



**REQUEST FOR CEO ENDORSEMENT/APPROVAL**  
**PROJECT TYPE: Full-sized Project**  
**THE GEF TRUST FUND**

**Submission Date:** 15 February 2011  
**Re-submission Date:** 19 May 2011  
**Re-submission Date:** 06 September 2011  
**Re-submission Date:** 04 November 2011

**PART I: PROJECT INFORMATION**

**GEFSEC PROJECT ID: 3943**  
**GEF AGENCY PROJECT ID: XX/NIR/09/X01**  
**COUNTRY(IES): FEDERAL REPUBLIC OF NIGERIA**  
**PROJECT TITLE: MINI-GRID BASED RENEWABLE ENERGY (BIOMASS) SOURCES TO AUGMENT RURAL ELECTRIFICATION**  
**GEF AGENCY(IES): UNIDO**  
**OTHER EXECUTING PARTNER(S): FEDERAL MINISTRY OF ENERGY, ENERGY COMMISSION OF NIGERIA AND FEDERAL MINISTRY OF ENVIRONMENT, HOUSING AND URBAN DEVELOPMENT**  
**GEF FOCAL AREA(S): CLIMATE CHANGE**  
**GEF-4 STRATEGIC PROGRAM(S): SP4: PROMOTING SUSTAINABLE ENERGY PRODUCTION FROM BIOMASS**  
**NAME OF PARENT PROGRAM/UMBRELLA PROJECT: GEF PROGRAMMATIC APPROACH ON ACCESS TO ENERGY IN WEST AFRICA**

| Expected Calendar (mm/dd/yy)     |               |
|----------------------------------|---------------|
| Milestones                       | Dates         |
| Work Program (for FSPs only)     | April 2009    |
| Agency Approval date             | January 2011  |
| Implementation Start             | November 2011 |
| Mid-term Evaluation (if planned) | October 2013  |
| Project Closing Date             | October 2015  |

**A. PROJECT FRAME WORK (Expand table as necessary)**

| Sl. No. | Project Components  | INV, TA, or STA <sup>a</sup> | Expected Outcomes   | Expected Outputs   | GEF Financing |    | Indicative Co-Financing |    | Total (\$ c = a + b) |
|---------|---|------------------------------|---|--|---------------|----|-------------------------|----|----------------------|
|         |   |                              |   |  | (\$ a)        | %  | (\$ b)                  | %  |                      |
| 1.      | Development of techno-economic feasibility studies and business plans for identified potential sites to facilitate replication. | TA                           | Preparatory works completed for facilitating replication in the identified potential sites  | 1.1. Techno-economic feasibility studies and business plans developed for the 3 identified potential sites to facilitate replication.  | 137,000       | 41 | 200,000                 | 59 | 337,000              |
| 2.      | Demonstration of techno-economic viability of biomass based mini-grid.  | INV                          | Acceptance by stakeholders on the technical and financial viability of selected site for setting up of biomass based mini-grid for rural electrification. | 2.1 A biomass based power plant of 5 MW installed capacity commissioned in the selected site along with mini-grid.<br>2.2 Capacity on biomass power plant operation and maintenance (O & M) as well as mini- | 1,917,000     | 15 | 10,575,000              | 85 | 12,492,100           |

|    |  |    |  |   |                  |           |                   |           |                   |
|----|--|----|--|---|------------------|-----------|-------------------|-----------|-------------------|
|    |  |    |  | grid management developed.<br>2.3 The mini-grid independently monitored, evaluated, lessons learnt and information widely distributed.  |                  |           |                   |           |                   |
| 3. | Strengthening of financial and policy environment to support RE based mini-grid systems. | TA | Conducive financing and policy environment for promoting investments in rural mini-grids in place. | 3.1 Feed-in-tariff (FiT) for biomass power in place.<br>3.2 Appropriate financing facility developed for RE related projects.   | 93,000           | 32        | 200,000           | 68        | 293,100           |
| 4. | Capacity development for replication of RE mini-grid technologies.                       | TA | Capacity of local planners, institutions and experts for RE based mini-grid enhanced.              | 4.1 Local capacity in designing mini-grid developed.<br>4.2 Experts, planners and institutions trained in developing biomass based energy and mini-grid systems.<br>4.3 Capacity of RE related and financing institutions strengthened.<br>4.4 Capacity of local engineering firms and O&M companies developed in operation and maintenance of biomass power plant and mini-grid systems. | 274,800          | 35        | 500,000           | 65        | 774,900           |
| 5. | Project management   |    |  |   | 200,000          | 30        | 460,000           | 70        | 660,100           |
|    | <b>Total project costs</b>   |    |  |   | <b>2,621,800</b> | <b>18</b> | <b>11,935,000</b> | <b>82</b> | <b>14,556,900</b> |

\* List the \$ by project components. The percentage is the share of GEF and Co-financing respectively to the total amount for the component.

\*\* TA = Technical Assistance; STA = Scientific & technical analysis.

**B. SOURCES OF CONFIRMED CO-FINANCING FOR THE PROJECT** (expand the table line items as necessary)

| <i>Name of Co-financier (source)</i>                           | <i>Classification</i> | <i>Type</i> | <i>Project (USD)</i> | <i>%*</i> |
|--|-----------------------|-------------|----------------------|-----------|
| Federal Ministry of Environment, Housing and Urban Development | National Government   | In-kind     | 2,280,000            | 19.1      |
| Federal Ministry of Environment, Housing and Urban Development | National Government   | In cash     | 20,000               | 0.2       |
| UNIDO  | Implementing Agency   | Cash        | 60,000               | 0.5       |
| Private  | Private Sector        | Investment  | 9,575,000            | 80.2      |
| Total Co-financing   |                       |             | 11,935,000           | 100.0     |

\* Percentage of each co-financier's contribution at CEO endorsement to total co-financing.

**C. FINANCING PLAN SUMMARY FOR THE PROJECT (\$)**

|               | <i>Project Preparation<br/>a</i> | <i>Project<br/>b</i> | <i>Total<br/>c = a + b</i> | <i>Agency Fee</i> | <i>For comparison:<br/>GEF and Co-financing<br/>at PIF</i> |
|---------------|----------------------------------|----------------------|----------------------------|-------------------|--|
| GEF financing | 60,000                           | 2,621,800            | 2,681,800                  | 268,180           | 2,667,273  |
| Co-financing  | 60,000                           | 11,935,000           | 11,995,000                 |                   | 7,360,000  |
| <b>Total</b>  | 120,000                          | 14,556,800           | 14,676,800                 | 268,180           | 10,027,273   |

**D. GEF RESOURCES REQUESTED BY AGENCY(IES), FOCAL AREA(S) AND COUNTRY(IES)<sup>1</sup>**

| <i>GEF Agency</i>          | <i>Focal Area</i> | <i>Country Name/<br/>Global</i> | <i>(in \$)</i>     |                                    |                    |
|----------------------------|-------------------|---------------------------------|--------------------|------------------------------------|--------------------|
|                            |                   |                                 | <i>Project (a)</i> | <i>Agency Fee ( b)<sup>2</sup></i> | <i>Total c=a+b</i> |
| N/A                        | N/A               | N/A                             | N/A                | N/A                                | N/A                |
| <b>Total GEF Resources</b> |                   |                                 |                    |                                    |                    |

<sup>1</sup> No need to provide information for this table if it is a single focal area, single country and single GEF Agency project.

<sup>2</sup> Relates to the project and any previous project preparation funding that have been provided and for which no Agency fee has been requested from Trustee.

**E. CONSULTANTS WORKING FOR TECHNICAL ASSISTANCE COMPONENTS:**

| <i>Component</i>           | <i>Estimated person weeks</i> | <i>GEF amount (\$)</i> | <i>Co-financing (\$)</i> | <i>Project total (\$)</i> |
|----------------------------|-------------------------------|------------------------|--------------------------|---------------------------|
| Local consultants*         | 730                           | 394,000                | 336,000                  | 730,000                   |
| International consultants* | 188                           | 540,000                | 24,000                   | 564,000                   |
| <b>Total</b>               | 918                           | 934,000                | 360,000                  | 1,294,000                 |

\* Details to be provided in Annex C.

**F. PROJECT MANAGEMENT BUDGET/COST**

| <i>Cost Items</i>  | <i>Total Estimated person weeks</i> | <i>GEF amount (\$)</i> | <i>Co-financing (\$)</i> | <i>Project total (\$)</i> |
|--|-------------------------------------|------------------------|--------------------------|---------------------------|
| Local consultants*   | 200                                 | 108,000                | 8,000                    | 116,000                   |
| International consultants*                                 | 12                                  | 36,000                 | 0                        | 36,000                    |
| Office facilities, equipment, vehicles and communications* |                                     | 26,000                 | 332,000                  | 358,000                   |
| Travel*  |                                     | 30,000                 | 60,000                   | 90,000                    |
| Others**   |                                     | 0                      | 60,000                   | 60,000                    |
| <b>Total</b>   |                                     | <b>200,000</b>         | <b>460,000</b>           | <b>660,000</b>            |

\* Details to be provided in Annex C. \*\* For others, it has to clearly specify what type of expenses here in a footnote.

**G. DOES THE PROJECT INCLUDE A “NON-GRANT” INSTRUMENT?** yes  no

(If non-grant instruments are used, provide in Annex E an indicative calendar of expected reflows to your agency and to the GEF Trust Fund).

**H. DESCRIBE THE BUDGETED M & E PLAN:**

Project monitoring and evaluation (M&E) will be carried out in accordance with established UNIDO and GEF guidance and procedures.

The overall objective of the monitoring and evaluation process is to ensure successful and quality implementation of the project by: i) tracking and reviewing the execution of project activities and the actual accomplishments; ii) providing visibility into progress as the project proceeds so that the implementation team can take early corrective action if performance deviates significantly from original plans and iii) adjusting and updating project strategy and implementation plan to reflect possible changes on the ground results achieved and corrective actions taken.

A detailed monitoring plan for tracking and reporting on project time-bound milestones and accomplishments will be prepared by UNIDO in collaboration with the Project Management Unit (PMU) and project partners at the beginning of project implementation and then will be updated periodically.

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

- a. Implementation of a biomass mini-grid project
- b. Replication potential of similar biomass mini-grid projects elsewhere in Nigeria
- c. CO<sub>2</sub> emission reduction resulted from the implemented biomass mini-grid project
- d. CO<sub>2</sub> emission reduction potential from other replicable projects
- e. Various capacity building trainings conducted and their usefulness
- f. Level of awareness and technical capacity within relevant institutions in the market and within enterprises.
- g. Readiness of financial institutions to fund biomass mini-grid projects
- h. Improvement in Government policy measures to support biomass based mini-grids
- i. Effectiveness and usefulness of the dissemination activities such as trainings, seminars, site visits, mini-grid performance reports, project website, leaflets, etc.

The PMU will be responsible for continuous monitoring of project activities execution, performance and track progress towards milestones.

However, the project manager will take the responsibility for a) tracking and monitoring the project performance with respect to each project activity and output, b) the overall project milestones and progress towards the attainment of the set project outputs and c) for the narrative reporting to the GEF.

There will be two project evaluations. One evaluation will be carried out during the mid-term and the other, final external evaluation will be carried out after the operational completion of the project. The following table provides the tentative budget for the total evaluation, which has been included in project management budget.

**Total evaluation budget**

| <b>Activity</b>            | <b>USD</b>    |
|----------------------------|---------------|
| Mid-term evaluation        | 8,000         |
| Mid-term evaluation travel | 6,000         |
| Final evaluation           | 36,000        |
| Final evaluation travel    | 10,000        |
| <b>Total</b>               | <b>60,000</b> |

**PART II: PROJECT JUSTIFICATION:**

**A. STATE THE ISSUE, HOW THE PROJECT SEEKS TO ADDRESS IT AND THE EXPECTED GLOBAL ENVIRONMENTAL BENEFITS TO BE DELIVERED:**

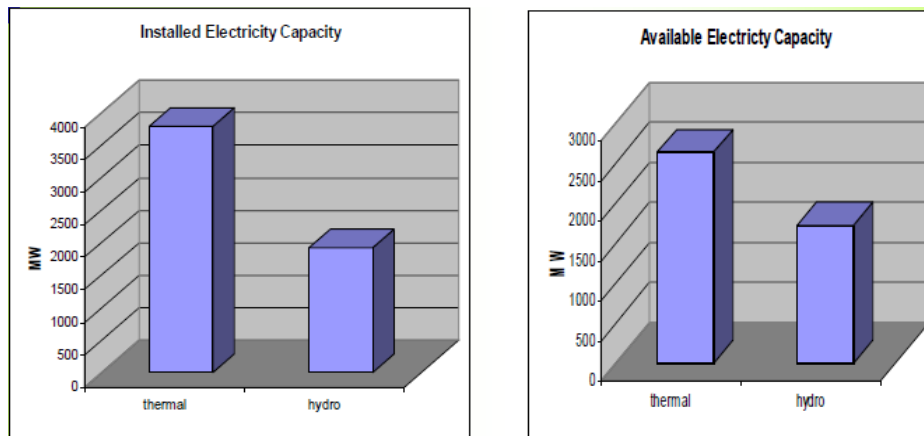
**Background**

In Nigeria, only 40% of the total population has access to electricity. The majority of the people who have access to electricity live in urban areas. But, more than 50% of the Nigerian population lives in rural areas. Only less than 20% of the rural households have access to electricity. The electricity that is being supplied is also unreliable and of inferior quality for the end users with frequent shutdowns and grid failures.

Most of the industries are not connected to national grid thereby resulting in 100% dependency on diesel generators or diesel drives for their energy needs. The electricity generation cost becomes high when diesel generators are used. The industries that are already connected to the Government electricity distribution lines receive electricity only for few hours a day. Hence, these industries also depend on their own backup diesel generators for their electricity needs. Due to diesel usage, the electricity cost for industries are very high resulting in increased production cost affecting their competitiveness. This limits the growth of the industries and hinders the overall development of the country. Moreover, the usage of diesel also generates considerable amount of GHG emissions.

Presently, the electricity demand in Nigeria is over and above 15,000 MW, whereas, the installed capacity is around 5,000 MW only. There is a large gap existing between the demand and supply of electricity. A part of this large gap is being met out by electricity generated using individual diesel generating sets installed by capable industrial and commercial sectors and also by few households.

The supply and demand gap in the electricity sector is growing day by day and the public utility is unable to keep up with the increasing demand. The statistics show that in the next two decades, Nigeria's population is likely double. The following figure shows the installed and available electricity generation capacity of Nigerian grid in the year 2007<sup>1</sup>.



**Figure 1: Installed and available electricity capacity**

<sup>1</sup> Source: *Electricity Demand from Customers of INGA Hydropower Projects: The Case of Nigeria*, Prof. A.S. Sambo, Director General, Energy Commission of Nigeria, 2007

The following figure shows the projected electricity demand up to the year 2030 using three different GDP growth rate assumptions. Electricity demand in Nigeria would be between 50,820 MW to 70,760 MW within the year 2020.

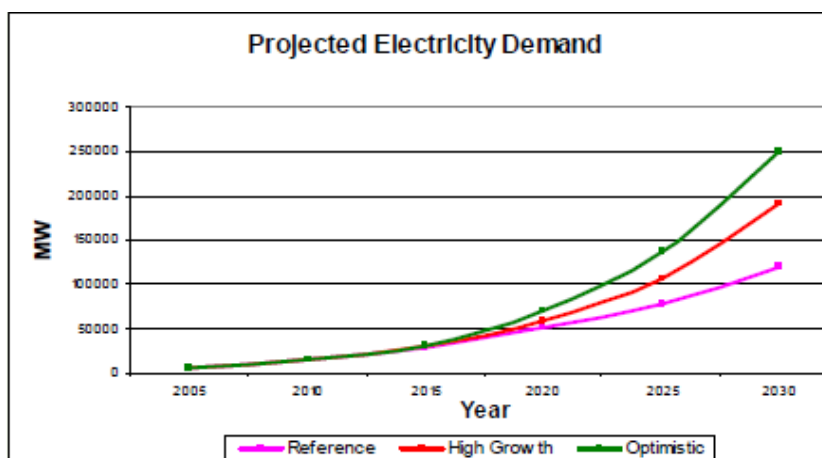


Figure 2: Projected electricity demand up to year 2030

Table 1: Projected electricity demand until year 2030 for Nigeria<sup>2</sup>

| Scenario           | Projected electricity demand, MW |        |        |        |         |         |
|--------------------|----------------------------------|--------|--------|--------|---------|---------|
|                    | 2005                             | 2010   | 2015   | 2020   | 2025    | 2030    |
| <i>Reference</i>   | 5,746                            | 15,730 | 28,360 | 50,820 | 77,450  | 119,200 |
| <i>High growth</i> | 5,746                            | 15,920 | 30,210 | 58,180 | 107,220 | 192,000 |
| <i>Optimistic</i>  | 5,746                            | 16,000 | 31,240 | 70,760 | 137,370 | 250,000 |

Note:

Reference growth: 7% annual GDP growth

High growth : 10% annual GDP growth

Optimistic : 11.5% annual GDP growth

As of today, the tariff for the Nigerian electricity market is one of the lowest tariffs in the world. With increasing costs, the current tariff level has not been sufficient to meet the operating or capital investment costs of the unbundled companies along with the gas supply payment and the IPP payments. Other major reasons for this deficiency are, high technical loss levels and low collection efficiencies. These two factors together, account for almost 50% of the potential revenue loss. As a result, there is a yearly revenue gap, which has been historically met by the Government through ad hoc transfers.

The Power Holding Company of Nigeria (PHCN), the national electricity utility, is unable to extend the grid to all areas of the country due to resource constraints. The electricity sector in Nigeria has been constrained by many other factors such as generation deficit, weak transmission and distribution infrastructure, poor utility performance, over dependence on fossil resource and neglected investment for a long period of time.

The country is endowed with lot of biomass energy resources which are not being utilized for the right purpose. The country's biomass energy resources have been estimated to be 83 million tonnes of crop residues / year and 61 million tonnes of animal waste / year. At present in most of the agro industries, these wastes are either dumped or burnt.

<sup>2</sup> Source: *Electricity Demand from Customers of INGA Hydropower Projects: The Case of Nigeria*, Prof. A.S. Sambo, Director General, Energy Commission of Nigeria, 2007



Dumping of rice husk in Nigeria



Dumping of saw dust in Nigeria



Burning of rice husk in Nigeria



Burning of wood waste in Nigeria

### **The Problem**

The agricultural wastes and wood wastes generated in several parts of Nigeria are either dumped or burnt, without being used for any energy or non-energy purposes. This results in significant environmental hazards and health problems due to methane and other harmful emissions. Alternatively, large amount of electricity can be generated if these biomass and animal waste residues are used for power generation.

In 2004, Nigeria's energy consumption mix was dominated by fossil fuels namely the oil (58 %) and the natural gas (34 %). Renewable resources, primarily in the form of hydroelectricity, contributed to 8 % only. This situation if continued could lead to significant increase in the country's GHG emissions. Therefore, it is important to use the country's renewable energy resources instead of the fossil fuels. This is particularly the case in rural electrification schemes, where, the potential of locally available biomass energy resources can be tapped.

Electricity generation from the biomass will also result in global environmental benefit in the form of CO<sub>2</sub> emission reduction by replacing fossil fuel based power generation.

The Nigerian Government has put forth many policies, legal and regulatory frameworks for promoting renewable energy based electricity generation in Nigeria. Some of such important policies are:

- The National Energy Policy (NEP 2003)
- The Electricity Power Sector Reform Act (EPSR 2005)
- The REA and the Rural Electrification Fund (REF 2006)
- Nigerian Renewable Electricity Policy (NREP 2006)
- Renewable Energy Master Plan (REMP 2007)



Though there are several policies and regulatory frameworks formulated for promoting the renewable energy based electricity generation, there is no growth in the biomass based power generation in Nigeria. It is mainly due to the several barriers that hinder the development of biomass power generation. The major barriers constraining the development of biomass based mini-grids are listed below:

(1) Lack of awareness and data

In general, there is a lack of awareness about the biomass power generation among all sectors of the population such as the project developers, financial institutions, engineering companies, insurance companies, construction companies, private investors, etc. The technical capacity of the Government remains seriously constrained by the lack of knowledge and expertise to implement the biomass based power generation and mini-grid projects in Nigeria. As a result, the biomass based mini-grid projects are not popular when compared to many other countries in the world. Moreover, the data required for the development of such projects is also lacking in Nigeria. Hence, collection of realistic information/data becomes practically very difficult for any project development.

(2) Policy and regulatory barriers such as lack of FiT

Though there are several policies and regulatory frameworks available for promoting the renewable energy based electricity generation, there are no defined and well framed path ways that make the policies successful enough to bring the desired outputs. At present, there is no FiT scheme for the biomass based mini-grid projects. In the absence of FiT, it is not possible for biomass based small scale power generation to compete with large scale fossil fuel based power generation, where the investment cost and the generation cost are lower.

(3) Lack of human and institutional capacity

The lack of awareness leads to lack of technical capacity. The capacities of various stakeholders, such as the project developers, engineering companies, insurance companies, construction companies, investors, local employees hired for operation and maintenance, etc. and the institutions, such as the Federal Government, related Ministries, financing institutions, etc., who will be involving in the biomass mini-grid projects, needs to be developed. Though the potential for biomass based mini-grid projects are high in Nigeria, this potential is not transformed into realistic projects, as the knowledge level and technical capacity within Nigeria is very much limited. There are no full scale demonstration projects for biomass based mini-grid where interested stakeholders can visit to gain knowledge and confidence.

(4) Financing/private sector investments in RE

Though feasibility studies conducted in some sites are encouraging, obtaining finance for these projects are difficult in Nigeria. Financial institutions are hesitant to lend for biomass mini-grid projects. This is mainly due to their lack of capacity in understanding, assessing and evaluating biomass projects. Private investors are also hesitant to invest in biomass mini-grid projects, as the investment costs are higher when compared to that of fossil fuel power plant. In addition to that, due to lack of experience, the cost of development and operation for the first few plants in Nigeria is expected to be higher.

The project aims to remove all the above barriers in order to establish a biomass based mini-grid demonstration project in the country.

**How the project seeks to solve the Issue:**

The proposed project aims at promoting RE, mainly in the form of biomass based mini-grids as viable options for augmenting the rural electrification programme in at Ikwo cluster, Ebonyi state Nigeria.

Ikwo cluster is a new cluster being developed by Ebonyi State Government. One of the companies to start construction of a rice mill in the cluster is Ebonyi Agro, a private enterprise. By 2013, the capacity will be 16 tph.

In addition to this, Ebonyi State Government is also planning a 5 tph rice mill in this cluster. Rice mill association's 3 tph mill is also expected to come in this cluster.

The existing Abakaliki rice mill cluster is expected to close soon and a part of the mills are expected to be relocated to this cluster. Ebonyi State Government has assured to give land at free of cost in the Ikwo cluster, for those existing rice mills in Abakaliki, to encourage relocation.

By the end of 2013, the Ikwo cluster is expected to have the following rice milling capacity:

**Table 2: Processing Capacity of Rice Mills in Ikwo Cluster in 2013**

| S. No. | Rice Mill             | Processing capacity (tph)* |
|--------|-----------------------|----------------------------|
| 1.     | Ebonyi Agro           | 16                         |
| 2.     | State Government      | 5                          |
| 3.     | Rice Mill Association | 3                          |
| 4.     | Small rice mills      | 10                         |
|        | <b>Total</b>          | <b>34</b>                  |

Note: Processing capacity is for paddy input

It is expected that the annual operating hours in the cluster is around 7,500 hours. Annual paddy processing in the cluster is given in the following table:

**Table 3: Annual Paddy Processing**

| S. No. | Rice Mill             | Processing capacity (tph) | Annual Paddy Processing (tons/year) |
|--------|-----------------------|---------------------------|-------------------------------------|
| 1.     | Ebonyi Agro           | 16                        | 120,000                             |
| 2.     | State Government      | 5                         | 37,500                              |
| 3.     | Rice Mill Association | 3                         | 22,500                              |
| 4.     | Small rice mills      | 10                        | 75,000                              |
|        | <b>Total</b>          | <b>34</b>                 | <b>255,000</b>                      |

The following table shows the expected rice husk generation in Ikwo rice mill cluster in the year 2013.

| S. No. | Rice mill             | Annual paddy processing (tons) | Annual rice husk generation (tons/year) |
|--------|-----------------------|--------------------------------|---|
| 1.     | Ebonyi Agro           | 120,000                        | 30,000                                  |
| 2.     | State Government      | 37,500                         | 9,375                                   |
| 3.     | Rice Mill Association | 22,500                         | 5,625                                   |
| 4.     | Small rice mills      | 75,000                         | 18,750                                  |
|        | <b>Total</b>          | <b>255,000</b>                 | <b>63,750</b>                           |

The 5 MW rice husk based power generation project will be installed within the Ikwo rice mill cluster which generates around 63,750 tons of rice husk per year. Annual rice husk requirement for the power plant will be 45,030 tons per year. It is clearly evident that there is surplus rice husk available in the cluster.

After GEF intervention, the rice mills in the Ikwo cluster, Ebonyi State are expected to get electricity directly from the 5 MW rice husk power plant replacing diesel generators for electricity. In addition, hospital, University, school, local communities, etc. in the nearby area of the power plant will also get electricity from the power plant. Hence, the use of fossil fuel based electricity (from diesel generators) will also be reduced.

As the rice mills get electricity from the 5 MW rice husk power plant, considerable reduction in milling cost is expected. This will result in significant growth of rice milling sector in Ebonyi State which will increase the rice farming as well. The increased rice production and millings are expected to increase the employment opportunities, revenue generation, etc. for the local people. Moreover, increased electricity availability to University, hospital, Government Houses, school, local community, etc. will also increase their quality of life and productivity.

Use of biomass electricity will save significant amount of diesel and hence will save significant cash outlay from the State for the purchase of diesel. This savings can be used for other productive uses.

The demonstration of technical and financial viability of 5 MW biomass based power generation and mini-grid will enable the Government to further establish appropriate policy and regulatory framework, to strengthen institutions and to build capacity leading to the creation of a conducive market environment for increased private sector investment programmes in renewable energy.

The proposed biomass based mini-grids to be set up under the project are expected to bring about global benefits in reducing 501,936 t CO<sub>2</sub>e directly and 2,509,680 t CO<sub>2</sub>e indirectly, for a period of 20 years, which otherwise would have resulted from the use of diesel generators, as is currently the case in Nigeria.

The project is also expected to bring about considerable socio-economic benefits by improving the electricity access situation, industrialization and employment generation. The implementation of 5 MW biomass based mini-grid project will reduce the energy cost of rice milling and save a considerable amount of spending on diesel, which can be diverted to the other economic activities. By selling rice husk to the power plant, the rice mills also get economic benefit. The project will bring new technology, knowhow and skill level to Nigeria. The increased availability of power will spur the growth of other industries nearby the project location. The direct and indirect employment generation will be an added economic benefit.

In addition, the project has huge replication potential, where the agro residues generated in the agro processing industries will be utilized. If this potential is realized, there will be a considerable reduction in the energy related CO<sub>2</sub> emissions in Nigeria and the energy supply situation in the country will be improved.

The project consists of four technical components:

**Project component 1 – Development of techno-economic feasibility studies and business plans for identified potential sites to facilitate replication**

Project Component 1 (PC1) aims at conducting techno-economic feasibility studies, development of business plans for the identified potential sites for facilitating replication and other necessary activities for the development of the feasibility study power plants. Based on the available information from the site visit and studies conducted during the PPG stage, the following sites were identified for full feasibility study and for further development:

- a) 5 MW wood waste power plant in Ondo State
- b) 2 MW wood waste power plant in Ogun State and
- c) 2 MW rice husk power plant in Benue State

These 3 projects are not included in the investment portfolio of the GEF project because these projects were identified only during PPG stage and all these projects are in early stage of development. For these projects, ownership title, investment and operational arrangements are not yet finalised. All these sites mentioned are in clusters having many small mill owners. It is very difficult to explain to them, make them understand, unite them and make any progress towards power plant installation. Based on the experience gained in the 5 MW demonstration site in Ebonyi State, it will take at least 2 years to develop these projects to an advanced stage suitable for implementation. Hence, it is not possible to demonstrate in these sites, but at least initiation of the work can be done and which otherwise will not happen without GEF funding.

GEF funding along with co-financing towards these 3 projects will contribute to the replication of the projects and will result in additional emission reduction. This will also give new confidence to the country as a whole to take positive actions in realising more and more biomass power plant projects in the country.

Under this component, the project will work with the State Governments, National and International experts and will deliver the following output:

*1. Techno-economic feasibility studies and business plans developed for the 3 identified potential sites to facilitate replication.*

Techno-economic feasibility studies and business plans developed for the 3 identified potential sites to facilitate replication

A report on list of agro-processing industries, production capacity, annual production data of the industries, etc., will be prepared. After that, detailed techno-economic feasibility studies will be conducted by international biomass experts in all the sites mentioned above. Appropriate business plan for further development of these sites will also be formulated. The techno-economic feasibility study will also include a study on historical biomass generation at these sites in order to ensure the sustainable operation of the power plants throughout their life time. In order to get the accurate assessment of biomass availability, the daily, weekly, monthly and yearly operating patterns of the related industrial activities including the operational variations during different seasons such as rainy, dry, peak, off-peak, etc., will be thoroughly studied. The biomass supply assessment will be done for the entire year, with a special focus on supply during rainy seasons, when the industrial processing activities are expected to be minimal. Activities related to planning and preparation of the mini-grid establishment on these feasibility study sites including, an assessment of the electricity demand for all the nearby electricity consumers and their current electricity sources will be done in order to determine the possibility of selling the electricity to them. The study will also include an assessment on establishing the mini-grid. Information on the potential investors for the power plant projects will also be collected. Based on all the above assessments, a business plan will be developed for the investment, financing, construction and operation of the project. These business plans will be used to attract project developers and investors to replicate the projects. In addition, identification of licensing and permits required, processing procedures and time required for these 3 sites will be carried out by national experts. Similarly, compilation of BoI privileges and any other privileges along with the existing tax schemes applicable for the biomass project feasibility study sites will be carried out by the national experts. National experts will be engaged for the compilation of environmental regulation from relevant departments, processing time, procedures, etc. for these sites.

In addition, under this output, compilation of proposed government supports/schemes possible for the biomass feasibility projects, compilation of meteorological data, seismic data and other relevant data for the implementation for the biomass project feasibility study sites will also be completed.

Assistance in data collection such as projected Government grid electricity pricing for the next 15 years for feasibility study will be provided through co-financing resources.

Also, co-financing resources will be provided for facilitation and participation of GEF experts' missions and data collection.

### **Project component 2 - Demonstration of techno-economic viability of biomass based mini-grid**

Project Component 2 (PC2) aims in commissioning a biomass based mini-grid of 5 MW installed capacity that will replace diesel power generation and thereby contributing to the reduction of around 25,000 t CO<sub>2</sub> emission per year. As the project is new to Nigeria sufficient capacity development in operation and maintenance (O&M) of biomass power plant as well as the management of mini-grid will be provided. The biomass mini-grid project will be monitored for its performance and the result will be widely disseminated. All the stakeholders are expected to gain considerable knowledge and experience and are expected to replicate such projects elsewhere in Nigeria.

During the PPG stage, in addition to the 5 MW rice husk power plant, potential sites for a 2 MW biomass power plant and two 0.5 MW Small Hydro Power (SHP) plants were identified for a total capacity of 3 MW and detailed studies were carried out. However, the 5 MW biomass project in Ebonyi State was brought up to an advanced stage, where the support and co-financing commitments by shareholders were finalised. The Government requested UNIDO to support further in this project, as it is in the advanced stage. Hence, the 5 MW biomass project was considered instead of the 2 MW biomass and 2 x 0.5 MW SHP projects.

The GEF contribution will not be used for the EPC contract of the power plant. The GEF contribution will be mainly used towards the development aspects before the construction of the power plant and for distribution of electricity to various customers.

This is the first rice husk power plant project in Nigeria. There is no local expertise, knowledge, skill in any of the project development activities. Hence more international expertise is required to bring this project to the operational level and provide necessary trainings to the various stakeholders of the project, so that they will ensure sustainable operation of this plant as well as replication of projects.

Without GEF grant, the breakeven electricity sales price from the power plant is very high and it is difficult to find buyers near the project site. GEF involvement will bring down the electricity sales price to a reasonable level and will help in the realisation of the project.

Under this component, the project will work with the Ministry of Energy, Energy Commission, Federal Ministry of Housing, Environment and Urban Development, State Government, international experts, national experts, private sectors, financing institutions, equipment suppliers, engineering companies, etc. and will deliver the following output:

- 1. A biomass based power plant of 5 MW commissioned in the selected site along with mini-grid*
- 2. Capacity on biomass power plant operation and maintenance as well as mini-grid management developed*
- 3. The mini-grid independently monitored, evaluated, lessons learnt and information widely distributed*

#### A biomass based power plant of 5 MW commissioned in the selected site along with mini-grid

It aims to implement biomass based mini-grid in the selected site. The electricity produced will be distributed to the consumers through the mini-grid.

Detailed technical specification will be incorporated in the bid documents along with commercial conditions. Once the share holding patterns are finalized, bid document will be launched internationally for sourcing biomass power plant equipments. Once bidders submit their bids, they will be evaluated and

shortlisted and the project will be awarded to the most competent and capable bidder based on the scoring mechanism set forth. After the contract is awarded to the bidder, the bidder is expected to implement the project based on the cost and time frame fixed in the bid document. An international expert will be hired to oversee the site construction activities. All necessary licenses, permits and contracts required for the construction and the operation of the power plant will be arranged before starting the construction of the plant. An international insurance expert will study the insurance regulations and practices in Nigeria and come-up with suitable recommendations on the insurance required for the construction and operation of the power plant.

Similarly, the tender document preparation, launching, tender evaluation, etc. will be done for the mini-grid and mini-grid Installation Company will be selected. For mini-grid construction, grid interconnection with the power plant, metering distribution lines, provision of energy efficient meters for the consumers, etc., an amount of USD 450,000 will be borne by GEF. Without this contribution from GEF, the power plant will result in higher electricity sale price which will be difficult to find buyers. Commissioning and other costs will be taken care by the Ebonyi State Government. The construction and commissioning activities will be supervised by the local experts.

In the construction site, mini-grid owners (shareholders) will have a site office to manage the day-to-day activities during the construction and commissioning of the biomass based mini-grid and will have their own staff for this purpose. This team will work closely with the equipment supplier/EPC contractor and the construction companies in order to facilitate their works in the sites. UNIDO project management team, the international experts and the local experts will closely interact with the site office team and will assist and advice them in the implementation activities.

Since this is the first biomass power plant in Nigeria, there is not much experience in O&M of the plant. Hence the equipment supplier/EPC contractor will provide four overseas power plant operational experts for operating the power plant for a period of 1 year. These operational experts will train the local operators for the sustainable operation of the power plant throughout its lifetime.

Once the project construction is over, performance tests will be conducted by the EPC contractor in the presence of the international expert.

GEF resources will be used for providing technical assistance for the development, installation and commissioning of the proposed biomass based mini-grid power plant and will not be used for any other equipment purchase other than mini-grid installation. Only the co-financing resources will be utilised for power plant equipment purchase and installation activities. To be precise, the co-financing resources will be utilised for purchase of land and power plant construction and commissioning, and for a part of mini-grid construction activities.

GEF resources will be used for the technical assistance of the activities such as, preparation and launching of bid documents for power plant and mini-grid, evaluation of bid, selection of equipment suppliers for power plant and mini-grid, detailed testing of soil, water and fuel, analysis of electricity customer profile, Obtaining licenses and permits, providing expert inspection and supervision during construction of power plant and mini-grid, arrangements for insurance and contracts, etc.

#### Capacity on biomass power plant O&M and mini-grid management developed

One of the major issues in Nigeria is the lack of manpower capacity in O&M of the biomass power plant and management of mini-grid. The project will identify the operators with adequate educational background and experience and then train them in O&M aspects of biomass power plant and management of mini-grid. Operators will be hired in two stages. In the first stage, around five operators will be hired and they will be given a two week classroom training on “Understanding biomass power plant, its construction and operation”. Power plant administration staff and other key stakeholders will also participate in the training activities.

After classroom training, around 10 operators will get hands-on-training in the existing boiler-turbine power plant systems within Nigeria.

After getting reasonable training, suitable operators will be placed in the power plant and they will be trained by equipment suppliers during the construction, commissioning and test runs. They will be given on-the-job training and class room training. The contents of exact training will be finalized after discussion with the equipment suppliers. The operators will also assist the project owners in the day-to-day site activities in construction, commissioning and test run.

In addition to this, training to the electricity distribution company on management of electricity distribution, metering and fee collection will be organised.

#### Independent monitoring and evaluation of mini-grid and distribution of the lessons learnt

After completion of the project, the project performance monitoring will be conducted to study the technical, financial, environmental and socio-economic performance of the projects. A monitoring report will be prepared based on the monitoring and analysis. Full scale project demonstration site visit and seminars will be organized and the project experiences will be disseminated to various interested stake holders in order to increase the replication potential of the project. Various dissemination tools such as leaflets, website, etc., will be used for effective dissemination.

#### **Project component 3 – Strengthening of financial and policy environment to support RE based mini-grid systems.**

Project Component 3 (PC3) aims to strengthen the financial and policy environment to support RE based mini-grid system. This will be done through close cooperation with Ministry of Energy, Energy Commission of Nigeria, Nigeria Electricity Regulatory Authority, CBN, BoI and local financing institutions. Recommendations on FiT for biomass power plant will also be made.

Under this component, the project will work with Federal Ministry of Energy, Federal Ministry of Housing, Environment and Urban Development, Energy Commission, CBN, BoI, State Governments, international experts, national experts, financing institutions and other commercial banks and will deliver the following output:

- 1. Feed-in-Tariff for biomass power in place.*
- 2. Appropriate financing facility developed for RE related projects*

#### Development of Feed in Tariff (FiT) for biomass power

One of the major policy and regulatory issue in Nigeria for the development of biomass based power generation is the lack of FiT scheme for renewable energy. FiT scheme already exists for large IPPs. But, when this power purchase tariff is applied for RE based power plants it is very low as the cost of power generation from biomass is much higher when compared to large scale IPPs such as natural gas based gas turbines/combined cycle power plants. Hence, in order to promote biomass based power generation, attractive FiT scheme is required. The project will engage national experts for compiling the various studies done so far in Nigeria related to FiT scheme to provide feedback to international experts for the creation of new, workable FiT scheme. International experts will be engaged to study, develop and recommend appropriate FiT for the Government. National experts will be engaged for liaising with relevant agencies for the creation of the Feed-in-tariff scheme. Consultative workshops will be conducted to get a feedback on the FiT scheme. All these activities shall aid in the development of FiT for biomass power in Nigeria.

### Appropriate financing facility developed for RE related projects

At present the financial institutions lack knowledge and experience in financing the biomass energy projects. They also lack the knowledge to assess the biomass projects and related project risks. Moreover, good demonstration projects are not available in Nigeria for them to learn from.

The project will conduct specific training programmes for financing institutions, so that they can understand and assess the project and related risks. These activities in addition to the demonstration project are expected to change the mindset of the financial institutions and they are likely to finance more and more for biomass energy projects.

During the project implementation stage, a financial scheme, specifically for the RE projects, similar to the one which was introduced in Nigeria recently for power projects (mostly from fossil fuel), called the Power Fund, will be developed.

GEF and co-financing contributions will be used only for facilitating the financing scheme and not for establishing the facility. Hence, the actual capital investment for the scheme is expected to come from outside of the project resources.

The Power Fund scheme was introduced by Central Bank of Nigeria (CBN) on March, 2010. Under this scheme, CBN provided N 500 Billion investment facility towards the development of 2,000 MW power projects across major commercial and industrial cities in the country. The fund is being administered by the state-owned Bank of Industries (BoI), while the African Finance Corporation (AFC) serves as its adviser. The funds are given to BoI at 1% interest rate. BoI distributes the fund in the form of concessionary loan at a interest rate of not more than 7% with a tenor of 10 to 15 years. Already projects are identified and the implementations are going on.

National experts will be engaged for coordinating with various relevant departments to design appropriate financial mechanism along with international experts. In developing the proposed financing facility, during the project implementation, efforts will be taken in collaboration with Ministry of Energy, CBN, BoI and other commercial banks for creating a similar financial facility exclusively for RE related projects. This would add momentum to the RE investments which would in-turn augment rural electrification in the country. Efforts will be taken to disseminate the information on newly created RE power fund.

Similarly, efforts will be taken to consolidate various support schemes and to streamline the support schemes of various departments into a centralized well co-ordinated one.

### **Project component 4 – Capacity development for replication of biomass mini-grid technologies**

Project Component 4 (PC4) will facilitate the capacity building on both human and institutional fronts at various levels including, engineers, energy service companies, O&M companies, etc. Various stakeholders of biomass power plant mini-grid system such as experts, planners, project developers, private investors, RE related and financial institutions, engineering companies and construction companies will be trained in biomass project development and implementation. Capacities of financial institutions will be developed for assessment and evaluation of biomass power plant projects to increase their knowledge and capacity on financing these projects. Local electrical companies will be trained in mini-grid design and the engineering companies will be trained in biomass power plant O&M aspects.

Under this component the project will work with the State Government, international experts, national experts, equipment suppliers, local engineering firms, O&M Companies, RE related and financial institutions and will deliver the following output:



1. *Local capacity in designing mini-grid developed*
2. *Experts, planners, and institutions are trained in developing biomass based energy and mini-grid system*
3. *Capacity of RE related and financing institutions strengthened*
4. *Capacity of local engineering companies and O&M companies on operation and maintenance of biomass power plant and mini-grid system developed*

#### Development of local capacity in designing mini-grid

At present there is a lack of knowledge and experience in designing mini-grid for the biomass projects. In order to remove this barrier, a training program will be specifically arranged for interested local electrical companies. They will be trained mainly on design of mini-grid, integration aspects of mini-grid with biomass power plant including distribution lines, integration with consumers of electricity from biomass power plants, usage of step up/step down transformers, plant outage, fault levels, safety aspects, etc.

#### Training in developing biomass based energy and mini-grid systems to experts, planners and institutions

Various stakeholders of biomass power plant mini-grid system such as experts, planners, project developers, private investors, financial institutions, engineering companies and construction companies will be trained in biomass based mini-grid project development and implementation. Specific three day trainings will be organized in two different locations in Nigeria. In addition to that, biomass based mini-grid project development guide will be prepared for the usage of various stakeholders for implementation of biomass based mini-grids. Using co-financing resources, study tours will be organized for various government agencies to the demonstration project site for developing their capacities. Efforts will be taken to create a nationwide awareness on biomass power generation/renewable energy. Also, co-ordination workshops will be conducted for various departments to simplify licensing, permit procedures for Biomass/Renewable energy (RE) plants.

Under this output, it is planned to establish a one-stop information centre for renewable energy projects, especially biomass energy projects. The State Government will be responsible for this. A department level consultation meeting for the establishment of the information centre for RE projects will be organized. The location of such an information centre, modalities and procedures for establishment and operation of that centre, etc. will be decided during the inception period of the project by the State Government. Database/information to be kept at the information centre will be prepared by an international expert in assistance with national experts. At the information centre, trainings and workshops for relevant government staff on capacity development in Biomass/Renewable Energy technologies will be conducted periodically.

Also, co-ordination workshops among various departments to simplify licensing and permit procedures for Biomass/Renewable energy plants will be conducted.

#### Capacity of RE related and financing institutions strengthened

The project will identify few relevant renewable energy institutions in Nigeria and will provide necessary supports and adequate training for them on biomass project development in order to strengthen their capacities further; so that they will be able to assist development of similar biomass projects in the future in other places of Nigeria.

One of the major issues faced by Nigerian financing institutions is the lack of capacity in understanding, assessing and evaluating biomass projects for financing. As a result, whenever potential project

developer/investors approach them for financing, they are hesitant to provide loan for the biomass projects. The project will remove this barrier by selecting several financing institutions and train them on understanding, assessing and evaluating biomass projects for financing.

After completion of the training, the knowledge of the financing institutions about the biomass mini-grid projects is expected to increase considerably and they are expected to consider biomass projects more favourably.

#### Development of capacity of local engineering companies and O&M companies on operation and maintenance of biomass power plant and mini-grid systems

A list of existing local engineering companies and O&M companies that are capable in operating and maintaining the biomass power plant, mini-grid systems and other renewable energy technologies will be compiled. Two or three local engineering companies and O&M companies will be identified and they will be trained by equipment suppliers during the construction, commissioning and test runs. They will be given on-the-job training and class room training. The contents of exact training will be finalized after discussion with the equipment suppliers. These engineering companies and O&M companies will be engaged later on for the actual maintenance of the power plant.

#### **Expected global environmental benefits to be delivered**

The proposed biomass based mini-grid project is expected to reduce a considerable amount of CO<sub>2</sub> emissions, which otherwise would have resulted from the use of diesel generators, as is currently the case in Nigeria (this is the baseline). In addition, this project has huge replication potential of about 25 MW<sup>3</sup> using the agro residues generated in many of the agro processing industries. If this potential is realized, then there will be a considerable reduction in the energy related CO<sub>2</sub> emissions in Nigeria. Moreover, the energy supply situation in the country will also be improved remarkably.

Based on the data collected, it has been estimated that over the project's lifetime of 20 years, the project will be instrumental in reducing 501,936 t CO<sub>2</sub>e directly and 2,509,680 tCO<sub>2</sub>e indirectly over a period of 20 years. Please see Annex F for a detailed description of the direct and indirect GHG emission reductions.

Though there is a good potential for biomass projects in Nigeria, biomass power projects are not happening as the investment cost is high especially when it is developed for the first time. Also the investor confidence is low in the absence of GEF. When GEF support, the project investors are encouraged to invest in the project and realize it, resulting in the global environmental benefits.

If this 5 MW project is implemented successfully with GEF support, it would act as catalyst for further replication of biomass projects, thus contributing to more global environmental benefits.

#### **Institutional continuity and replicability and sustainability of global environmental benefits**

The outputs to be generated by the GEF UNIDO Project Components 1, 2, 3 and 4 aim and contribute towards creating an environment favourable for implementation of several biomass projects. The outputs are consistent with and instrumental in achieving the objectives of Nigerian key energy policies as well as the recommended plan of actions.

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<sup>3</sup> Study of energy resource assessment of agricultural wastes in Nigeria during 2006

### Project Component 1: Development of techno-economic feasibility studies and business plan for identified potential sites to facilitate replication

One of the key aspects for replicability of the project and sustainability of global environmental benefits depends upon the identification of technically feasible and commercially viable projects. In the project component 1, through detailed techno-economic feasibility studies for the identified potential sites, technical and financial viability of the sites will be thoroughly studied and a business plan will be prepared for each site. Also, through other support and development activities, this project component will contribute towards the replication of the sites.

### Project component 2: Demonstration of techno-economic viability of biomass based mini-grid

The 5 MW biomass power plant project to be implemented in PC 2, will demonstrate the technology, economics and environmental benefits of the project throughout Nigeria. Through the training programmes aimed for biomass power plant O&M as well as mini-grid management, sustainable operation of the power plant is ensured. This will further ensure the sustainability of global environmental benefits resulting from the operation of the biomass power plant.

The monitoring, evaluation and dissemination of the results of 5 MW biomass power plant implementation and operation will increase the replicability of similar projects in Nigeria and will also increase the global environmental benefits on the whole. In addition to that, the result of the mini-grid monitoring and evaluation will assist in the replication of several other mini-grids in Nigeria.

Though the capacity of implemented project is 5 MW, the capacity of replicable biomass projects are not necessarily exactly the same size, but it can be of any size ranging from 1 MW to 20 MW capacity.

### Project component 3: Strengthening of financial and policy environment to support RE based mini-grid systems

Once FiT for biomass power plant and appropriate financing facility is in place, several similar biomass power plant projects will be replicated and this will assure additional global environmental benefits. The FiT for biomass power plant implemented by the Government is expected to ensure pre-defined income from biomass projects and will completely eradicate the electricity off-take risks and income risks, thereby resulting in increased interest among the investors to invest in biomass power plant projects.

The financing facility created will be a big boost for institutional continuity and replicability of the project.

### Project component 4: Capacity development for replication of RE mini-grid technologies.

Once local capacity in designing the mini-grids are developed and the experts, planners and institutions are trained in developing biomass based energy and mini-grid systems, the confidence of developing biomass based mini-grid projects locally will be enhanced. Study tours to the demonstration project site will further enhance their confidence and capacity in developing biomass based mini-grids. When local capacity of financing institutions is developed, the financing possibilities of several other biomass mini-grid projects in the future will be enhanced.

Strengthening of RE related institutions will significantly help in the enhancement of skills in biomass project development and knowledge in assessment and operation of biomass mini-grid projects in Nigeria. This local knowledge base is very crucial with respect to the institutional continuity and the replicability of biomass projects in Nigeria in future. This will also ensure the sustainability of global environmental benefits.

Moreover, under this component, a one stop information centre for biomass/RE project will be established. The centre will conduct trainings and workshops for relevant government staff, as and when required, for capacity development, in Biomass/Technologies. This will ensure the development of human and institutional capacity in these areas. In addition, nationwide awareness programmes will be conducted on biomass power generation/RE.

Training to local engineering companies and O&M companies on operation and maintenance of biomass mini-grids will boost their knowledge and confidence.

All the above aspects will favour institutional continuity, replicability and global environmental benefits of the project.

Preliminary resource assessment conducted during the PPG stage indicated that the power generation potential in rice, sugar, palm oil and wood sectors alone was above 50 MW. Though the demonstration project belongs to the rice sector, the principle is exactly the same for other biomass sectors also. A replication potential of total 25 MW is assumed for the next 10 years which is conservative and practically achievable target. This target is justified as there are several wood clusters, rice mill clusters, sugar mills, palm oil mills, already in place in Nigeria which has high potential to implement such biomass projects.

#### **B. DESCRIBE THE CONSISTENCY OF THE PROJECT WITH NATIONAL AND/OR REGIONAL PRIORITIES/PLANS:**

Following are the various policies formulated by the Government to promote rural electrification and renewable energy including biomass power in Nigeria:

##### (1) The National Energy Policy (NEP 2003)

It covers all the energy sectors. The key objectives and targets for the power sector are (i) to expand electricity access to 75 % of the population by 2020, (ii) to provide electricity supply for all local government headquarters and other cities by 2010 and (iii) to promote private sector participation. It involves the development and promotion of the country's renewable energy resources, promotion of decentralized energy supply, especially in rural areas, based on RE resources, promotion of efficient methods in the use of biomass energy resources, following the trends of international developments in renewable energy technologies and applications and discouraging the use of wood as fuel.

##### (2) The Electricity Power Sector Reform Act (EPSR 2005)

The Federal Government set a target for increasing electricity access in rural areas from 40 % in 2005 to 75 % by 2015. The rural electrification strategy and plan aim at the expansion of the main grid, the development of isolated and mini-grid systems, the creation of an enabling environment to promote investments in RE power generation and the fostering of public and private sector partnerships designed to supply electricity for the rural population.

##### (3) Nigerian Renewable Electricity Policy (NREP 2006)

The objectives of this policy are (i) to promote biomass as an alternative energy resource especially in the rural areas, (ii) to promote efficient use of agricultural residues, animal and human wastes as energy sources and (iii) to reduce health hazards arising from open burning of biomass resources and agricultural residues. It also supports the construction of independent renewable electricity systems in areas not covered by the electricity grid to provide power service for local economic activities and sustainable living

#### (4) Renewable Energy Master Plan (REMP 2007)

It envisages aggregating the electrification demand of 14,000 MW by 2015 of which RE will constitute about 5 % (701 MW). In 2025, the electricity demand is projected to increase to 29,000 MW with RE satisfying up to 10 % of the country's overall energy demand. REMP targets contributions to the electricity supply mix from biomass sources to around 50 MW for the year 2015 and 400 MW for the year 2025 respectively.

It is clear that this project is in line with all the above mentioned government policies and decisions and also fits well within the national priorities of providing access to rural energy through expanded rural electrification in the country.

#### **C. DESCRIBE THE CONSISTENCY OF THE PROJECT WITH [GEF STRATEGIES](#) AND STRATEGIC PROGRAMS:**

The project is consistent with the GEF Climate Change focal area Strategic programme SP-4: Promoting sustainable energy production from biomass. As described in the climate change focal area strategy, the proposed project will contribute positively to the Renewable Energy market transformation process, which will result in reduced fossil fuels use and GHG emission reductions. The project also promotes sustainable electricity generation from biomass.

#### **D. JUSTIFY THE TYPE OF FINANCING SUPPORT PROVIDED WITH THE GEF RESOURCES.**

The GEF resources will be utilized to support the development of biomass based mini-grid system thereby demonstrating the viability of RE based mini-grid system. Some of the resources will also be used for providing capacity building especially (1) in the mapping of biomass resources; (2) in the development of biomass based mini-grid system for the operators and (3) in strengthening of the financing institutions on biomass based mini-grid project assessment and evaluation.

The context and barrier analysis as well as stakeholders discussions carried out during the PIF preparation and PPG implementations have clearly shown that:

- The Government has insufficient resources, lack the technical expertise, confidence and institutional capacity to implement biomass power plant project and to implement programs for promoting and supporting biomass mini-grid projects in Nigeria in short to medium-term.
- The very limited expertise currently available in Nigeria is not going to be addressed without transfer of knowledge, expertise and implementation experience from other countries.
- To convince private sectors that investing in biomass power plant projects make a very good and economical sense and availability of national success story is a critical component for the effective promotion of biomass power plant project in Nigeria.
- Without sufficient support, it is not possible for private investors to carry out such projects independently in Nigeria, as there are several such barriers existing in the market.

The project is targeted to address and remove existing policy gaps and technical capacity barriers at the institutional and market level by providing technical assistance. GEF resources are needed to secure incremental international and national expertise; human resources and services needed to address and remove many of identified barriers implement biomass mini-grids by carrying out the described activities.

Moreover, there is a part of GEF contribution towards mini-grid establishment. Without GEF grant for this activity, the breakeven electricity sales price from the power plant will be very high and it will be

very difficult to find electricity buyers near the project site. GEF involvement will bring down the electricity sales price to a reasonable level and will help in the realisation of the project.

Without GEF grant in other components, the expected overall outcomes of the project are not likely to materialise. Hence, without GEF contribution, there will not be significant development in biomass power generation in Nigeria for several forthcoming years.

#### **E. OUTLINE THE COORDINATION WITH OTHER RELATED INITIATIVES:**

The project will complement the ongoing policy thrust to promote national projects and programmes on rural electrification. Currently, Nigeria has not benefited much from GEF or other multi/bilateral funds in promoting renewable energy based mini-grids in the country. Therefore, this project would be a significant investment to meet the targets of the rural energy demand in Nigeria. The project will complement the efforts of UNDP supported REMP and World Bank (WB) projects.

The present project will liaise with these specific regional activities under the umbrella of the GEF Programmatic Energy programme for West Africa lead by UNIDO. At the regional level, great emphasis will be given for coordinating and harmonizing the project with several other similar projects focusing on national market transformations to promote the uptake of mini-grids powered by renewable energy (Cape Verde, Côte d'Ivoire, Chad, The Gambia, Guinea, Liberia, Nigeria and Sierra Leone) through the GEF-funded Programmatic Approach on Access to Energy in West Africa which is lead by UNIDO. This regional harmonization and coordination will be undertaken through ECOWAS (the Economic Commission of West African States), of which Nigeria and all the other countries are members. Because ECOWAS has a focus on promoting renewable energy among its members, it is by far the most suited regional institution to organize the coordination and harmonization between these GEF projects through UNIDO. Through UNIDO, policies and strategies to promote market-based RE powered mini-grids will progressively be expanded to all countries in the region.

#### **F. DISCUSS THE VALUE-ADDED OF GEF INVOLVEMENT IN THE PROJECT DEMONSTRATED THROUGH INCREMENTAL REASONING :**

At present, there are several barriers for the development and implementation of biomass mini-grid projects in Nigeria and GEF funding is being requested to remove those barriers. GEF funding will be used to provide the necessary technical assistance for the development and implementation of biomass mini-grid projects through improved policies and compatible financial environment. The GEF funding to be used in the 5 MW biomass mini-grid demonstration project will demonstrate the technical feasibility and commercial viability of biomass mini-grid projects, which will help in replication of such projects in future.

The identified barriers will be significantly removed once the demonstration effect is proved through project replications. GEF financing will help in institutional strengthening, capacity building and also in creation of FiT. In addition to that, the GEF funding is expected to bring favourable financing environment for the biomass mini-grid projects. The fund will also help in the project management in coordination activities.

#### **Baseline**

Nigeria is currently experiencing severe shortage of electricity for household, commercial and industrial applications. Only less than 20% of the rural households have access to electricity. The electricity being supplied is also unreliable and of inferior quality with frequent shut downs and grid failures. Most of the industries are not connected to national grid and they depend upon diesel generators for their energy needs.

Lack of electricity significantly reduces the new investments in modern technologies and industries. Use of diesel in industrial and commercial sectors contributes significantly to the CO<sub>2</sub> emissions. On the other hand, considerable amount of agricultural and wood wastes generated in several parts of Nigeria are either dumped or burnt without being utilized for energy generation or other commercial purposes. Dumping and burning of these wastes results in significant environment pollution and human health hazards.

Though electricity can be generated from these biomass wastes, there is no knowledge and experience in Nigeria in this aspect. In addition, favourable policies and financial environment are not in place thereby making the investors hesitant to invest in such projects in Nigeria. There are limitations in the Government Ministry levels in terms of resources to prepare new policies and institutional framework.

Significant capacity building is needed in the form of trainings to improve the situations. The financial institutions in Nigeria are not experienced with biomass mini-grid projects and lack knowledge in assessment and evaluation of such projects. The Government is very well aware of these barriers, resource and capability constraints and is seeking the GEF support to remove those barriers.

In the case of Ebonyi State in Nigeria, rice milling is one of the major industrial activities. The local economy very much depends upon this activity. However, these rice mills are not connected to grid due to the electricity shortage. They use old inefficient diesel drives for rice milling.

### **Baseline trajectory**

In the absence of the proposed GEF- UNIDO project, no significant improvement is expected within the short term. In that case, the biomass mini-grid project implementation cannot be expected to happen and the biomass fuel will be wasted continuously without any energy usage thereby resulting in continuous environmental and health hazards. Moreover, the Nigerian Government's Policy initiatives will not result in any tangible output within the short term.

Without the GEF intervention, funding of this project could be difficult considering the barriers present in the country in developing RE based mini-grid projects and related investments, which are made worse by the current economic situation. Like in many other developing countries, the public sector in Nigeria will not be able to finance all the investment needed to satisfy the growing energy demand. Thus, it is important to seek the help of international funding agencies to remove the existing barriers, mobilize necessary technical support and for the financial means necessary to implement the project by the private sector.

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

In the absence of the proposed GEF-UNIDO project, very little steps, if at all any, towards the implementation of policies and programs to monitor, promote and support biomass mini-grid projects are likely to be made in the short-term. The vast majority of manufacturing enterprises will continue to suffer from lack of knowledge, understanding and technical capacity to manufacture the required biomass mini-grid components.

The main potential stake holders will continue to suffer from lack of information, understanding, experience and technical capacity in biomass mini-grid projects. There will not be any demonstration project to demonstrate smooth operations of such projects. Without GEF intervention, no new policy and regulatory framework can be prepared, as there is a lack of knowledge and resource for making it to happen.

In conclusion, the baseline scenario would not be able to bring about significant mitigation of most of the barriers that hamper the implementation of biomass mini-grid projects in Nigeria within the short-term. The underlying critical problem of the lack of adequate institutional capacity and supporting policy programs for biomass mini-grid projects and good technical expertise and skills on the market would remain unsolved.

### **GEF project alternative scenario**

The proposed UNIDO-GEF project would provide the incremental policy, technical and financial inputs required for supporting and effectively leveraging the national efforts in setting up and maintaining an infrastructure capable of supporting RE policy development and implementation, stimulating the creation of a market for biomass mini-grid components, services, electricity and in obtaining relevant GHG emission reductions. In doing so, the project would multiply the impact and global environmental returns of resources allocated by the Nigerian Government as well as by other international initiatives and programs.

GEF financing is sought to provide technical assistance as well as some part of equipment investment for implementing 5 MW biomass mini-grid project. The GEF co financing would facilitate this project to get off the ground. Hence, without the GEF funding, this project would not go ahead. The implementation, monitoring and dissemination activities of this project will result in significant confidence building in Nigeria and will enhance the interest in developing more biomass mini-grid projects.

The GEF financing will strengthen the institutional capacities, local knowledge and the expertise in the development, implementation and operation of biomass mini-grid projects. After GEF intervention, the rice mills are expected to get electricity from biomass power plant thereby reducing the cost of rice milling. This will result in significant growth of rice milling sector in Ebonyi State which will increase the rice farming as well.

As per the feasibility study of the 5 MW rice husk power plant, the cut-off electricity sales price is found to be 18.0 Naira/kWh and that with the GEF grant was found to be 16.7 Naira/kWh.

Generally, rice millers and other industrial consumers pay around 16 to 20 Naira/kWh for grid electricity depending upon the load utilization. However, the grid electricity is unreliable and inconsistent. In the absence of grid electricity, (which is the situation most of the day) the rice millers use their own diesel engines and sometimes, the mills are even closed. The cost of diesel electricity is around 30 Naira/kWh.

In the absence of GEF involvement, this project will not happen. GEF investment is instrumental in catalyzing the process of development of this project and bringing together a number of stakeholders, which otherwise would not have happened. In the absence of the GEF involvement, on an average, the electricity consumers would have spent an amount of anywhere around 16 to 30 Naira/kWh.

It is clear that there is a tangible impact to the price of electricity for the consumers when GEF involvement is considered.

In the absence of the GEF involvement, the biomass power plant will not materialise, because of the following reasons:

- In the absence of involvement of specialised agency such as GEF, the local state government (Ebonyi State) and the private sector investors will not have the confidence to invest in the project. Hence, GEF involvement is the only motivation for the investors to involve in the project
- Without the involvement of GEF, proper project development practices may not be followed, which may lead to the failure of the project.



- Since this is the first biomass power plant project in Nigeria, without participation of specialised agency such as GEF, the project will not take place.

The increased milling and production of rice is expected to increase the opportunities for employment and revenue generation for the local. In addition to the rice mills, University, Government guest house, hospital, school and other local communities in the nearby area will be receiving the electricity from the power plant. Use of biomass electricity will save significant amount of diesel, which otherwise would be used by them in diesel generators for electricity. The amount spent by general public and commercial and industrial establishments on the purchase of diesel for power generation can be utilized for other alternative productive purposes.

Considering the articulated structure of the GEF-UNIDO project and its high complementary, with other ongoing and planned renewable energy related technical assistance programs, project implementation would provide and receive critical contributions for multiplying the overall impact of Climate Change related technical assistance to Nigeria.

**G. INDICATE RISKS, INCLUDING CLIMATE CHANGE RISKS, THAT MIGHT PREVENT THE PROJECT OBJECTIVE(S) FROM BEING ACHIEVED AND OUTLINE RISK MANAGEMENT MEASURES:**

Six categories of risks related to the project and achieving its objectives are considered:

- i. Institutional,
- ii. Technical,
- iii. Market,
- iv. Financial,
- v. Implementation, and
- vi. Sustainability
- vii. Climate change risk

| Component          | Risk  | Potential impact | Probability | Risk Management   |
|--------------------|---|------------------|-------------|---|
| Institutional risk | Inadequate policy, regulatory and institutional framework | Medium           | Very low    | As the project is designed as independent mini-grid project and is not connected to the national grid, it faces less regulatory issues and hurdles. But, all these hurdles are expected to increase the investment and operation cost. Though, there are some legal procedures to be followed, they are manageable and do not pose serious implementation risk  |
| Technical risk     | Power plant not in operation for its designed life time   | High             | Very low    | Internationally accepted best practice project development steps will be carried out in the implementation of mini-grid project. High quality, experienced equipment supplier with proven track record will be considered. A fixed price, time bound contract will be signed with the EPC contractor having adequate performance guarantees and related liquidated damages for non-compliance. Project performance such |

|                     |  |          |          |   |
|---------------------|--|----------|----------|---|
|                     |  |          |          | as gross and net power generation, equipment warranty, etc. will also be managed by selecting the EPC contractor with proven track record.  |
| Market risk         | No off-takers for the generated electricity  | Medium   | Very Low | The electricity generated from the power plant is supplied to the rice mills and the other customers. The present demand of electricity outstrips the supply and hence there will not be any risk for electricity off-take.   |
| Financial risk      | No investors willing to invest in biomass mini-grid                                    | High     | Low      | In Project Component 2, UNIDO will mobilize investors to invest in the biomass mini-grids. During the last four years, UNIDO has conducted several activities related to the biomass power plant projects in Nigeria and already created awareness among the potential investors and lenders. Such activities already carried out by UNIDO in Nigeria is expected to help successful mobilization of financing both in the form of equity investment and loan for the mini-grid projects.     |
| Implementation risk | Failure of project implementation  | Medium   | Very Low | UNIDO will mitigate this risk through detailed development of activities plans in close cooperation with in-country project partners, stakeholders and developers. Agreed and transparent modus operandi will be defined before the start of the project implementation   |
| Sustainability risk | Failure to achieve project outcomes and objective after successful delivery of outputs | High     | Very Low | One of the project components is to train the operators for the sustainable operation of the power plant. Moreover, local industries will be identified and trained in the equipment maintenance activities during the project implementation stage and they will be engaged by project owners for future maintenance activities along the life time of the biomass power plants. The project investors' commercial interest in the project will ensure sustainable operation of the project. |
| Climate change risk | Floods   | Moderate | Low      | Power plant building, fuel storage area and site office will be located on an elevated area to prevent flooding. All buildings and structures will be designed and built appropriately to prevent flooding.   |

## **H. EXPLAIN HOW COST-EFFECTIVENESS IS REFLECTED IN THE PROJECT DESIGN:**

The project is considered to be cost effective intervention for GEF due to the CO<sub>2</sub> emission reduction potential from enhanced use of RE for mini-grid based electrification of Nigeria. Currently, most of the electricity generation in Nigeria is small scale diesel based individual generation. For a GEF contribution of US\$ 2.6 million, this project will directly result in 5 MW additional installed capacity based on biomass fuel. More importantly, the project is expected to result in the replication of several biomass mini-grid projects in Nigeria thus making it a high impact GEF intervention with enormous potential for promoting renewable energy markets in the country as well as in the region. The pilot projects established by the project will increase the local capacity in such a way that the future interventions will be further cost effective. The project is expected to generate cumulative direct GHG emission savings of 501,936 ton CO<sub>2</sub>e and indirect GHG emission savings of 2,509,680 ton CO<sub>2</sub>e.

### **Incremental cost principle applied on emission reduction from the project**

#### **Business-as-usual (BAU) scenario:**

The BAU scenario describes what would happen without the GEF project. In the absence of implementation of this project, most of the rice mills will be operating using diesel as their energy source.

In the absence of the project, small rice mills (which are expected to relocate from Abakaliki to Ikwo) will be operating using the existing diesel mill drives. Similarly, in the absence of the project, modern rice mills which are being developed in the Ikwo rice mill cluster will have to depend upon diesel generators. University, Government guest house, hospital, local community, etc. will continue to depend upon diesel generators for electricity.

Even though rice mills in Ikwo cluster will produce huge amount of rice husk, it will be left unused, without the availability of any technology to utilise it for energy purpose. Therefore, the baseline scenario would be the establishment of a diesel generator of capacity equivalent to 5 MW rice husk power plant capacity in the new cluster. This will lead to increased emissions due to burning of diesel. Although it is not practical to install a centralised 5 MW diesel engine, just for comparison purpose, such an option is considered. The investment under baseline scenario of installing a diesel generator of capacity equivalent to 5 MW rice husk power plant capacity is estimated at about 3.1 million USD including the mini-grid cost.

#### **GEF Project scenario:**

The alternative scenario relies on electricity production using the rice husk from rice mills in the cluster. This is the way of effective utilization of rice husk for power generation. In the project scenario, there are 3 modern rice mills in the cluster and other small rice mills which generate about 63,750 tons of rice husk/year. Entire amount of generated rice husk is available for power generation.

A 5 MW rice husk power plant will be installed in the cluster. The net available power of 3.97 MW will be supplied to rice mills and other customers. In the baseline, this amount of electricity would have been generated using diesel generator.

The investment for GEF project scenario for the 5 MW rice husk power plant is US\$ 12.49 million. This will replace diesel power generation and will contribute to emission reduction of about 501,936 t CO<sub>2</sub>e over a lifetime of 20 years (assuming an emission factor for diesel is 0.8 t CO<sub>2</sub>/MWh).

|  | <b>Baseline</b> | <b>Alternative</b> | <b>Increment</b> |
|--|-----------------|--------------------|------------------|
| Renewable electricity available for usage (MWh)        | 0               | 31,371             | 31,371           |
| Grid displaced emission reduction, t CO <sub>2</sub> e | 0               | 501,936            | 501,936          |
| Investment, '000 USD                                   | 3,100           | 12,492             | 9,392            |
| Increment Cost USD/t CO <sub>2</sub>                   | 18.7            |                    |                  |

There is a part of GEF contribution towards mini-grid establishment. Without GEF grant for this activity, the breakeven electricity sales price from the power plant will be very high and it will be very difficult to find electricity buyers near the project site. GEF involvement will bring down the electricity sales price to a reasonable level and will help in the realisation of the project.

Without GEF grant in other components, the expected overall outcomes of the project are not likely to materialise. Hence, without GEF contribution, there will not be significant development in biomass power generation in Nigeria for several forthcoming years.

### **PART III: INSTITUTIONAL COORDINATION AND SUPPORT**

#### **A. INSTITUTIONAL ARRANGEMENT:**

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

#### **B. PROJECT IMPLEMENTATION ARRANGEMENT:**

UNIDO will take the responsibility of implementing the project, the delivery of the planned outputs and the achievement of the expected outcomes. The project will be executed by UNIDO in collaboration with the concerned Federal Ministries, State Governments and the private sector stakeholders.

UNIDO will be responsible for:

- The general management and monitoring of the project,
- Reporting on the project performance to the GEF.
- Procuring the international expertise needed for delivering the planned outputs under the four project components.
- Managing, supervising and monitoring the work of the international teams and ensuring that the deliverables are technically sound and consistent with the project requirements.

A Project Management Unit (PMU) will be established within the Energy Commission of Nigeria. The PMU will consist of a Project Manager (PM) and the Project Administrative Assistant (PAA). The responsibilities of PMU will be as follows:

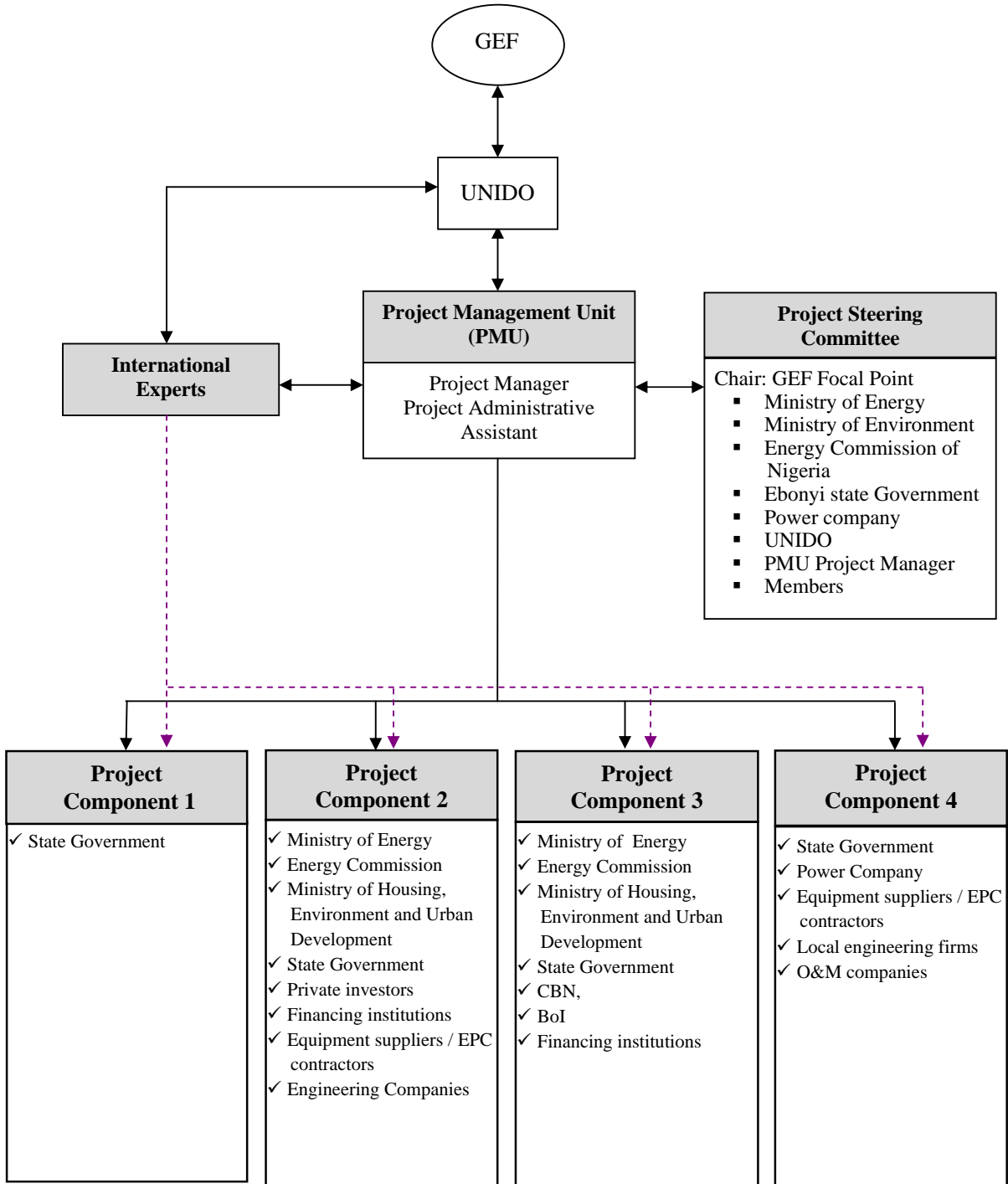
- Coordination of all project activities carried out by the national experts and other partners by having close association with the Ministry of Energy/State Governments.
- Day-to-day management, monitoring and evaluation of project activities as per planned project work.
- Organization of the various seminars and trainings to be carried out under Project Components 2, 3 and 4.

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

A Project Steering Committee (PSC) will be established. The purpose of this committee will be to review the progress in project implementation, to facilitate co-ordination among project shareholders and to maintain transparency in ensuring ownership and to support for the sustainability of the project. The PSC will have a balanced representation from key stakeholders including counterpart Ministries, public institutions and private sector representatives and UNIDO. The committee will be chaired by the GEF Focal point (Operations). The final composition of the PSC will be defined during the project implementation start-up phase. The PSC is envisaged to meet twice a year.

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

The following figure shows a diagram of the project implementation arrangement:



**Figure 3: Diagram of project implementation arrangement**

UNIDO will closely coordinate with ongoing as well as planned relevant initiatives to ensure maximum synergies and overall impact of Climate Change related technical assistance to Nigeria.

**PART IV: EXPLAIN THE ALIGNMENT OF PROJECT DESIGN WITH THE ORIGINAL PIF:**

The final design of the project is in line with the approved PIF. Further context analysis, review of existing barriers, meetings with various stakeholder groups carried out during the PPG phase, have confirmed the strong relevance of the original UNIDO GEF project and its additionality to ongoing and planned national programs to promote and support increased renewable energy based electricity in Nigeria.

In the original PIF, 2 x 0.5 MW Small Hydro Power (SHP) and 2 MW biomass projects were considered. As per the present situation, instead of 2 x 0.5 MW SHP and 2 MW biomass mini-grids, a single 5 MW biomass mini-grid project is considered. This is mainly because of the surety of co-financing possibilities available for this project. Moreover, this project is in an advanced level of preparation in terms of stakeholders’ awareness and involvement when compared to the other biomass projects and the SHP sites, where possibilities of co-financing are very limited. Feasibility study has already been conducted for this biomass project and the project development activities in Abakaliki rice mill cluster is in an advanced stage when compared to the development activities in other project sites. The stake holder commitments are much better and firmed up.

For the same GEF funding, instead of total 3 MW power generation capacity, a higher capacity of 5 MW power generation will be achieved. With this option, the success factors and the cost effectiveness are higher when compared to the previous situation, as the investors are already identified and companies required for the implementation of the 5 MW project are already in advanced stage of formation.

Cumulative direct emissions of a 3 MW project is around 254,387 t CO<sub>2</sub>e over a lifetime of 20 years and indirect emissions are around 1,271,936, t CO<sub>2</sub>e, , whereas a 5 MW project results in reducing 501,936 t CO<sub>2</sub>e directly and 2,509,680 t CO<sub>2</sub>e indirectly over the same period of 20 years. Thus the global environmental benefits are also higher in this 5 MW biomass project when compared to the earlier 3 MW power generation project as the CO<sub>2</sub> emission reduction is higher in the present case.

The table below lists and compares the original PIF expected outputs and the final project design expected outputs. Observations are also made regarding the changes.

|     | <b>Original PIF Expected Outputs</b>  | <b>Final Project Design Expected Outputs</b>  | <b>Observation</b>  |
|-----|---|---|---|
| PC1 | <p>1.1 Report on biomass resource site specific availability and potential pilot sites for development identified.</p> <p>1.2 Report on small hydro power resource site specific availability and potential sites for development identified.</p> | <p>1.1 Techno-economic feasibility studies and business plans developed for the 3 identified potential sites to facilitate replication.</p>   | <p>Biomass resource assessment has already been carried out during PPG stage. Hence the project component has been revised to facilitate replications.</p>  |
| PC2 | <p>2.1 Biomass and SHP based mini-grids established for demonstration.</p> <p>2.2 Distribution network and productive uses established in and around mini-grids.</p> <p>2.3 The mini-grids independently monitored and evaluated,</p>             | <p>2.1 A biomass based power plants of total of 5 MW installed capacity commissioned in the selected site along with mini-grid.</p> <p>2.2 Capacity on biomass power plant operation and maintenance as well as</p> | <p>Instead of 2 x 0.5 MW SHP and 2 MW biomass mini-grids, a single 5 MW biomass mini-grid project is considered.</p> <p>Capacity development on O &amp; M of the power plant and management of mini-grid is introduced.</p> |

|     |  |  |  |
|-----|--|--|--|
|     | lessons learned and information widely distributed.  | mini-grid management developed.<br>2.3 The mini-grid independently monitored, evaluated, lessons learnt and information widely distributed.  |  |
| PC3 | 3.1 Appropriate financial mechanism created and institutional structures strengthened.<br>3.2 Relevant financing institutions ready to fund RE based mini-grid projects in Place.<br>3.3 Renewable portfolio standard, a strategic policy tool to promote RE systems developed and put in place. | 3.1 Feed-in-tariff for biomass power in place.<br>3.2 Appropriate financing facility developed for RE related projects.  | To be more specific and focused towards the project output, renewable portfolio standard is removed and activities related to feed-in-tariff are carried out.<br><br>Appropriate financing facility similar to the power fund, as already existing in Nigeria, will be created. But the new scheme will be specifically for the renewable energy projects. |
| PC4 | 4.1 Experts, planners, and institutions are trained in RE based mini-grid systems.<br>4.2 Local capacity of engineering firms and partners in operation and maintenance is developed.  | 4.1 Local capacity in designing mini-grid developed.<br>4.2 Experts, planners, and institutions trained in developing biomass based energy and mini-grid systems.<br>4.3 Capacity of RE related and financing institutions strengthened.<br>4.4 Capacity of local engineering firms and O&M companies developed in operation and maintenance of biomass power plant and mini-grid systems. | More capacity building aspects are introduced especially for RE related and financial institutions.<br><br>More training programs are introduced especially on designing mini-grids.   |

In the PIF the total indicative co-financing for the project source and by name was around USD 7,360,000 only. But in the new project design, it is around USD 11,935,000 which is much higher than that of the original PIF value. This is due to the fact that presently it is a single biomass mini-grid project of higher capacity than it was in during the PIF stage. Project component 1 has been changed along with few changes in the outputs of other project components. This has lead to changes in component's budget when compared to the PIF.

The GEF funding in the PIF stage was USD **!The Formula Not In Table** which is slightly reduced to USD **!The Formula Not In Table** during the CEO stage. For comparatively lesser GEF funding, the 5 MW project brings more benefits.




The following table compares the indicative budget estimate during the PIF stage and during the CEO stage:

|                   |   | During PIF Stage                  |                  |                   | During CEO Stage                  |                   |                   |
|-------------------|---|-----------------------------------|------------------|-------------------|-----------------------------------|-------------------|-------------------|
| Project Component |   | Indicative Budget Estimate (US\$) |                  |                   | Indicative Budget Estimate (US\$) |                   |                   |
| No                | Details   | GEF Fund                          | Co-financing     | Total             | GEF Fund                          | Co-financing      | Total             |
| 1                 | Development of techno-economic feasibility studies and business plans for identified potential sites to facilitate replication. | 100,000                           | 200,000          | 300,000           | 137,000                           | 200,000           | 337,000           |
| 2                 | Demonstration of techno-economic viability of biomass based mini-grid.  | 2,000,000                         | 6,000,000        | 8,000,000         | 1,917,000                         | 10,575,000        | 28,492,000        |
| 3                 | Strengthening of financial and policy environment to support RE based mini-grid systems.  | 100,000                           | 200,000          | 300,000           | 93,000                            | 200,000           | 893,000           |
| 4                 | Capacity development for replication of RE mini-grid technologies.  | 227,273                           | 500,000          | 727,273           | 274,800                           | 500,000           | 2,229,346         |
| 5                 | Project management  | 240,000                           | 460,000          | 700,000           | 200,000                           | 460,000           | 2,060,000         |
| <b>Total</b>      |   | <b>2,667,273</b>                  | <b>7,360,000</b> | <b>10,027,273</b> | <b>2,621,800</b>                  | <b>11,935,000</b> | <b>34,011,346</b> |

**PART V: AGENCY(IES) CERTIFICATION**

This request has been prepared in accordance with GEF policies and procedures and meets the GEF criteria for CEO Endorsement.

| Agency Coordinator,<br>Agency name                                   | Signature   | Date<br>(Month,<br>day, year) | Project Contact Person   | Telephone                       | Email Address      |
|--|---|-------------------------------|--|---------------------------------|--------------------|
| Mr. Dmitri Piskounov,<br>Managing Director,<br>UNIDO GEF Focal Point |  | 02/14/11                      | Mr. Jossy Thomas,<br>Industrial Dev.<br>Officer,<br>Energy & Climate<br>Change Branch,<br>PTC, UNIDO | +43- 1 -<br>26026-<br>Ext. 3727 | j.thomas@unido.org |

**ANNEX A: PROJECT RESULTS FRAMEWORK**

| Project Strategy  |  | Objectively verifiable indicators   |  |   |   |  |
|---|--|---|--|---|---|--|
|   |  | Indicator<br>(quantified and time-bound)  | Baseline   | Target  | Source of verification  | Risks and Assumptions  |
| Goal  | To reduce and avoid GHG emission from the energy sector of Nigeria.  | Incremental CO <sub>2</sub> emission reduction.   | CO <sub>2</sub> emission due to diesel based power generation.   | 1. 5 MW of biomass based mini-grid capacity added during the project period.  | 1. Physical verification of projects in operation.<br>2. End of project survey. | Continuous support of all participating organizations, State Government and project investors.   |
| Objective of the project  | To promote renewable energy (biomass) based mini-grid as an alternative to diesel based energy generation systems in Nigeria | 1. 5 MW of biomass based power generation.<br>2. Investments by financial institutions to biomass projects.                                       | 1. No biomass based power plant and mini-grid exists in Nigeria.<br>2. No practically workable support schemes available in Nigeria for the promotion of biomass projects. | 1. 5 MW of biomass power plant capacity established.<br>2. Policy, regulatory regime established.<br>3. Replication potential of biomass projects identified. | 1. Physical verification of Implemented project.<br>2. End of project survey.   | 1. Sustained government / investor support to the agreed project activities.<br>2. Commitment of Government agencies in building capacity and making policy changes. |
| Outcome 1   | Preparatory works completed for facilitating replication in the identified potential sites.                                  | Feasibility study, business plans and other power plant support/development activities and reports available for the potential replication sites. | No preparatory works for the replication of the biomass power plants have been taken   | Techno-economic feasibility studies, business plans and other essential reports for the three identified sites.   | Project reports.  | Sustained Government support.  |
| <b>Project Component 1- Development of techno-economic feasibility studies and business plans for identified potential sites to facilitate replication.</b> |  |   |  |   |   |  |
| Output 1.1  | Techno-economic feasibility studies and business plans   | 1. Techno-economic feasibility studies and business plans   | 1. Techno-economic feasibility studies and business plans  | 1. 3 techno-economic feasibility studies and business plans   | Project reports.  | Sustained Government support.  |

| Project Strategy  |  | Objectively verifiable indicators  |  |   |  |   |
|---|--|--|--|---|--|---|
|   |  | Indicator<br>(quantified and time-bound)   | Baseline   | Target  | Source of verification                                   | Risks and Assumptions   |
|   | developed for the 3 identified potential sites to facilitate replication.  | for the identified sites<br>2. Reports on existing tax schemes, BoI privileges, required licenses and permits, environmental regulations, proposed government schemes, meteorological, seismic data and other relevant data for the implementation for the biomass project feasibility study sites | not available for the identified sites.<br>2. Very little information available on existing set-up and schemes | developed for the identified sites.<br>2. Other compiled reports                                    |  |   |
| Outcome 2   | Acceptance by stakeholders on the technical and financial viability of selected site for setting up the biomass based mini-grid for rural electrification. | Investors ready to invest and agreement signed for implementing the biomass based mini-grid project.   | Investors not ready to invest/develop biomass projects in Nigeria due to risks and lack of knowledge.          | Investors are ready to invest in the biomass based mini-grid project identified for implementation. | Shareholder agreement.                                   | Investors' support and Government support.                            |
| <b>Project Component 2 - Demonstration of techno-economic viability of biomass based mini-grid.</b> |  |  |  |   |  |   |
| Output 2.1  | A biomass based power plant of 5 MW installed capacity commissioned in the selected site   | 1. A biomass mini-grid of capacity 5 MW is established.<br>2. Electricity usage by   | 1. Biomass based mini-grid not in place.<br>2. Diesel based power  | 1. A biomass based power plant including mini-grid is in operation.                                 | 1. Physical verification of biomass power plant project. | Sustained Government / investor support to agreed project activities. |

| Project Strategy |   | Objectively verifiable indicators   |   |  |  |   |
|------------------|---|---|---|--|--|---|
|                  |   | Indicator<br>(quantified and time-bound)  | Baseline  | Target   | Source of verification   | Risks and Assumptions   |
|                  | along with mini-grid.   | the consumers.<br>3. CO <sub>2</sub> emission reduction from biomass electricity usage.   | generation in the absence of biomass based electricity.<br>3. No biomass electricity available.       | 2. 25,000 t CO <sub>2</sub> emission reduction annually from biomass electricity usage.<br>3. Above 31,000 MWh of annual electricity supply to various users from biomass mini-grid. | 2. Records of biomass power plant<br>3. UNIDO expert report  |   |
| Output 2.2       | Capacity on biomass power plant operation and maintenance as well as mini-grid management developed | Trained personals in place for operation and maintenance of the biomass power plant including management of mini-grid.                    | No local capacity to operate, maintain power plant and mini-grid.                                     | Number of operators identified and trained for the operation and maintenance of power plant and management of mini-grid.   | 1. Physical verification of operation and maintenance personal in the power plant.<br>2. Trainings given to operation and maintenance staff. | Sustained investor support to agreed project activities.                                |
| Output 2.3       | The mini-grid independently monitored, evaluated, lessons learnt and information widely distributed | 1. Plant performance study reports.<br>2. Full scale demonstration site visits and seminars.<br>3. Dissemination leaflets.<br>4. Website. | Biomass based mini-grid projects not in place to study the performance and to learn the lessons from. | 1. Performance assessment report<br>2. Full scale demonstration site visits and seminar<br>3. Website<br>4. Project leaflet  | Performance monitoring report, site visit/seminar, programme evaluation form, seminar material, leaflet, website.                            | Sustained investor support to visit the project while in operation and data collection. |
| Outcome 3        | Conducive financing and policy environment for promoting  | Favourable policy and investment conditions for biomass mini-grid   | The existing policy, financing, investment facilities are not   | 1. Favourable policy and feed-in-tariff schemes are in   | 1. End of project survey   | Sustained government support to agreed project activities.                              |

| Project Strategy   |   | Objectively verifiable indicators  |  |  |   |  |
|--|---|--|--|--|---|--|
|  |   | Indicator<br>(quantified and time-bound)   | Baseline   | Target   | Source of verification  | Risks and Assumptions  |
|  | investments in rural mini-grids in place.   | projects.  | adequate and institutional capacity for biomass mini-grid projects are limited.  | place.<br>2. More and more financing institutions and investors ready to finance/invest.<br>3. Increased local capacity of institutions. | 2. Final evaluation   |  |
| <b>Project Component 3 - Strengthening of financial and policy environment to support RE based mini-grid systems</b> |   |  |  |  |   |  |
| Output 3.1   | FiT for biomass power in place.   | FiT for biomass power plant exporting electricity to national grid in place.   | There is no FiT specific to the biomass projects in Nigeria.   | FiT is in place for the biomass power projects.  | 1. End of project survey<br>2. Final evaluation                                     | Sustained government support.  |
| Output 3.2   | Appropriate financing facility developed for RE related projects.                     | More supportive financing facility in place for RE related projects including biomass power projects.  | Financing facility not in place to fund biomass mini-grid projects.  | Exclusive financing facility available for RE projects including biomass projects.   | 1. End of project survey.<br>2. Final evaluation.                                   | Support from commercial and development banks.   |
| Outcome 4  | Capacity of local planners, institutions and experts for RE based mini-grid enhanced. | 1. Number of local planners, institutions and experts for RE based mini-grids trained.<br>2. Establishment of one-stop information centre for biomass/renewable energy | 1. Number of local planners, institutions and experts do not have capacity to develop and implement biomass power plant mini-grids.<br>2. No such centralized information centre | 1. More than 100 persons trained.<br>2. Establishment and operation of the centre  | 1. No. of persons trained.<br>2. Training material<br>3. Training evaluation report | Sustained support from Government, local planners, institutions and experts for RE based mini-grids. |

| Project Strategy  |  | Objectively verifiable indicators   |   |  |   |  |
|---|--|---|---|--|---|--|
|   |  | Indicator<br>(quantified and time-bound)  | Baseline  | Target   | Source of verification  | Risks and Assumptions  |
|   |  |   | available   |  |   |  |
| <b>Project Component 4 - Capacity development for replication of RE mini-grid technologies.</b> |  |   |   |  |   |  |
| Output 4.1  | Local capacity in designing mini-grid developed  | Number of local companies trained on mini-grid design.  | Lack of knowledge and experience in mini-grid design for biomass projects.  | One training programme for mini-grid design conducted for local companies.   | 1. No. of persons trained.<br>2. Training material<br>3. Training evaluation report | Interest of local electrical companies.  |
| Output 4.2  | Experts, planners, and institutions are trained in developing biomass based energy and mini-grid systems | 1. Biomass project development and implementation training programme conducted<br>2. No. of participants benefited from the training<br>3. Biomass mini-grid project development guide prepared | Lack of knowledge and experience in the development of biomass mini-grid projects in Nigeria.                                   | 1. Two biomass project development trainings conducted<br>2. More than 60 participants trained<br>3. Biomass mini-grid project development guide prepared.<br>4. | 1.No. of persons trained.<br>2.Training material<br>3.Training evaluation report    | Sustained support from Government, local planners, institutions and experts for RE based mini-grids. |
| Output 4.3  | Capacity of RE related and financing institutions strengthened.  | Number of RE related and financial institutions trained.  | Financing institutions lack knowledge on assessment and evaluation of biomass based mini-grid projects.<br>RE institutions lack | Minimum of 5 financing institutions and 2 RE related institutions trained.   | 1. No. of persons trained.<br>2.Training material<br>3.Training evaluation report   | Sustained support from Government renewable energy institutions and financial institutions support.. |

| Project Strategy |   | Objectively verifiable indicators  |  |  |   |   |
|------------------|---|--|--|--|---|---|
|                  |   | Indicator<br>(quantified and time-bound)   | Baseline   | Target   | Source of verification  | Risks and Assumptions                   |
|                  |   |  | knowledge and skill in biomass based mini-grids.   |  |   |   |
| Output 4.4       | Capacity of local engineering firms and O&M companies developed in operation and maintenance of biomass power plants and mini-grid systems. | Number of local engineering companies trained in operation and maintenance services. | There is no or very limited local capacity for operation and maintenance of biomass Power plants in Nigeria. | More than 2 local engineering firms ready to provide operation and maintenance service | <ol style="list-style-type: none"> <li>1. No. of persons trained.</li> <li>2. Training material</li> <li>3. Training evaluation report</li> </ol> | Support of local engineering companies. |



**ANNEX B: RESPONSES TO PROJECT REVIEWS** (from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion and the Convention Secretariat and STAP at PIF)

STAP Scientific and Technical screening of PIF:

Date of screening: 18<sup>th</sup> May 2009

| Sl. No. | STAP Comment  | Response to STAP comment   |
|---------|---|--|
| 1.      | To take final decision on the capacity of the renewable energy systems based on the detailed assessment of biomass resources.                     | A detailed biomass resource assessment was carried out and based on the resource assessment a 5 MW power plant capacity is finalized.  |
| 2.      | Biomass feedstock availability within a short catchment area to be considered.  | The power plant will be established within the Ikwo rice mill cluster. The power plant will be located centrally in the cluster such that it is closer to the rice mills. The maximum distance of the power plant from a single mill is only 500 meter.  |
| 3.      | Evaluation of the biomass combustion and gasification systems and designs is necessary to identify the most suitable design for local conditions. | For 5 MW capacity, biomass steam thermal technology involving boiler and turbine is the most suitable technology. Gasification can be considered only if the size is less than 2 MW, where the feasibility of steam thermal power plant is in question due to low capacity for local conditions.                 |
| 4.      | STAP proposed the conduct of barrier analysis for promoting biomass power systems.  | A barrier analysis was conducted and is given in project design document. In the CEO approval document it is given in section A of Part II under the title "The problem"   |
| 5.      | Technical feasibility and commercial viability of the RE based mini-grid when compared to the fossil fuel sources to be considered.               | The technical feasibility and commercial viability of the biomass based mini-grid was compared with that of the diesel based mini-grid option and was found that the cost of power generation was lower on life cycle assessment bases when compared to mini-grid based on fossil fuels.                         |
| 6.      | Project document should provide baseline assessment for regions where RE systems will be installed.   | In the absence of the 5 MW biomass power plant project, the baseline would be diesel based electricity generation. The project document provides baseline assessment for the region where the biomass system will be installed and these details are given under Section H, Part II of the CEO Approval Document |

**ANNEX C: CONSULTANTS TO BE HIRED FOR THE PROJECT USING GEF RESOURCES**

| <i>Position Titles</i>                                    | <i>\$/<br/>person week*</i> | <i>Estimated<br/>person<br/>weeks**</i> | <i>Tasks to be performed</i>   |
|---|-----------------------------|---|--|
| <b>For Project Management</b>                             |                             |   |  |
| <b>National Expert</b>                                    |                             |   |  |
| Project Administrative Assistant                          | 562.5                       | 192                                     | Responsible for the financial and administrative activities of the project, tracking and ensuring timely disbursement of project funds, assist the PM in the organization of the training sessions and to be held under PC2 and PC4.<br><br>Full-time assignment for the entire duration of the project, i.e., 4 years.<br><br>1 week= 5 working days; 1 months= 4 weeks;  |
| <b>International Expert</b>                               |                             |   |  |
| Evaluation expert   | 3,000                       | 12                                      | Evaluation of the project (final evaluation)   |
| <b>For Technical Assistance</b>                           |                             |   |  |
| <b>International Experts</b>                              |                             |   |  |
| <b>International Experts on Biomass Based Mini-Grid</b>   |                             |   |  |
| PC 1  | 3,000                       | 32                                      | <ul style="list-style-type: none"> <li>• Conduct of feasibility studies and preparation of business plans for the 3 identified potential sites for further replication</li> </ul>  |
| PC 2  | 3,000                       | 92                                      | <ul style="list-style-type: none"> <li>• Bidding document preparation</li> <li>• Bid evaluation</li> <li>• Assistance in selection of equipment supplier/EPC contractor</li> <li>• O&amp;M planning for the biomass power plant</li> <li>• Training the power plant staff in O&amp;M of biomass based power plant</li> <li>• Performance monitoring of the projects and Preparation of monitoring reports.</li> <li>• Supervision of project during project implementation.</li> <li>• Development of dissemination tools.</li> <li>• Estimation of environmental benefits in the project</li> </ul> |
| PC 4  | 3,000                       | 28                                      | <ul style="list-style-type: none"> <li>• Developing Biomass mini-grid project development guide</li> <li>• Developing training material and providing training on “biomass mini-grid project development and implementation”</li> <li>• Developing training material and providing training for Renewable energy and financing institutions on “biomass project assessment and evaluation”</li> </ul>  |
| <b>International Expert for Policy and Feed-in tariff</b> |                             |   |  |
| PC 3  | 3,000                       | 8                                       | <ul style="list-style-type: none"> <li>• Drafting the feed-in-tariff scheme</li> </ul>   |
| <b>International Expert on Financing</b>                  |                             |   |  |
| PC 3  | 3,000                       | 12                                      | <ul style="list-style-type: none"> <li>• Liaising with Ministry of Energy, CBN, BoI and other commercial banks for the creation of RE Power Fund</li> <li>• Recommendations on the modalities and procedures of the RE power fund.</li> </ul>  |
| <b>International Expert on Insurance</b>                  |                             |   |  |
| PC 2  | 3,000                       | 8                                       | <ul style="list-style-type: none"> <li>• Responsible for study of insurance aspects of the power plant during construction and operation.</li> </ul>   |
| <b>National Expert</b>                                    |                             |   |  |
| PC 1  | 1,000                       | 23                                      | <ul style="list-style-type: none"> <li>• Coordinating with “International Expert on Biomass”</li> <li>• Conduct of feasibility studies and preparation of business plans for the 3 identified potential sites for further replication</li> </ul>   |

|  |       |     |  |
|--|-------|-----|--|
| PC 2   | 1,000 | 328 | <ul style="list-style-type: none"> <li>• Arranging the required licenses, permits and contracts for the power plant</li> <li>• Assisting the international expert on studying the insurance required for the power plant during construction and operation.</li> <li>• Coordinating with “International Expert on Biomass” for the preparation of bidding document for the power plant</li> <li>• Coordinating with “International Expert on Biomass” for launching the bid document, bidding, evaluation and selection of contractor for power plant</li> <li>• Coordinating, organising, managing and monitoring the entire project work activities.</li> <li>• Preparing bidding document for min-grid and distribution network</li> <li>• Launching the tender document, bidding, evaluating and selecting the contractor for mini-grid.</li> <li>• Supervision of mini-grid construction and commissioning</li> <li>• Getting trained in existing boiler-turbine power plant system in Nigeria in order to get expertise in that area to serve the power plant.</li> <li>• Dissemination of project results and findings</li> </ul> |
| PC 3   | 1,000 | 19  | <ul style="list-style-type: none"> <li>• Coordinating with the “International Expert on Financing” in liaising with Ministry of Energy, CBN, BoI and other commercial banks for the creation of RE Power Fund</li> <li>• Coordinating with the “International Expert on Financing” to recommend the modalities and procedures of the RE power fund</li> </ul>  |
| PC 4   | 1,000 | 24  | <ul style="list-style-type: none"> <li>• Coordinating with the “International Expert on Biomass” in developing the training material and providing training on “biomass mini-grid project development and implementation”</li> <li>• Coordinating with “International Expert on Biomass” in developing Biomass mini-grid project development guide</li> <li>• Coordinating with the “International Expert on Biomass” in developing training material and providing training for RE and financing institutions on “biomass project assessment and evaluation”</li> </ul>   |
| PC1 – International experts’ travel – USD 12,000<br>PC 1 – National experts’ travel – USD 6,000<br>PC 2 – International experts’ travel – USD 64,000<br>PC2 – National experts’ travel – USD 38,000<br>PC3 - International experts’ travel – USD 8,000<br>PC 3 – National experts’ travel - USD 6,000<br>PC 4 – International experts’ travel – USD 12,000<br>PC 4 – National experts’ travel – USD 6,000<br>Project Management – Travel allocation – USD 30,000 |       |     |  |

\* Provide dollar rate per person week. \*\* Total person weeks needed to carry out the tasks.

Note: The geographical location of the project site in Ebonyi State, Nigeria has difficult travel access from the capital Abuja or Lagos. Also the local transportation cost within Ebonyi state is high. Hence travel cost is expected to be on the higher side.

**CONSULTANTS TO BE HIRED FOR THE PROJECT USING CO-FINANCING RESOURCES**

| <i>Position Titles</i>                                  | <i>\$/<br/>person week*</i> | <i>Estimated<br/>person<br/>weeks**</i> | <i>Tasks to be performed</i>   |
|---|-----------------------------|---|--|
| <b>For Project Management</b>                           |                             |   |  |
| <b>National Expert</b>                                  |                             |   |  |
| <b>National Expert</b>                                  |                             |   |  |
| Evaluation expert                                       | 1,000                       | 8                                       | Evaluation of the project (mid-term)   |
| <b>For Technical Assistance</b>                         |                             |   |  |
| <b>International Experts</b>                            |                             |   |  |
| <b>International Experts on Biomass Based Mini-Grid</b> |                             |   |  |
| PC 4  | 3,000                       | 8                                       | <ul style="list-style-type: none"> <li>Developing data base/information to be kept at the information centre</li> </ul>  |
| <b>National Expert</b>                                  |                             |   |  |
| PC 1  | 1,000                       | 116                                     | <ul style="list-style-type: none"> <li>Preparing report on list of agro processing industries, production capacity, annual production data, etc</li> <li>Facilitating the licenses and permits required, processing procedures and time required for feasibility study sites</li> <li>Compiling BoI privileges and other privileges applicable for the biomass project feasibility study sites</li> <li>Compiling the existing tax schemes applicable for the biomass project feasibility study sites</li> <li>Compiling the environmental regulation from relevant departments, processing time, procedures, etc for the biomass feasibility study projects</li> <li>Compiling the proposed government supports/scheme possible for the biomass feasibility projects</li> <li>Compiling the meteorological, seismic data and other relevant data for the implementation for the biomass project feasibility study sites</li> <li>Assisting the data collection such as projected Government grid electricity pricing for the next 15 years for feasibility study</li> <li>Facilitating and participating in GEF experts missions and data collection</li> </ul> |
| PC 3  | 1,000                       | 88                                      | <ul style="list-style-type: none"> <li>Compiling various studies done so far related to FiT scheme in Nigeria and providing feedback to international experts for the creation of new, workable FiT scheme</li> <li>Liaising with relevant agencies for the creation of the FiT scheme</li> <li>Conducting consultative workshop for obtaining feedback on the FiT scheme</li> <li>Co-ordinating with various relevant departments for designing appropriate financial mechanism along with international experts</li> <li>Liaising with Ministry of Energy, CBN, BoI and other commercial banks for the creation of RE Power Fund</li> <li>Consolidating the various support schemes and streamlining the support schemes of various departments into a centralized well co-ordinated one</li> <li>Disseminating the information on the RE power fund</li> </ul>  |
| PC 4  | 1,000                       | 132                                     | <ul style="list-style-type: none"> <li>Organizing study tours for various government agencies to the demonstration project site for developing their capacities.</li> <li>Organizing a department level consultation meeting for the establishment of the information centre Establishing the one-stop information centre</li> <li>Assisting international experts in developing the data</li> </ul>   |

|  |  |  |   |
|--|--|--|---|
|  |  |  | <p>base/information to be kept at the information centre</p> <ul style="list-style-type: none"> <li>• Conducting periodical trainings and workshops for relevant government staff on capacity development in Biomass/RE technologies</li> <li>• Creating nationwide awareness on biomass power generation/renewable energy</li> <li>• Conducting co-ordination workshops among various departments to simplify licensing and permit procedures for Biomass/RE plants</li> <li>• Compiling the list of existing local engineering companies and O&amp;M companies capable of operating and maintaining the biomass power plant, mini-grid systems and other RE technologies</li> </ul> |
|--|--|--|---|

\* Provide dollar rate per person week.    \*\* Total person weeks needed to carry out the tasks.

**ANNEX D: STATUS OF IMPLEMENTATION OF PROJECT PREPARATION ACTIVITIES AND THE USE OF FUNDS**

**A. EXPLAIN IF THE PPG OBJECTIVE HAS BEEN ACHIEVED THROUGH THE PPG ACTIVITIES UNDERTAKEN.**

PPG objectives have been almost fully achieved.

1. Project document has been formulated on the basis of further analysis of the Nigeria's renewable energy policy frame work, capacity building and stake holder consultations.
2. Detailed feasibility study was made for a 5 MW biomass power plant. However, in the PPG stage, one 2 x 0.5 MW SHP and another 2 MW biomass plants were envisaged.
3. Direct and indirect GHG emission reductions have been estimated on the basis of more empirical ground (based on the 5 MW baseline and operational parameters). This is more than what was put forth during the PPG stage.

**B. DESCRIBE FINDINGS THAT MIGHT AFFECT THE PROJECT DESIGN OR ANY CONCERNS ON PROJECT IMPLEMENTATION, IF ANY:**

Findings that might affect project design

Although private investors have committed to invest in the power plant projects, the money transfer has not yet taken place. Private investors support is very crucial for the successful implementation of the 5 MW power plant project. Implementation of the 5 MW biomass power plant is the most important for building confidence among various stake holders. Result of monitoring and evaluation of implemented project is very beneficial for knowledge transfer. Other than this, there is no finding that might affect project design.

Any concerns on project implementation

No additional concern beside the risks discussed in PART II, SECTION G.

**C. PROVIDE DETAILED FUNDING AMOUNT OF THE PPG ACTIVITIES AND THEIR IMPLEMENTATION STATUS IN THE TABLE BELOW:**

| <i>Project Preparation Activities Approved</i> | <i>Implementation Status</i> | <i>GEF Amount (\$)</i> |                             |                         |                            | <i>Co-financing (\$)</i> |
|--|------------------------------|------------------------|-----------------------------|-------------------------|----------------------------|--------------------------|
|  |                              | <i>Amount Approved</i> | <i>Amount Spent To date</i> | <i>Amount Committed</i> | <i>Uncommitted Amount*</i> |                          |
| Collection of supplemental data                | Completed                    | 15,000                 | 15,000                      |                         |                            | 20,000                   |
| Stakeholder consultations                      | Completed                    | 15,000                 | 15,000                      |                         |                            | 20,000                   |
| Design of pilot projects                       | Completed                    | 20,000                 | 20,000                      |                         |                            | 10,000                   |
| Project strategy and implementation detailing  | Completed                    | 10,000                 | 10,000                      |                         |                            | 10,000                   |
|  |                              | <b>60,000</b>          | <b>60,000</b>               |                         |                            | <b>60,000</b>            |

\* Any uncommitted amounts should be returned to the GEF Trust Fund. This is not a physical transfer of money, but achieved through reporting and netting out from disbursement request to Trustee. Please indicate expected date of refund transaction to Trustee.

**ANNEX E: CALENDAR OF EXPECTED REFLOWS**

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

**NOT APPLICABLE**

## ADDITIONAL ANNEXES

### ANNEX F: ESTIMATE OF GHG EMISSIONS REDUCTIONS

The project activity is the installation of 5 MW biomass power plant. The project involves direct and indirect emission reductions. The activity contributing to direct emission reduction is due to the installation of 5 MW biomass power plant and that of indirect emission reduction is replication of similar type of power plants within 10 years in the location of the project.

#### Direct Emission Reduction:

5 MW biomass power plant directly results in emission reduction through electricity generation that replaces diesel usage. The direct emission reduction is calculated using fuel savings attributable to the investment. The power generation capacity of the plant is 5 MW. Out of the 5 MW gross capacity with 95% load factor, 12% of parasitic load and 5% of transmission and distribution losses. The net 3.97 MW will be the power available for sales. The power plant can operate 7,900 hours in a year. Hence, the net amount of electricity is 31,371 MWh.

The power plant has a useful lifetime of 20 years. Over its lifetime, the rice husk based electricity will replace existing diesel based electricity generation. The emission factor for the technology used in baseline scenario is 0.8 t CO<sub>2</sub>/MWh.

|                                    |     |                              |
|------------------------------------|-----|------------------------------|
| Amount of electricity generated    | (A) | : 31,371 MWh                 |
| Emission factor for diesel         | (B) | : 0.8 t CO <sub>2</sub> /MWh |
| Average useful investment lifetime | (C) | : 20 years                   |

$$\begin{aligned}\text{Direct emission reduction} &= A \times B \times C \\ &= 31,371 \text{ MWh} \times 0.8 \text{ t CO}_2/\text{MWh} \times 20 \text{ years} \\ &= 501,936 \text{ t CO}_2\text{e}\end{aligned}$$

The direct emission reduction from the generated electricity, which replaces diesel usage in the baseline scenario is 501,936 tCO<sub>2</sub>e.

#### Indirect Emission Reduction (Bottom-up Approach):

The installation of 5 MW biomass power plant also contributes in emission reduction after the project completion, which is accounted as indirect emission reductions. The approach used in this project to calculate indirect emission reduction is bottom-up approach, which considers only the number of times that the project might be replicated after the project completion.

The project activity has long term emission reduction after the project that is achieved through the installation of similar type of power plants in the project area. The number of similar projects in a period of 10 years represents the replication factor. The replication factor of 5 was chosen for this project, which means that 5 number of similar project are possible within 10 year period.

|                           |     |                               |
|---------------------------|-----|-------------------------------|
| Direct emission reduction | (A) | : 501,936 t CO <sub>2</sub> e |
| Replication factor        | (B) | : 5                           |

$$\begin{aligned}\text{Indirect emission reduction} &= A \times B \\ &= 501,936 \text{ t CO}_2\text{e} \times 5 \\ &= 2,509,680 \text{ t CO}_2\text{e}\end{aligned}$$



## Results

| <b>Emission reductions</b>               | <b>t CO<sub>2</sub>e</b> |
|--|--------------------------|
| Direct emissions reductions              | 501,936                  |
| Direct post project emissions reductions | -                        |
| Indirect emissions reductions            | 2,509,680                |

**ANNEX G: LETTERS OF CO-FINANCING**