74200	Printing and publication costs	1,000	3,000	2,000	2,000	2,000	10,000	3)
				74500	Miscellaneous	2,000	2,000	2,000	2,000	2,000	10,000	4)
					sub-total GEF	**15,000**	**34,000**	**50,000**	**36,000**	**30,000**	**165,000**	
					TOTAL OUTCOME 2	**15,000**	**34,000**	**50,000**	**36,000**	**30,000**	**165,000**	
Outcome 3	**EEAA**	**62000**	**GEF**	71200	International Consultants		10,000	10,000	10,000		30,000	
				71300	Local Consultants	10,000	10,000	20,000	15,000	15,000	70,000	
				71400	Contractual services – Individual	5,000	20,000	25,000	25,000	15,000	90,000	
				71600	Travel		2,000	3,000	3,000	2,000	10,000	1)
				72100	Contractual Services – Companies		70,000	70,000	30,000		170,000	9)
				72200	Equipment		10,000	10,000	10,000		30,000	5)

				74200	Printing and publication costs		10,000	10,000	10,000		30,000	
				74500	Miscellaneous		5,000	10,000	10,000	10,000	35,000	4)
					sub-total GEF	**15,000**	**137,000**	**158,000**	**113,000**	**42,000**	**465,000**	
					TOTAL OUTCOME 3	**15,000**	**137,000**	**158,000**	**113,000**	**42,000**	**465,000**	
Outcome 4	**EEAA**	**62000**	**GEF**	71300	Local Consultants	5,000	10,000	20,000	10,000	10,000	55,000	
				71400	Contractual services – Individual			10,000	5,000	10,000	25,000	
				71600	Travel		1,000	5,000	2,000	7,000	15,000	1)
				72100	Contractual services - Companies	5,000	10,000	20,000	10,000		45,000	9)
				74100	Professional Services		2,000	25,000	3,000	25,000	55,000	6)
				74200	Printing and publication costs		2,000	3,000	5,000	5,000	15,000	3)
				74500	Miscellaneous	2,000	5,000	5,000	5,000	3,000	20,000	4)
					sub-total GEF	**12,000**	**30,000**	**88,000**	**40,000**	**60,000**	**230,000**	
		4000	**UNDP**	71400	Contractual services – Individual.	4,000	4,000	4,000	4,000	4,000	20,000	
				74100	Professional Services			25,000		25,000	50,000	6)
					Sub-total UNDP	**4,000**	**4,000**	**29,000**	**4,000**	**29,000**	**70,000**	
					TOTAL OUTCOME 4	**16,000**	**34,000**	**117,000**	**44,000**	**89,000**	**300,000**	
Project Management	**EEAA**	**62000**	**GEF**	71400	Contractual services – Individual.	46,000	60,000	60,000	60,000	60,000	286,000	
				71600	Travel	2,000	3,000	3,000	3,000	3,000	14,000	1)
					sub-total GEF	**48,000**	**63,000**	**63,000**	**63,000**	**63,000**	**300,000**	
		4000	**UNDP**	72200	Equipment	7,000	2,000	3,000	5,000	3,000	20,000	
				72400	Communication	3000	3000	3000	3000	3000	15,000	
				73100	Rental and Maintenance of Equipment	2,000	2,000	2,000	2,000	2,000	10,000	
				72500	Office supplies	3,000	4,000	5,000	4,000	4,000	20,000	
				74500	Miscellaneous	3,000	3,000	3,000	3,000	3,000	15,000	4)
					Sub-total UNDP	**18,000**	**14,000**	**16,000**	**17,000**	**15,000**	**80,000**	
					TOTAL PROJECT MANAGEMENT	**66,000**	**77,000**	**79,000**	**80,000**	**78,000**	**380,000**	
Total	**62000**	**GEF**				**350,000**	**651,000**	**805,000**	**640,000**	**554,000**	**3,000,000**	
Total	**62040**	**Gov't**				**150,000**	**500,000**	**500,000**	**350,000**	**260,000**	**1,760,000**	
Total	**4000**	**UNDP**				**22,000**	**18,000**	**45,000**	**21,000**	**44,000**	**150,000**	
Total		**Private Sector**				**50,000**	**50,000**	**50,000**	**50,000**	**50,000**	**250,000**	
Project Total						**572,000**	**1,219,000**	**1,400,000**	**1,061,000**	**908,000**	**5,160,000**	

Budget Notes:

Number	Note
1	The overall project management will be centrally based in Cairo, while the project sites will be in rural areas within 4 -5 Governorates at a distance between 200 - 600 km from Cairo, which is resulting some travel costs for the project staff (DSA and others). The possibility of establishing sub -offices in governorates with large operations will be explored in the due course of implementation. The travel budget line will cover local travel for project staff and local consultants site visits. This budget line will also cover the travel costs of International Consultants.
2	**Including a project vehicle and required mobile measuring, installation and maintenance equipment to monitor and optimize the performance of the pilot bioenergy units installed. The v** ehicle is considered as an absolute necessity, since the project's PMU will be located in Cairo, while the actual bioenergy units are in remote and off-road rural areas. Renting a car that would be both durable enough and would be able to accomodate the required measuring and maintenance equipment would become significantly more expensive.
3	Including public awareness raising and marketing suppor t as well as training materials
4	**Miscellaneous expenses to cover the costs of training workshops and stakeholder consultations meetings**
5	Required equipment for training of operators, installers and other supply side professionals
6	**Professional services to cover costs of annual external financial audit fees, independent mid term and final evaluations by international and national evaluators**
7	**GEF contribution to the Bio -energy Development Fund (BDF) which will be used as loans to Business Service P roviders (BSF)**
8	**Government and others contribution to the Bio -energy Development Fund which will be used as grants to complement the GEF loans to BSPs**
9	**Can include both international and national consultanting firms/institutions on as needed basis**

Table III-4 Draft timeline of the outputs

Outcome	Output	Year 1	Year 2	Year 3	Year 4	Year 5
1. New business and financing models successfully introduced and tested by using appropriate technical solutions	**Output 1.1** An updated market analysis and finalized plans and operational manual for the project's technical assistance and financial component, respectively	X				
	Output 1.2 The initial awareness raising and marketing successfully finalized (for replication the awareness raising and marketing under Outcome 3).	X				
	Output 1.3 The Bioenergy Development Fund successfully announced and launched.	X				
	Output 1.4 The BET systems installed as per the project annual and final targets.		X	X	X	X
2. An enabling policy framework, effectively promoting rural bioenergy development adopted.	**Output 2.1** An updated study on the technical, economic and financial feasbility of the different bioenergy technologies to contribute to meeting the rural energy needs and to reduce the open burning of agricultural residues in the field	X				
	Output 2.2 Enhanced awareness of and established policy dialogue with the key stakeholders and decision makers on the results of the study and the socio-economic benefits of BET systems.	X	X			
	Output 2.3 A draft policy paper highlighting the barriers and recommending improvements for the current policy framework to develop rural bio-energy market.		X			
	Output 2.4 Continuing consultations, promotional events, high-level meetings and other measures to facilitate the adoption of the recommendations.		X	X	X	X
3. Enhanced capacity of the local supply chain to market and deliver sustainable rural bioenergy products and services, including financing.	**Output 3.1** An updated survey and evaluation of the existing (or potential future) market players and their capacity to produce rural biomass energy related products and services.	X				
	Output 3.2 Channels and opportunities for information exchange, networking, match making missions and conditions for different local and foreign entities to explore opportunities for co-operation created		X			
	Output 3.3 A manual for the development and financing of rural bioenergy projects in Egypt		X			
	Output 3.4 An information and marketing package tailored for the targeted co-financing sources to support the BSPs and related awareness raising / match making finalized		X	X	X	X
	Output 3.5 Draft technical standards and certification system (to be adopted either as a voluntary or as a mandatory quality control scheme – see outcome 2).				X	X
	Output 3.6 Trained and, as applicable, certified product and service providers, including manufacturers, technicians etc.			X	X	X

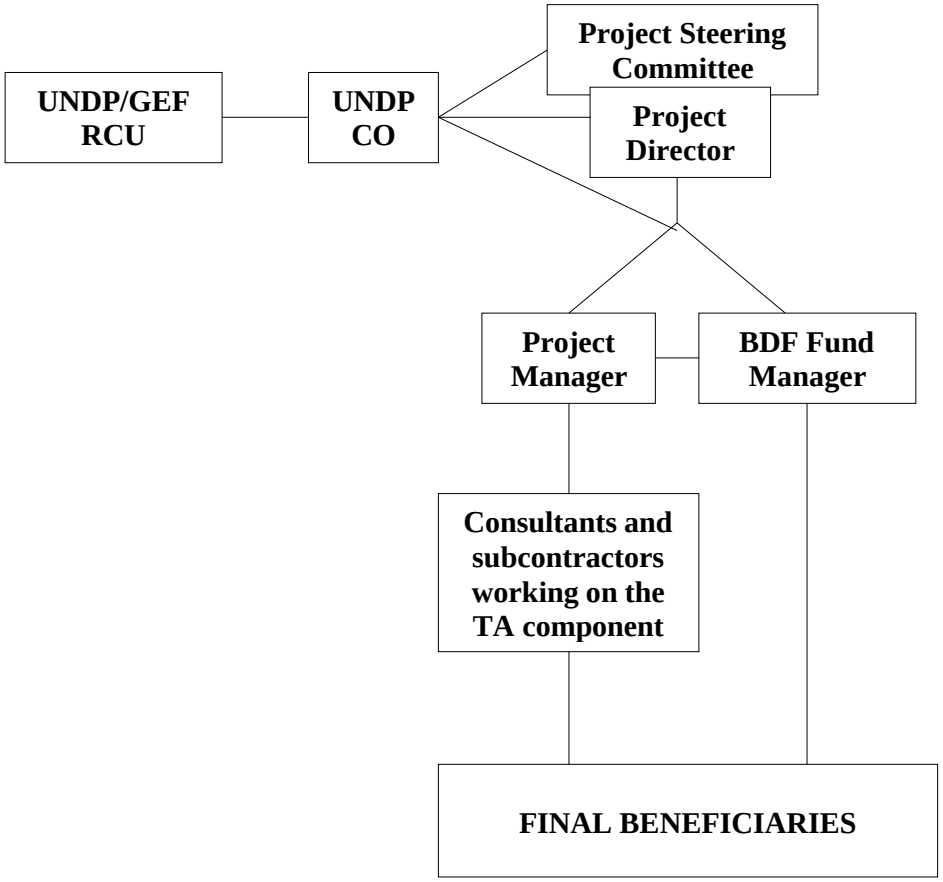
	Output 3.7 A joint public awareness raising and marketing campaign with supply side product or service providers for the targeted customers		**X**	**X**	**X**	**X**
4. Institutionalization of the support provided by the project, including monitoring, learning, adaptive feedback and evaluation.	**Output 4.1** An updated baseline study, against which the impact of the project can be measured.	**X**				
	Output 4.2 Project mid-term evaluation and other required reviews, including annual reports from continuing monitoring and evaluation of all the investment projects facilitated by the project		**X**	**MTE**	**X**	**X**
	Output 4.3 Adding the topic of rural biomass energy increasingly into the curricula of the relevant academic and other educational instititutions			**X**	**X**	**X**
	Output 4.4 A Biomass Energy Association or another applicable entity continue to serve as a focal point for further promotional activities on a self-sustaining basis.				**X**	**X**
	Output 4.5 As needed, further elaboration and financing leveraged for applicable financial support mechanisms to continue the promotion of bioenergy			**X**	**X**	**X**
	Output 4.6 Final project report consolidating the results and lesson learnt from the implementation of the different project components and recommendations for the required next steps.					**X**
	Output 4.7 Final project evaluation.					**X**

SECTION IV: ADDITIONAL INFORMATION

Part I: Other agreements

The endorsement and cofinancing letters presented as a separate Annex.

Part II: Organigram of Project



Part III Stakeholder Involvement Plan

The list of the key stakeholders sought to be involved are summarized in the table below, together with the description of their envisaged role and way of invovement. Several of these organizations have been already consulted in different elements of the project.

Depending on their contribution expected, some of the above-mentioned stakeholders can be asked to join the PSC, while others can continue to serve as project advisors, contractors or other implementing partners. Some of them can join committees to be established locally at the Governorate or village level to plan and monitor the implementation of the BET systems in the field.

Table IV-I Stakeholder Involvement Plan

Stakeholder	**Envisaged Role in the Project**
Government Institutions	
Ministry of State for Environmental Affairs / Egyptian Environmental Affairs Agency	Executing Agency Coordination of inputs and efforts among stakeholder Co-financing: - Loans provided to young graduates to develop business in collection and compaction of agricultural residues in collaboration with SFD - Two gasification units owned by EEAA will be at the disposal of the project - Integration of the project activities into nation wide initiatives on solid waste management.
Ministry of Local Development	Responsible for the development of the rural communities
Ministry of International Co-operation	Support in leveraging other, international financing resources for supporting the project activities.
Supreme Council of Energy	A key partner to discuss the energy pricing, possible incentives and the overall energy policy issues.
Ministry of Finance, Ministry of Petroleum and Ministry of Energy.	See above
Rural Electrification Authority (REA).	Rural Electrification Authority (REA) is concerned with the extension of electricity from the main grid to rural areas.
Egyptian Electric Utility and Consumer Protection Regulatory Agency	The Egyptian Electric Utility and Consumer Protection Regulatory Agency, is responsible for studies on electricity prices and regulation of the construction of power project by private and other enterprises
New and Renewable Energy Authority (NREA), Ministry of Electricity Responsible entity for promotion of using renewable energy resources at the national level, incuding a unit for bio-energy	The New and Renewable Energy Authority (NREA), established in 1986, serves as the focal point for expanding the use of renewable sources of energy in Egypt and is implementing projects involving the use of wind energy, solar energy and biogas. NREA has a well-equipped bioenergy testing laboratory and has also implemented a project on briquetting of agricultural residues (especially cotton stalks). During the project implementation, NREA is expected to support the with qualified national experts and making available its testing laboratories for performance checking and quality control.
Agricultural Research Center (ARC) and the Institute of of Soil, Water and Environment	ARC will support the project with large experience in biogas technologies in Egypt including an adapted design for Egyptian conditions developed by the ARC. ARC can also support the project with trained technicians on providing advisory services to farmers adopting BETs. The Institute of Soil, Water and Environment of the ARC has also been involved in experimental composting..
Other Academic and Research	Other Academic and Research Institutions, including the National Research

Institutions	Centre, will provide their latest results on the adaptation of BET systems to Egyptian Conditions
Specific Financing Entities	Identified candidates to manage the BDF
National Bank of Egypt (NBE)	A government owned bank, which is the largest Egyptian bank in terms of deposits and loans and with a network of over 361 branches and outlets. spread over the country. Extensive experience in managing soft credit lines for other international donors and development banks.
Commercial International Bank (CIB)	A joint venture established in 1975 between the National Bank of Egypt (51%) and the Chase Manhattan Bank (49%). Experience from managing soft credit lines for other international donors or developoment banks (such as KfW) starting in 1992.
Principal Bank for Development and Agricultural Credit (PBDAC)	Established in 1931, the Bank provides seasonal, investment loans and trade-related credit to the agricultural sector. It also finances private companies, agricultural cooperative societies, agents and distributors to ensure the availability of production inputs. The bank offers special credit schemes for rural women and young farmers. Since the liberalisation of the economy in the beginning of the 90s, the bank has been restructured and the activities have been diversified. So deposit facilities like current accounts for companies and governmental organizations, passbook savings and certificates of deposits for the general public are also part of the banking. Other features offered are storage space and services throughout the country at favourable rates.
Social Fund For Development (SFD)	The Social Fund for Development (SFD) is an autonomous governmental institution established in 1991 to support Government's Economic Reform and Structural Adjustment Program. The SFD works under direct supervision of the Prime Minister and has five core programmes: (a) the Public Works Programme (PWP); (b) the Community Development Programme(CDP); (c) Small Enterprise Development Programme (SEDO); (d) the Human Resources Development Programme (HRDP), and (e) Institutional Development Programme (IDP). In the UNDP/GEF Project, SFD's role is seen as: • A candidate to manage the BDF; • can support SMEs in the bioenergy business by establishing business incubators for training small investors on operation and management of BETs. ; • can make available additional funds for loans on top of the BDF funds for replication on the national level based on the success of the GEF project demonstrations. • may provide community development support as grants for initial pilots to demonstrate technical and financial feasibility of BETs services (Requested by SFD to be negotiated after GEF approval)
NGOs	Several National NGOs with previous experience in BETs can play a major role in the outreach of technologies to the household level in rural Egypt, and can act as managers of small grants or service providers for BETs in some communities. NGOs can also provide in-kind contribution in the establishment of the BETs such as labour effort and construction materials
Bassisa Community Development Society,	Bassisa Community Development Society is a non-governmental society with good experience in household biogas plants. The society has built several plants in Bassisa, South Sinai, and is working on the basis of shared costs and fee-for-service concept. A candidate to strengthen its operations as a Bioenergy Service Provider (BSP) with project support.
Children and Development Society, Assuit	A non-governmental society located in Assuit, which has wide experience in community work and mobilizing people in rural areas for implementing development projects. The society was of great help during field surveys in Assuit for the proposed project within the framework of the PDF-B phase.

The Coptic Evangelical Organization for Social Services (CEOSS),	The CEOSS is a non-governmental society having experience in establish ing household biogas plants in Minia and Beni Suef Governorates. A candidate to strengthen its operations as a BSP with project support
International Centre for Environment and Development (ICED)	ICED was established in 1993. It has experience in enviro nmental matters and has executed several projects on solid waste management, financed by World Bank, Italian Co-operation and Social Fund for Development.
Private Commercial Sector	Private Sector can will play a major role in investing and providing BE T services after the project will remove restricting legislative, financial and technical barriers. Foreign BET service providers can also negotiate with the government on the construction of larger facilities for electricity generation by using agricultu ral waste, should the necessary preconditions for that exist.
International Reseach Insititutions	Indian and Chinese institutions such as The Energy and Resources Institute in India (TERI) will be contacted to provide technical assistance, sharing experience and facilitating technology transfer.
Public media	Channel for public awareness raising and marketing activities
Other parallel projects	
Organization for the Reconstruction and Development of the Egyptian Village (ORDEV),	The Organization for t he Reconstruction and Development of the Egyptian Village (ORDEV) was established in 1973 and it has been implementing a comprehensive programme for rural development since 1994. The programme, named as "El-Shorouk Programme" (Shorouk in Arabic means sunri se), is based on co-operation between the Government and the local rural communities. It encourages public participation in initiating, planning, financing, implementing and evaluating different development projects. Public participation and voluntary effo rts are considered as the core of the Shorouk programme, supplemented by Government financial and technical assistance. Under the Shorouk Programme, projects are classified into three main categories: (a) infrastructure projects (supply of drinking water, sanitation services, roads, irrigation and drainage system, communications, transport, electricity, etc); (b) human and institutional development projects (education, health services, family planning, training, child and mother care, etc); and (c) economic development projects (agricultural mechanization, poultry projects, vegetable and fruit packaging and processing, rural industries, etc).
MISR Programme A UNDP/Ministry of Planning initiative, funded by several donors, to support participatory planning and decentralization in the implementation of rural development activities in the Egyptian Villages	A recently launched project aiming at rural development (especially poor areas). The project is to focus on ten rural areas to provide them with services and infrastructure. The estimated costs of the project are L.E. 140 million over six years. The MISR Programme is expected to provide the GEF Project with an established mechanism for participatory planning as the main venue for promoting BETs in rural Egypt within local communities. MISR Programme will build capacity of local communities on management of BET systems on the community level and/or management of funds for BETs on the household level. MISR Programme will also co-finance demonstrations and later on support mobilization of additional resources for replications in case of success of demonstrations.
Joint UN Climate Change Risk Management Programme supported by the UNDP/Spanish MDG Achievement Fund	Through its Energy Policy Reform component and co-operation with the Supreme Energy Council, a main partner for promoting the establishment of a more conducive policy framework for bioenergy.

Part IV: Terms of Reference for Key Project Personnel

Project Steering Committee (PSC)

Duties and responsibilities

The Project Steering Committee (PSC) is the main body to supervise the project implementation in accordance with UNDP rules and regulations and referring to the specific objectives and the outcomes of the project with their agreed performance indicators;

The main functions of the PSC are:

- General monitoring of the project progress in meeting of its objectives and outcomes and ensuring that they contionue to be in line with the national development objectives;
- Facilitating the co-operation between the different Government entities, whose inputs are required for succesful implementation of the project, ensuring access to the required information and resolving eventual conflict situations raising during the project implementation when trying to meet its outcomes and stated targets;
- Supporting the elaboration, processing and adoption of the required instititional, legal and regulatory changes to support the project objectives and overcoming of the related barriers;
- Facilitating and supporting other measures to minimize the identified risks to project success, remove bottlenecks and resolve eventual conflicts;
- Approval of the annual work plans and progress reports, the first plan being prepared at the outset of project implementation;
- Approval of the project project management arrangments; and
- Approval of any amendments to be made in the project strategy that may arise due to changing circumstances, after the careful analysis and discussion of the ways to solve problems.

PSC Structure and Reimbursement of Costs

The PSC will be chaired by the Project Director or the EEAA CEO, if different. The PSC will include a representative from each of the key Ministries and Agencies involved in the project, a representative of UNDP and, as applicable, representatives of project's other cofinancing partners. Other members can be invited by the decision of the PSC, however by taking care that the PSC still remains operational by its size. The project manager will participate as a non-voting member in the PSC meetings. When and as needed, the meetings of the PSC can be extended to Technical Advisory Group meetings

The costs of the PSC's work shall be considered as the Government's or other project partners' voluntary in-kind contribution to the project and shall not be paid separately by the project. Members of the PSC are also not eligible to receive any monetary compensation from their work as experts or advisers to the project.

Meetings

It is suggested that the PSC will meet at least twice a year, including the annual TPR meeting. A tentative schedule of the PSC meetings will be agreed as a part of the annual work plans, and all representatives of the PSC should be notified again in writing 14 days prior to the agreed date of the meeting. The meeting will be organized provided that the executing agency, UNDP and at least 2/3 of the other members of the PSC can confirm their attendance. The project manager shall distribute all materials associated with the meeting agenda at least 5 working days in prior to the meeting .

National Project Director

As a representative the Government and project's executing agency, the National Project Director is having the main responsibility to ensure that the project is executed in accordance with the project document and the UNDP guidelines for nationally executed projects.

His/her main duties and responsibilities include:

- Supervising the work of the Project Manager through meetings at regular intervals to receive project progress reports and provide guidance on policy issues;
- Certifying the annual and, as applicable, quarterly work plans, financial reports and requests for advance of funds, ensuring their accuracy and consistency with the project document and its agreed amendments;
- Authorizing the project contracts, following the approval of UNDP;
- Unless otherwise agreed, chairing the Project Steering Committee and representing the project in other required meetings;
- Taking the lead in developing linkages with the relevant authorities at national, provincial and governmental level and supporting the project in resolving any institutional or policy related conflicts that may emerge during its implementation;

Project Manager (full time)

Duties and responsibilities:

Operational project management in accordance with the project document and the UNDP guidelines and procedures for nationanally executed projects, including:

- General coordination, management and supervision of project implementation;
- Managing the procurement and the project budget under the supervision of the Executing Agency and with support from UNDP to assure timely involvement of local and international experts, organisation of training and public outreach, purchase of required equipment etc. in accordance with UNDP rules and procedures;
- Submission of annual Project Implementation Reviews and other required progress reports (such QPRs) to the PSC, Executing Agency and the UNDP in accordance with the section "Monitoring and Evaluation"of the project document;
- Ensuring effecetive dissemination of and access to information on project activities and results, (including an regularly updated project website);
- Supervising and coordinating the contracts of the experts working for the project;

- Communicating with international investors and financial organizations to define fields of cooperation and attracting additional financing in order to fulfill the project objectives; and
- Ensuring successful completion of the project in accordance with the stated outcomes and performance indicators summarized in the project's logframe matrix and within the planned schedule and budget otherwise.

Expected Qualifications:

- Advance university degree and at least 15 years of professional experience in the specific areas the project is dealing with, including good knowledge of the international experiences, state of the art approaches and best practices in bioenergy and their sustainable promotion (by applying different policy measures, new financing mechnisms etc.)
- Experience in managing projects of similar complexity and nature, including demonstrated capacity to actively explore new, innovative implementation and financing mechanisms to support the targeted bioenergy technologies and leveraging of financing for them;
- Demonstrated experience and success on the engagement of and working with the private sector and NGOs, creating partnerships and leveraging financing for activities of common interest;
- Good analytical and problem solving skills and the related ability to adaptive management with prompt action on the conclusion and recommendations coming out from the project's regular monitoring and self-asssesment activities as well as from periodical external evaluations;
- Ability and demonstrated success to work in a team, to effectívely organise it works and to motivate its members and other project counterparts to effectively work towards the project's objective and expected outcomes;.
- Good communication skills and competence in handling project's external relations at all levels; and
- Fluency in English and Arabic languages.
- Familiarity and prior experience with the specific UNDP and GEF requirements are considered as assets

Project Assistant (full time)

Duties and responsibilities:

Supporting the project manager in the implementation of the project, including:

- Responsibility for logistics and administrative support of the project implementation, including adminstrative management of the project budget, required procurement support etc.
- Maintaining the business and financial documentation up to date, in accordance with UNDP and other project reporting requirements;
- Organizing meetings, business correspondence and other communication with the project partners;

- Supporting the project outreach and PR activities in general, including keeping of the project web-site up to date;
- Managing the projects files and supporting the project manager in preparing the required financial and other reports required for monitoring and supervision of the project progress;
- Supporting the project manager in managing the contracts, in organising correspondance and in ensuring effective implementation of the project otherwise

Expected Qualifications:

- Fluent in English and Arabic
- Demonstrated experience and success of work in a similar position
- Good administration and interpersonal skills
- Ability to work effectively under pressure
- Good computer skills

International Project Adviser(s) (part time)

Duties and Responsibilities:

Support UNDP and the project management to monitor the progress of the project and its different subcomponents, and, as needed, build the capacity of the local experts working for the project to successfully implement the project activities ensuring that they comply with the agreed benchmarks and success indicators of the project as well as international best practices and lessons learnt.

The specific responsibilities include, among others to:

- support the local project team in organising the implementation of the different sub-components of the project at the inception phase and after that, including support to the project manager in the preparation of the project inception report and the annual work plans, drafting of Terms of Reference for the national and, as needed, additional international experts and subcontractors, required tender documents etc;
- support the project manager in supervising the work of the contracted individual experts and companies, including review of the feasibility studies and the technical design, financing and implementation arrengements of the planned pilot projects;
- support the project manager in arranging co-operation with the current project partners and, as applicable, in establishing new, additional national and/or international partnerships to support the project goals and objectives;
- support the local project team in monitoring and evaluating the performance and outcome of the pilot projects under implementation;
- monitor the progress of the project and participate in developing periodic progress reviews and, as applicable, the annual Project Implementation Reviews;
- train personally or, as needed, organize other training for the local stakeholders to successfully implement the project and to meet its capacity building objectives; and
- provide advice on the required institutional, legal and regulatory changes to support the reaching of the stated outcomes of the project and provide other required advice on the

succesful implementation of the specific project subcomponents and activities by drawing from the international lessons learnt and best practices.

Expected Qualifications:

- A university degree in the area the project is dealing with;
- Demonstrated experience and success in supporting similar projects (or its subcomponents) in other GEF programme countries;
- Good knowledge of the international experiences, state of the art approaches and best practices in the specific areas the project and its subcomponents are dealing with;
- Good analytical skills and effective communication and training skills and competence in handling external relations at all levels;
- Ability to work in a team and to motivate other team members and counterparts;
- Fluency in english, including the ability to draft and edit required project documentation
- Familiarity with the specific UNDP and GEF requirements is considered as an asset.

Part V Description of the Proposed Bioenergy Development Fund (BDF)

Background

The energy consumption patterns and energy mix in rural areas of Egypt have changed considerably over the past three decades. In lighting, kerosine has been largely replaced by electricity. For cooking, kerosine and LPG have become primary fuels, while the traditional use of fuel wood and agricultural waste is estimated to account currently for less than 20%. Apart from some pilot installations, the use of modern bioenergy technologies such as biogas digesters or gasification is still practically absent, despite the significant potential that the agricultural waste would pose for rural energy production in Egypt.

While the strong Government support by the provision of subsidized electricity and fossil fuels has greatly improved the quality of energy supply in many rural areas, there are many communities that still do not have adequate access to affordable or secure energy supply. The fossil fuel prices are also expected to continue to increase, thereby creating an additional burden to the already stretched family budgets, while the subsidies, on the other hand, continue to burden the national budget.

The GEF Council approved in August 2006 a project "Egypt - Bionergy for Sustainable Rural Development" with a USD 3 million grant from the GEF. The objective of the project is to promote the use of agricultural waste as an economically and environmentally feasible alternative energy source to kerosine, LPG or diesel oil in rural communities by relying on modern technologies such as biogas digesters and, as applicable, biomass gasifiers or combustion plants. This objective is to be achieved by (i) demonstrating the technical and, in particular, the economic and financial feasibility of selected bioenergy technologies on the basis of new business and financing models; (ii) supporting the development and adoption of an enabling policy framework to implement and leverage financing for the recommended strategies; iii) building the capacity of the supply side to market, finance and deliver rural bioenergy services; and iv) institutionalizing the support provided to facilitate sustainable growth of the market after the end of the project.

While efforts have been made to introduce similar technologies in Egypt already earlier, these attempts have typically suffered from a too much technology driven focus without adequate follow up during the operation, and without recognizing or addressing those broader policy, capacity, financing and institutional barriers that stay in a way for sustainable market transformation. The project seeks to take lessons learnt from these previous attempts into account and to initiate a more sustainable market transformation, which is also linked to the overall social and economic development needs of the targeted rural communities.

By its successful completion, the project seeks to contribute to a) alleviation of poverty in rural areas by promoting their economic and social development and, as a part of that, by creating additional job opportunities; b) improved environmental conditions through better and environmentally sound management of agricultural and other domestic solid waste; and c) reduction of GHG emissions through substitution of fossil fuels and better management of organic waste.

Assessment of the Financial Feasibility and Different Financing Options of Selected Bionenergy Plants

As a part of the project preparatory phase, the assessment[7] of the technical, economic and financial feasibility of selected bioenergy technologies (BETs) concluded that in selected market areas and under otherwise favorable conditions the BETs can be economically feasible even in the current, quite challenging market environment with subsidized fossil fuel and electricity prices, but the non-availability of suitable long term credits and required long pay back periods in general are still posing a barrier to financing of BETs. As the goal should be to keep the monthly spending of the targeted beneficiaries lower than their current spendings on competing energy sources, this is seldom possible with the financing options requiring a payback period of under 5 years. The calculated lifetime of most new BETs promoted under this project is 15 years and the required simple payback typically between 5-10 years rather than under 5 years.

There are basically two ways of addressing this barrier: 1) to lower the initial capital costs with an appropriately sized capital subsidy, which can be phased out when the market develops further and/or 2) to facilitate the establishment of new, concessional lending schemes, which would allow longer payback periods with lower interest rates than the ones currently in the market. For the first option, the level of required investment support in the current market environment of Egypt to effectively support the initial market development phase of BETs was estimated to be in the range of 20-40%, which is comparable with the experiences from other countries. For the second option, credits up to 10 years should be made available with concessional interest rates, which would reduce the need for up-front capital subsidies. In both cases, the direct financial savings for the national economy by saved fossil fuel subsidies are evident, which should encourage also the Government participation in these support schemes.

As the implementation mechanism, the project is encouraging the local business development and maximum private sector participation in developing and promoting the rural bioenergy market through the concept of supporting professional Bionergy Service Providers (BSPs). These would be local NGOs, SMEs and other community based organisations interested in developing the rural bioenergy market as a commercial or semi-commercial activity, provided that adequate framework conditions and initial support to kick-start the market are in place. The project seeks to create these conditions by providing technical asistance for the initial market development as well as by creating a specific Bioenergy Development Fund, which can provide concessional funding for and share the risks with the new BSPs and their financiers at the initial market development phase as well as to leverage additional financing from outside the Fund.

Bioenergy Development Fund (BDF)

The purpose of the Fund is to support the development of the rural bioenergy market. It will consist of resources, which can be used as equity, loans or applicable credit enhancement instruments such as partial grants or guarantees to support new or existing "Bioenergy Service Providers" (BSPs) and to leverage additional financing for the targeted BET investments from the different public and private lending institutions.

[7] For further details, see the report "Pre-feasibility studies and draft business plans of selected bio-energy applications in Egypt", April 2006.

The initial amount to be invested into the Fund by the Government of Egypt and UNDP/GEF will be USD 3. million, including:

- USD 1.76 million from the Ministry of Environment and the Egyptian Environmental Agency in co-operation with the Ministry of International Co-operation, by using the resources originating from the Italian Environmental Debt Swap Program; and

- USD 1.2 million from the GEF (complementing the USD 1,8 million TA grant)

- USD 250,000 from Centurion Petrolum Corporation

The implementation is proposed to be launched in two phases:

1) For the pilot phase to be completed during the first 18 months of project implementation, the project has set the target to support the construction and starting of operation of 50 family size biogas units, 1-2 community size biogas unit producing gas for cooking and 1-2 community size biogas unit producing electricity with the total, estimated investment needs of up to USD 100,000.

The required share of the grants[8] in covering the initial investment costs of these pilot projects is expected to be higher than during the actual follow-up phase in order to overcome the initial doubts and public acceptance barriers and to get the first projects rapidly underway to start the collection of the required information about their operational performance and costs for further market development needs. For ensuring ownership and for increasing the demonstration value of the projects, however, it is considered as important that the funds are not all given as grants to the final beneficiary, but maximum cost recovery and a "fee for service" model will be introduced from the very beginning. Also, the use of contingent grants rather than simple non-recoverable grants shall be considered to overcome the initial, real or perceived, risks of the final beneficiaries.

2) For the follow up phase, the project has set a target to facilitate by the end of the project (over the next 5 years) the installation of at least 1,000 family size, 10 community size and 2 farm scale biogas units. For the gasification and/or combustion plants, the target has been set as 4 MWe of additional installed capacity by the end of the project. With these targets, the minimum financing needs for this follow-up phase would be in the range USD 4-5 million[9].

For the financing of this follow-up phase, the grants are gradually to be reduced or phased out and replaced with more sustainable financing mechanisms, including loans, possibly equity and partial guarantees to leverage additional resources from the financial market outside the Fund. In this respect, adequate risk mitigation by good banking practices will also be sought from the very beginning.

[8] by using the resources allocated by the MoE for this purpose - the final assessment of the required share of the grant financing to be done at the outset of project operations on the basis of more detailed feasibility studies and clarification of other cost-sharing opportunities of the particular projects to be con sidered for the pilot phase.

[9] By building on the initial investment cost estimates of the BTG report (see Part VI)

During the follow-up phase, efforts will be exerted to gradually complement the project funds by others, including, as applicable, specific Government funds, commercial or semicommercial banks and others to meet longer term replication targets of the project. In this context, possibility for leveraging CDM financing will also be explored

The investment project seeking to benefit from the resources of the Fund will be solicited and supplied with technical assistance from the project in addition to the financial support. Over the 5 year duration of the project, this is expected to provide technically and financially efficient models for replication and further the adoption of the bionergy technologies promoted for energy generation in the rural communities.

The longer term replication potential has been estimated at up to 63000 family scale, 3800 community scale and close to 70 farm scale biogas plants as well as as well as over 1500 gasification plants (or combustion plants with corresponding capacity).

Draft Operational Criteria of the Fund

- Eligible applicants are local private sector entities, NGOs and other community based organisations, which can act as professional Bioenergy Service Providers (BSPs) with concrete investment and business plans for increasing the bioenergy production in rural communities on a "fee for service" basis by relying on modern technologies;

- Eligible bioenergy projects or project portfolios are biogas projects (anaerobic digestion) of various size (family, community or farm scale), biomass combustion and, as applicable, gasification[10], with or without electricity generation;

- For smaller family scale projects, project portfolios can be proposed for funding. Other applications will be reviewed on a project by project basis. A monitoring and verification protocol to monitor and verify the CO_2 savings during the operation is to be attached to the funding request together with the required feasibility studies, investment and business plan(s);

- The resources of the Fund can be used as equity, loans or applicable credit enhancement instruments such as partial guarantees to leverage financing from other financing institutions. The share of each instrument in the final portofolio will depend on the market needs and opportunities, however so, that the Fund's equity investments shall not exceed 20% of the total resources of the Fund. The Fund's equity share in any single project shall also not exceed the equity share of project's principal beneficiar(y/ies).

- In addition, up to 1/3 (or USD 0,96 million) of the Fund's initial resources can be used as market incentives to accelerate the early market development phase and to build up the initial start-up capital of eligible BSPs in conformity with their verified investment and business plans[11]. This capital grant support for any single project after the pilot phase is not

[10] If applying, specific attention in the case of gasification projects will be put on ensuring that adequate documentation and/ or securities are in place to back up the technical performance of the technology

[11] The use of GEF resources for this purpose is limited to USD 150,000 in total and shall not exceed 20% of the total investments costs of the applicant project.

expected to exceed 50% of the total size of the investment and is expected to be gradually reduced when the Fund's operations proceed further.

- The use of GEF reources within the Fund is limited to loans or partial guarantees with the exception of an amount equal to USD 150,000, which can be used for other equity or grant based instruments. The total amount of UNDP/GEF funds to be invested in any single project shall not exceed USD 150,000. The GEF resources are also to be primarily used for financing the "bioenergy part" of the investment, to the extent that this can be separated[12].

- For each project, a minimum contribution of 20% of the project owner or final beneficiary is expected.

- In the case of loans, the interest rate has been estimated to be at around 6%[13] and the maximum loan duration 5 - 10 years with a grace period of up to 12 months. These figures are to be reviewed and, as applicable, revisited at the outset of project operations on the basis of an updated market assessment and more detailed contract negotiations with the selected financial intermediary, and after that on an annual basis. For guarantees, an annual fee to be added into the interest rate will also be discussed in further detail at the outset of project operations. In both cases, the fees and the interest rates have to be set as adequate to cover the direct management costs of the Fund and to maintain the real capital value of the revolving part of the Fund. Similarly, the real value of the Fund's equity shares is sought to be maintained and revolved back to the Fund at the appropriate time of sale. This, however, by recognising that the acceptable risks with any equity contribution can be higher than in the case of loans or guarantees

- The performance and impact of BDF will be closely monitored and the design fine-tuned, if needed[14]. When the market matures, the Fund's support can be gradually phased out or, as applicable, replaced with a broader Government program and incentive policy to support bioenergy by building on the financial support models demonstrated.

- The loan and other financial support applications received will be reviewed and approved jointly by the Project Management Unit and the financing entity managing the BDF and reported to PSC twice a year.

Management of the Fund

- The management of the Fund will be trusted with a financing entity to be selected at the outset of project operations on the basis of most competitive offers and fit with the other operations of that financing entity.

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[12] For instance, in the projects using biogas for electricity generation, the GEF funds are to be used for financing the investments required for biogas production, while the costs of the diesel gensets and other related costs are to be financed by project's cofi nancing resources (For further details, see the comments of the GEF Council members for the June 2006 Work Program submission and the related UNDP response).

[13] On the basis of the prelimimary consultations with a few candidate banks that have offered to manage the Fund, the credit premium to be charged by the banks on the outstanding loans was estimated to be between 3 and 4 %, while the other fees and commissions would add on this between 1 and 2 % per annum

[14] With the exception of the possibil ity to increase the GEF contribution of USD 150,000 for the "market development incentives"

- The Fund Manager, in co-operation with the PMU, is expected to actively explore and combine the use of the different instruments allowed by the Fund in structuring financing for eligible bioenergy projects by using Fund's own resources as well as by leveraging other resources (e.g. by using Fund's equity investment or partial guarantees) with an objective to maximize the number of projects to be supported and sustainable growth of the market as a results of the successes to be shown. The primary success criteria to be monitored in this respect will be:

  a) the amount of investments facilitated by the Fund;
  b) the amount of external resources leveraged for it in addition to Fund's own resources; and
  c) the amount of funds recovered into the Fund

- The Fund Manager is expected to maintain the real value of the resources assigned for the revolving part of the Fund. This is to be achieved by applying their normal risk management, due diligence and other credit review procedures when evaluating and deciding for the use of the funds as well as to initiate their normal procedures in the case of loan defaults. For any expected deviations, the Fund Manager shall immediate inform and initiate consultations with the PSC about the required management actions.

- For any guarantees, the Fund Manager shall maintain a ratio of liabilities, understood as cumulative guarantee commitments made by the Fund, to its reserves not less than 1:1 for the first years' of Fund's operations. A higher ratio can be requested and decided by the UNDP and PSC in co-operation with the Fund Manager for subsequent years, taking into account the progress of the project.

- The UNDP/GEF resources to be invested into the Fund will be disbursed in tranches in correspondance with the actual demand. The funds will placed in a specific, interest bearing account in the name BDF to be opened for this purpose. The Recipient Institution shall deposit all income, including guarantee fees, subrogation recoveries, interest and investment income, capital receipts or other contributions derived from this accont directly into the said account, provided that an amount to be agreed by UNDP and the executing agency may be used for covering the operating costs of the Fund.

- Withdrawals from the funds transferred by UNDP shall only take place for providing funding for particular projects in accordance with the financing intruments and project review criteria listed in this Term Sheet . If it is deemed that any payment is unwarranted, the Fund Manager shall reimburse the corresponding amount to the reserves of the Fund.

- If UNDP shall have determined at any time that any amount outstanding in the Partial Guarantee Fund will not be required to cover further guarantee commitments to any one of the Participating Banks, the Recipient Institution shall, promptly upon notice from the UNDP, refund to UNDP such outstanding amount;

Management Structure of the Fund and the Role and Responsibilities of Its Main Participants

The main participants in the management of the Fund will be the EEAA and the PSC established by it, the UNDP and the financial institution to be involved.

EEAA and PSC

The EEAA will be responsible for the overall execution of the project in line with the UNDP guidelines for nationally executed projects. It will appoint the Project Director as the formal Government representive to be in charge of the project, it will convene and chair the Project Steering Committee (PSC) acting also as the Executive Board of the Fund while the Project Management Unit will be responsible for the day-to-day management of the technical assistance component of the project, including the solicition and technical review (due diligence) of the projects seeking Fund's support.

The PSC will be in charge of:

- Establishment and approval of the operating manual of the BDF and any updates/alterations thereof
- Approve the Annual Work Plan and budget of the BDF
- Receive and endorse the Evaluation Reports
- Receive the various progress reports and updates concerning the BDF activities
- Issue and update policies and procedures related to the BDF based on work progress

UNDP

As a member of the PSC and the GEF Implementing Agency of the project, UNDP will supervise the overall management of the Fund with the specific responsibility to ensure proper use and reporting of the GEF resources invested into it .

Project Management Unit

In respect to the activities related directly to Fund's operations, the PMU and the experts reporting to it will be in charge of:

- Identification of projects and taking the lead in marketing and public awareness raising activities related to the Fund's financing possibilities for the duration of the UNDP/GEF project.
- Monitoring and, as required, supporting the completion of the project cycle (see below) for the initial project applications received, including communications with applicants, negotiations with applicants, projects' initial technical and financial review and analysis and liaison with financial institution managing the assets of the BDF when and as needed;
- Tehnical due diligence of the final investment proposals submitted for financing by using Fund's resources and, if approved, co-ordinate and support the further design, implementation and monitoring of the projects;

Financial Entity

The management of the asset side of the BDF (i.e. the extension, disbursement and monitoring of the revolving part of the Fund) will be under the responsibility of the financial institution selected for this task on the basis of the tender to be organized at the outset of project operations. It will maintain the undisbursed and recollected resources of the BDF in an interest bearing account in the name of the BDF and reinvest them into bio-energy

projects in the form agreed in the Fund's Operational Manual, subject to tehnical clearance of the Project Management Unit (for the duration of the UNDP/GEF project) and in accordance with the credit process and the associated financial due diligence of that financial institution.

The staff of the financial institution managing the assest of the BDF will also be in charge of:

- day-to-day administration and financial transactions of the BDF;
- monitoring and controlling the BDF bank accounts and cashflows consistently update the status to the PSC
- maintaining the BDF databases (financial, statistical and project related), keeping records on all expenses and the budgetary status, preparing yearly budgets, and making proposals for developing and amending the administrative and financial procedures, if needed; and
- actively explore and combine the use of the different instruments allowed by the Fund in structuring financing for eligible bioenergy projects by using Fund's own resources as well as by leveraging other resources to support Fund's operations.

Project cycle

The project cycle for candidate bioenergy projects is envisaged to consist of the following steps:

1. Soliciting and marketing the establishment of the bio-energy projects in specific geographical areas and engaging the key stakeholders
2. Screening the applicant projects on a pre-feasibility basis and conducting an initial financial analysis by taking into account the different financing possibilities and cost-sharing opportiunities as well as the payment capacity and willingness of the targeted final beneficiaries in the given market;
3. In case of positive pre-feasibility results, conduct a detail technical review, financial analysis and risk assessment of the project;
4. Submission of the feasibility study to the bank for the credit analysis, approval and disbursement of the loan, including securing the necessary financial and legal documents that relate both to the financial institution and the PMU
5. Monitoring and reporting the progress of the projects supported by the BDF, including financial monitoring and reporting;
6. Project completion reports, after all the outstanding payments to the BDF have been made.

Exit Strategy of the Fund

At the closure of the GEF project and upon envisaged, successful recovery of the funds invested, the UNDP/GEF funds will be granted to the Government of Egypt to continue the operation of the Fund until reaching its ultimate objective, and with expected incorporation into a broader Government program and incentive policy to support bioenergy by building on the support models demonstrated.

In the case of the exit strategy, it is also important to note that after formal completion of the UNDP/GEF project (expected in five years from the start), the BDF and the partner bank still

needs to continue the management of the loans taken during the implementation of the UNDP/GEF project for the agreed repayment period. It is, thus, essential that unless other management arrangements or transfer of the loans to another financing entity will be agreed upon, the agreement with the Bank managing the BDF assets shall be extended until the last outstanding loan payment, regardless of the change of ownership of the BDF.

As bioenergy projects with their typical financing need are not expected to belong to the primary target market of commercial financial institutions, a need for an external entity to orchestrate and enhance the demand is also seen for the future. This is expected to be addressed under Outcome 4 of the UNDP/GEF project. A specific task of the PMU during the implementation will also be to promote bio-energy technologies by raising awareness and by seeking other partners, who would enhance the financial base of the BDF and/or cooperate through cofinancing of the bio-energy projects. Without drastical changes in the prices of the other competing fuels, a continuing need for some sort of concessional financing scheme is expected to exist, which can maintain the regular payments of the targeted end users at the level or under their existing energy bills.

Part VI Summary of the Pre-Feasibility Studies and Draft Business Plans of Selected Bio-Energy Applications in Egypt - Possible Implementation and Financing Arrangements[15]

Family scale digesters

The majority of households in the studied area (Assuit and Fayoum) consist of 8-12 people, although this number may be less than 5 or more than 20. Most of the families own or rent a small plot of land, on which they cultivate food crops (e.g. maize, wheat), animal fodder (clover) and / or cash crops (cotton). The poorer families cultivate plots of typically 0.5-1 feddan.

Apart from using animal dung, farmers use additional chemical fertilisers in order to retain the fertility of the land. Farmers indicated to use around 10 bags of fertiliser (of different types) per feddan land per year. At an average price of 40 LE per 50 kg bag, annual costs are approximately 400 LE/feddan/a.

In general, the poorer families visited own 1 or 2 heads of (bovine) livestock, if any at all. Sometimes a donkey, some goats and/or some poultry is present. The animals stay in the house during the night, and in the field during the day. The manure is collected in a heap in the field, and most of it is applied on the land once per year. In many places, small groups of animals (e.g. 2-5 heads, usually belonging to households of the same family) are kept together. In some villages, larger numbers of livestock (e.g. 50-100 heads) belonging to a large number of families are kept in one central area. Each family then collects the manure of its animals for application on the land.

In sporadic cases, owners of livestock do not work land and thus have an excess of manure. This is either traded with neighbours for crop residues (for household energy) or sold for a small amount (around 4-10 LE/m3 wet manure).

Family scale digesters can be applied in different situations. Some households own the required number of heads of livestock by themselves; they could then purchase and install the system at their house, using the manure from their own livestock, use the effluent on their own land and use the gas in their own kitchen. In other situations, groups of households may “pool” their resources (manure) for a single digester. In such cases, arrangements will have to be made about the division of the effluent and the gas among the participating households.

For (major) maintenance and repair, technical backup will have to be provided by a nearby service point. The family could pay a monthly fee, for which they receive regular maintenance checks, and quick repair service in case of problems.

The financing mechanism of the initial investment will obviously be critical to the ability of the family to afford a biogas plant. There are different sources of financing that can be considered:

[15] Source: Prefeasibility Studies and Draft Business Plans of Selected Bioenergy Applications in Egypt, Biomass Technology Group BV, 2006

- In-kind investment by the family. As indicated by Arafa (2006), a considerable part of the cost are involved in works (e.g. site preparation and construction), which the family can put in themselves. Based on experiences in Nepal (Mendis & van Nes, 1999) it is assumed that the part of investment that can be covered by such an in-kind investment is up to 20% of the costs.
- Cash investment by the family. Assuming that the supplier of the system will provide all the materials, this amount would be paid directly to him. The amount of the cash investment will primarily depend on the investment capacity of the family, the financing alternatives (e.g. loan and investment support) and the down payment requirements by the provider of credit or support. Especially where loan capital and subsidies are available, levels of cash investments can be kept as low as 10-20% of the investment.
- Loans. Loan capital decreases the requirement of cash investments by the family, and lead to a situation where capital costs are more in pace with the benefits of a project. Furthermore, as long as the interest rate is below the IRR, a bank loan will increase the returns on the cash investment made by the family.
- Investment support programmes. In most countries where large scale biogas promotion programmes have been implemented, support levels in the range of 20-50% have been provided in order to improve the financial viability of the installations, and improve the accessibility to the technology for the poor.

Loans could also be supplied in the form of supplier credit. In such a case, the system supplier would apply for a larger loan which will enable him to provide credit for a large number of customers. This could improve the accessibility of the families to loan capital. However, the costs of credit are likely to go up, as the rates on larger loans are higher and the coverage of the risks for the supplier would have to be covered. This could be controlled by making special arrangements for the loan and/or by providing risk sharing for the supplier.

A financing model that could be particularly relevant for the financing of smaller (household scale) applications is that of the Bio-Energy Service Provider (BSP). In this model, the supplier of installations and after-sales maintenance services could also provide partial financing. The customers would pay the BSP a fixed fee over an extended period of time (typically 5-10 years), covering repayment of the installation (and interest), and regular maintenance services.

In order to work, the model should find a balance between a number of parameters:

- The size of the fee and the repayment period that is acceptable for the customer, and at the same time sufficient to cover the repayment obligations of the BSP;
- The extent of upfront payments, in-kind or in cash, by customers;
- Investments by the BSP itself;
- The loan conditions; and
- Initial support to build up financial sustainability of the model

Table 1 provides two cases of a small scale biogas system, one paid by own investments (in kind and cash, in total 40%) and loans (at 7% interest over 5 years), and one with an added investment support of 20% of the total investment costs. As a basis for savings, the actual (subsidized) prices for kerosene and LPG have been used.

Table 1 Financing scheme for family scale digester

	0% support	20% support	Unit
Total investment	4,000	4,000	LE
Own investment (in-kind)	800	800	LE
Own investment (cash)	800	800	LE
Investment support	0	800	LE
Loan (7% / 5 year)	2,400	1,600	LE
Annual savings	853	853	LE/a
Annual loan repayment	585	390	LE/a
Annual O&M	200	200	LE/a
Net annual profit (y1-5)	68	263	LE/a
Net annual profit (y5 onward)	653	653	LE/a
Loan repayment	49	33	LE/month
Loan repayment + O&M	65	49	LE/month
Energy savings	50	50	LE/month
Energy savings and fertiliser	71	71	LE/month
Current expenditures energy and fertiliser[16]	108	108	LE/month

Judging from the cost savings and total expenses, the system results in a modest annual net return so the family should be able to make loan repayments and expenses for operation and maintenance. However, the expenses will exceed the directly visible savings (for cooking fuels), and only after the loan has been repaid (i.e. after 5 years), the initial investment done by the family will start to be repaid.

The second column shows that a certain level of support could reduce the need for loan capital somewhat, resulting in lower monthly loan repayments. The monthly costs match the monthly savings in energy expenses, and the initial cash investment done by the family is repaid in 3 years.

From the economic perspective, the provision of investment support would be justifiable. By replacing fossil fuels, be it kerosene or LPG, the use of the biogas will save the State the subsidies that would otherwise have been paid on that specific amount of fuel. Comparing the amount of the initial investment support for the digester system with the annual savings of fossil fuel subsidy shows that the subsidy is repaid in approx 3-4 years. As subsidies on fuels are reduced over time, the financial viability of biogas systems will improve and the need for support decreases. Alternatively, longer term concessional loans could be offered.

Table 2 gives an overview of the basic financial parameters of a family scale biogas plant.

Table 2 Main financial parameters for household digester system

	Amount (LE/a)	Unit cost (LE/u)	Units/a
Investment I_0 (LE)	4,000		
Operation & Maintenanc e (5% of I_0)	200		
Biogas (m3)	603	0.54	3.1
Fertiliser (t)	250	160	1.56
Net annual cashflow	653		
Project lifetime (years)	15		
Simple payback period (years)	6.1		
IRR	14%		

[16] Based on 3 cylinders of butane gas, 2 litres of kerosene per day and 500 kgs of chemical fertiliser per year.

Community Scale Digesters

A community scale digester should preferably operate as a commercial organisation, taking in manure and supplying fertiliser to the community, and supplying gas or electricity to one or more consumers. An operator from the community could be trained to operate the plant for a salary, while technical backup and servicing is provided by the plant supplier for a fee.

As the continuous supply of manure and the use of the fertiliser will depend on the households in the community, it is envisaged that the villagers would participate and invest in the project. The supply of gas or electricity, and fertiliser, will earn the income that is needed to cover operational and maintenance costs, and possible loan repayments. Any net revenue can then be divided among the participating households.

Table 3 provides an overview of the financial analysis assuming an electricity sale price of LE 0.51 per kWh.

Table 3 Financing for a community scale digester for electricity production

	0% support	**25% support**	**40% support**	**Unit**
Total investment	94,560	94,560	94,560	LE
Own investment (in cash)	9,456	9,456	9,456	LE
Own investment (in kind)	18,912	18,912	18,912	
State subsidy	0	23,640	37,824	LE
Loan (7-9% / 5 year)	66,192	42,552	28,368	LE
Annual revenue	19,837	19,837	19,837	LE/a
Annual loan repayment	17,017	10,378	6,919	LE/a
Annual O&M	9,456	9,456	9,456	LE/a
Gross annual profit (y1-5)	-6,636	3	3,462	LE/a
Gross annual profit (y5 onward)	10,381	10,381	10,381	LE/a
Number of participants	50	50	50	
Investment per participant	189	189	189	LE
Gross annual profit pp (y1-5)	-133	0	69	
Gross annual profit pp (y5 onwrd)	208	208	208	LE

Assuming a limited investment capability (or preparedness) of the community, a cash investment of 10% of the total investment costs is assumed feasible. For 50 participants, this would be 189 LE per household. With respect to in kind contributions, these could be equal to those in the case of the family size digester and are therefore set at 20%.

The table shows that when no support is provided, a considerable negative cashflow would exist in the first five years of repaying the loan. In order to avoid the deficit, a 25% investment support would be needed. When 40% support is provided, the cashflow is positive, allowing for small cash returns for the participating households. The repayment period of their cash input would then be around 3 years. The supply of gas as a fuel replacement results in very similar schemes.

As indicated in the previous section, the low price level of the electricity is the main reason for the need for support. If alternative prices are higher, e.g. in remote areas where diesel generation is the first alternative and diesel prices are high due to the long transport distances, the need for support will be lower.

Also in this case, a substantial level of investment support can be justified. The replacement of diesel by biogas, be it for off-grid electricity generation of fuel replacement for shaft driven applications, will incur substantial savings of subsidies otherwise provided for those fuels. Comparing the amount of the initial investment support for the digester system with the annual savings of diesel subsidy shows that the subsidy is repaid in approx 3 years. With any reductions in diesel, the financial viability of biogas systems improves and the need for support decreases. Alternatively, longer term concessional loans could be offered.

Table 4 below gives an overview of the basic financial parameters of a community scale biogas plant for electricity generation.

Table 4 Main financial parameters for community digester system – gas for electricity production

	Amount (LE/a)	Unit cost (LE/u)	Units/a
Investment I_0 (LE)	94,560		
Operation & Maintenance (10% of I_0)	9,456		
Electricity (kWh)	15,485	0.51	30,401
Fertiliser (t)	4,352	27.2	160
Net annual cashflow	10,381		
Project lifetime (years)	15		
Simple payback period (years)	9.1		
IRR	7%		

The sensitivity to the electricity rate is large:

- Alterations in the electricity price of +/- 20% (reflecting e.g. increasing prices, alternative costs for remote small scale diesel generation, or lower preparedness to pay) result in IRR values changing with +/- 5% points.
- Without investment support, the electricity price would need to be 0.70 LE/kWh in order to reach an IRR of 15%.
- When the real cost of small scale diesel generated electricity (estimated at at least 0.80 LE/kWh) is used, IRR of the system would be approximately 20%.

The sensitivity to the fertiliser value is modest: +/- 50% deviations from the selected price level results in IRR changes of +/-3%.

Table 5 Main financial parameters for community digester system – gas as fuel replacement for direct use.

	Amount (LE/a)	Unit cost (LE/u)	Units/a
Investment I_0 (LE)	52,800		
Operation & Maintenance (10% of I_0)	5,280		
Biogas (m3)	7,092	0.30	65.7
Fertiliser (t)	4,352	160	27.2
Net annual cashflow	6,164		
Project lifetime (years)	15		
Simple payback period (years)	8.6		
IRR	8%		

Due to the very high level of diesel subsidies, the basic viability is not much better than when producing electricity. Varying the diesel price results in the following situations:

- When the real (unsubsidised) price of diesel is used as a reference, the value of the biogas increases dramatically from 0.30 to 0.79 LE/m3. IRR would then be more than 30% and payback period would then be 3 years.
- In order to reach an IRR of 15%, the gas value needs to increase to 0.42 LE/m3 which corresponds to a diesel price of about 0.78 LE/l.

The sensitivity to the fertiliser value is somewhat higher: +/- 50% deviations from the selected price level results in IRR changes of +/-6%.

Large (Farm) Scale Digesters

A large anaerobic digestion unit as described in this chapter will require the manure from a livestock farm, and supply energy to the grid or a commercial consumer. The technology would most likely be integrated in operations of the farm whose manure is being used, i.e. operate under commercial conditions.

As was the case with other technologies, a considerable part of the works may be covered in kind (labour and civil works, e.g. for the construction of the digester tank). The extent of this coverage is estimated at least 20% of the total investment cost.

In most likelihood, a considerable level of investment support (around 40%) will be needed in order to sufficiently improve the financial viability of the technology from the point of view of the project owner. A loan under favourable conditions could further contribute to the feasibility.

Including a 10% cash investment, the financing of an installation could look as follows, assuming a assuming an electricity sale tariff of LE 0.51 per kWh and no alternative costs for manure.

Table 6 Financing for a farm scale digester

	0% support	0% support	40% support	Unit
In kind investment (20%)	100,000	100.000	100,000	LE
Cash investment (10%)	50,000	200,000	50,000	LE
Investment support	0	0	200,000	LE
Loan (9-11% / 5 year)	350,000	200.000	150,000	LE
Annual income	100.968	100.968	100.968	LE/a
Annual loan repayment	94.700	51.418	38.564	LE/a
Annual O&M	50.000	50.000	50.000	LE/a
Net annual profi t (y1-5)	-43.732	-451	12.404	LE/a
Net annual profit (y5 onward)	50.968	50.968	50.968	LE/a

The investment without investment support leads to negative cash flows in the first years due to loan repayments. Only when the amount of the private investment is increased to about 200,000 LE, the cash flow would be approximately zero. Repayment of the private investment would then start after the repayment of the loan, and then take another 4 years to break even.

With investment support of 40%, the required amount of loan capital, and thus the annual repayments, can be limited. From the modest but positive cash flow in the first years, the cash investment can be repaid in about 4 years. Alternatively, longer term concessional loans could be offered.

Table 7 below gives an overview of the financial parameters in the base case situation.

Table 7 Financial parameters of a farm scale digester system

	Amount (LE/a)	Unit cost (LE/u)	Units/a
Investment	500,000		
Operation & Maintenance	50,000	10%	500,000
Manure alternative cost	33,333	75	444
Electricity value	67,528	0.51	132,407
Fertiliser value	33,440	160	209
Net cashflow	17,634		
Project lifetime (years)	15		
Simple payback period (years)	28.0		
IRR	-		

The base case situation is not financially sustainable. Although there is a considerable net cashflow, it is insufficient to recover the investment costs. Main cause is the high value of the livestock manure in the present situation as compared to the value of the dry fertiliser. In case there would be no value of the manure, the annual revenue would approximately 50,000 LE so the simple payback period would decrease to 10 years.

The conditions for financial sustainability (e.g. an IRR of 15%) would be the following:

- No alternative costs for manure, **and**
- Investment support of about 40% **or**
- Electricity price at 0.77 LE/a (e.g. at remote location where diesel costs are high) **or**
- A higher return on the fertiliser, e.g. at price levels around 320 LE/tDS **or**
- Different combinations of the above.

Biomass Gasification

Due to the large scale of the operation, the investments and the need for a team of skilled and professional operators, gasification projects should preferably be operated as private, commercial units. Two or three operators with a technical background should be living in the direct vicinity of the plant, i.e. in the village where it is constructed.

A private enterprise operating multiple units within a certain area. The available technical expertise can then be applied for multiple installations, bringing down the Operation & Maintenance cost.

Of extreme importance is a basic level of control over the fuel supply. Supply interruptions should be avoided at all time as they will cause downtime. Local fuel price levels may be pushed upward if demand increases. If possible, most of the required fuel should be contracted so that a basic amount for a basic price level is guaranteed. Furthermore, (large) potential suppliers of fuel could be invited to participate in the project.

Supplying the electricity to the grid at the current, applicable feed-in tariffs will not generate sufficient income. A large consumer of electricity (e.g. an agro-industry) that is now paying the highest rate should be identified to purchase the generated electricity. Such a partner could be invited to participate[17] .

[17] Comment: Alternatively electricity could be produced for communities, which otherwise would need to rely on stand alone diesel generators with high costs.

As was suggested in the previous section, due to the technical risks involved in gasification, a private investor may require higher returns on investment. This can be achieved by e.g. negotiating a higher feed-in tariff or a support grant[18]. Table 8 shows financing for the plant with and without investment support.

Table 8 below gives an overview of possible financing structures for a gasifier plant. The available amount of loan capital is set at 1,000,000 LE; investment support and own investment provide the remainder.

Table 8 Financing of gasifier plant

	0% support	20% support	40% support	Unit
Total investment	2,500	2,500	2,500	kLE
State subsidy	0	500	1,000	kLE
Loan (7%, 7 years)	1,000	1,000	1,000	kLE
Own investment	1,500	1,000	500	kLE
Annual revenue	826	826	826	kLE/a
Annual loan repayment	284	284	284	kLE/a
Annual O&M + fuel	393	393	393	kLE/a
Gross annual profit (y1-5)	149	149	149	kLE/a
Gross annual profit (y5 onward)	433	433	433	kLE/a

Without investment support, the share of private investment will be around 60% and will take about 7 years to repay. With 20% support, the investment is repaid within 6 years; with 40% support, own investments can be limited to 20% and repaid in little over 3 years assuming an average electricity sale tariff of LE 0.34 per kWh, biomass costs of LE 50 per ton and operation of 5,000 h/a. Alternatively, longer term concessional loans could be offered.

An overview of the financial parameters of a gasification system is presented in Table 9.

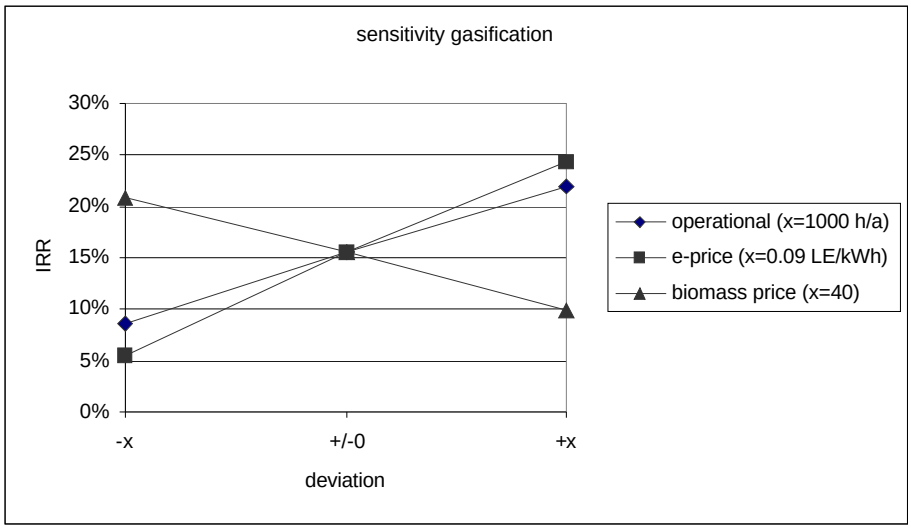
Table 9 Financial parameters of biomass gasification system (500 kWe gross)

	Amount (LE/a)	Unit cost (LE/u)	Units/a
Investment	2,500,000		
O&M costs	250,000	10%	2,500,000
Fuel cost	142,857	50	2,857
Electricity value	764,274	0.34	2,250
Income from CERs	61,867	62	
Net cashflow	433,285		
Project lifetime	15		
Simple payback period	5.8		
IRR	15%		

The above figures indicate that gasifier systems can in fact be financially sustainable, under the described conditions. An IRR of 16% is still quite low for any private investor, especially with a technology for which in general no guarantees are given with respect to its operation. However, with some risk sharing, loan capital and support this may improve.

[18] Comment: or by applicable risk sharing arrangements

With respect to sensitivity, of particular interest are the number of operating hours, the average electricity price and the fuel price. The figure below gives an overview:



- Sensitivity to variations in the electricity price (e.g. due to a different ratio of grid supplied / customer supplier electricity) have a considerable impact: variations of 25% lead to variations in IRR of about +/- 10% points.
- Sensitivity to variations in the number of operational hours (e.g. due to technical problems or flawless operation) have a considerable impact: variations of 20% lead to variations in IRR of about +/- 6% points.
- Variations in the price of biomass (e.g. due to different logistical costs) have a relatively modest impact: variations of +/-80% lead to variations in IRR of about +/- 6% points.

Part VII: Greenhouse Gas Emission Reductions

For the GHG reduction estimates presented in the project, the following estimates and assumptions have been used[19]

Emission reduction per bio-energy installation

Table V-1 Overview of annual emission reduction per bio-energy application

Application	Resources per installation	E.R. per installation (tCO2/a)	E.R. per unit resource (kgCO2/a/unit)
Biogas - family	6 bovine livestock	1.6	267
Biogas - community	100 bovine livestock	13.5	135
Biogas - farm	500 bovine livestock	58.6	117
Gasification	2,857 t/a air dry biomass	996	348
Combustion – medium	38,400 t/a air dry biomass	17,699	461
Combustion - large	219,429 t/a air dry biomass	141,592	645

With respect to the emission reductions from anaerobic digestion systems (biogas), the family scale units reduce the most. These installations directly replace kerosene (or butane), whereas the larger systems replace (grid supplied) electricity which is mainly produced with natural gas. Moreover, the smaller scale of electricity production results in much lower efficiencies (25-30%) than grid electricity (around 40%).

The emission reductions from the combustion of agricultural residues is considerably larger than that of gasification. This is due to the higher conversion efficiencies of the larger scale installations.

Emission reduction of project related installations

Table V-2 shows the emission reductions related to the installations included in the GEF project. Total reductions over a period of 20 years is 192,240 tonnes of CO2.

Table V-2 Emission reductions of GEF related installations

Application	tCO2/a per installation/MW	Number/capacity of installations	E.R. (tCO2/a)
Biogas - family	1.6 / unit	1,000 units	1600
Biogas - community	13.5 / unit	10 units	135
Biogas - farm	58.6 / unit	2 units	117
Combustion/gasification	1940/MW	4MW	7760
Total (tCO2/a)			9,612
Total (tCO2/20a)			192,240

[19] Source: Prefeasibility Studies and Draft Business Plans of Selected Bioenergy Applications in Egypt, Biomass Technology Group BV with the fuel prices as of January 2006.

Emission reduction potential bio-energy Egypt

Table V-3 recapitulates the annual production of agricultural residues in Egypt, and presents estimated amounts that can be made available for bio-energy production using the described bio-energy applications. The estimates are made based on the current uses of the residues for animal fodder and domestic energy. Agro-industrial residues are omitted because of their utilisation in agro-industry, and their limited use for the production of rural energy.

Table V-3 Agricultural residues in Egypt (2003)

Residue type	Production (kt/a)	Availability for energy (%)	Availability (kt/a)
Wheat straw	8,214	-	-
Rice straw	4,940	50%	2,470
Maize stalk	5,114	10%	511
Maize cob	1,534	10%	153
Sorghum stalk	1,273	10%	127
Barley straw	212	-	-
Cotton stalk	1,187	50%	594
Cane tops/leafs	4,874	10%	487
Total	27,348		4,343

Source: Hinnawi (2006c)

An overview of bovine livestock in Egypt, on larger farms and in households, is provided in V-4. A conservative estimate of the number of livestock whose manure could be made available for biogas production (10%) is also included.

Table V-4 Bovine livestock in Egypt (2003)

Animals	Total Egypt	On farms	Off farms
Cattle (head)	4,226,992	232,597	3,994,395
Buffalo (head)	3,777,155	103,313	3,673,842
Total (head)	8,004,147	335,910	7,668,237
10% of total (head)		33,591	766,824

Source: Hinnawi (2006c)

Combining the estimated resources from tables V-3 and V-4, and the emission reduction per unit of resource from table V-1, results in (practical) emission reduction potentials for each of the bio-energy applications. The figures are shown in V-5. The table also lists the number of installations that would be required to process the estimated resources and realise the calculated emission reductions. Total emission reductions are estimated at 1.67 million tonnes of CO2 per year, or 33.4 million tonnes over a period of 20 years.

Table V-5 Potential emission reductions from bio-energy applications in Egypt

Application	Available ressources	E.R. potential (tCO2/a)	Number of installations
Livestock for family biogas (head)	383,412	102,503	63,902
Livestock for community biogas (head)	383,412	51,576	3,834
Livestock for farm biogas (head)	33,591	3,936	67
Residues for gasification (t/a)	4,343,000	1,513,312	1,520
Total (tCO2/a)		1,671,327	
Total (tCO2/20a)		33,426,536	