CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAMME OF ACTIVITIES DESIGN DOCUMENT FORM
(CDM-SSC-PoA-DD) Version 01

CONTENTS

Annexes

NOTE:

(i) This form is for the submission of a CDM PoA whose CPAs apply a small scale approved methodology.

(ii) At the time of requesting registration this form must be accompanied by a CDM-SSC-CPA-DD form that has been specified for the proposed PoA, as well as by one completed CDM-SSC-CPA-DD (using real case).

SECTION A. General description of small-scale programme of activities (PoA)

A.1 Title of the small-scale programme of activities (PoA):

Biogas Utility Programme for Households by Grameen Shakti in Provincial Cities of Bangladesh

02/03/2011
Version: 1.2 [On-site Validation の結果を部分的に反映したバージョン]

A.2. Description of the small-scale programme of activities (PoA):

1. General operating and implementing framework of PoA

Grameen Shakti (GS), a non-governmental organization under the Grameen Group of Bangladesh, is one of the largest and fastest growing rural based renewable energy entities in the world. GS has developed one of the most successful market based programs with a social objective for disseminating biogas technology and solar home systems to millions of rural villagers.

Only 4% of the population is covered by the natural gas supply network in Bangladesh.[1] Most of the local cities do not have access to the natural gas supply. Households in local cities continue to use mainly biomasses for cooking. A significant portion of the fuel wood used in households belong to non-renewable biomass which generate a variety of gases including Carbon Dioxide (CO_2), one of the six Greenhouse Gases ("GHG") covered under the Kyoto Protocol ("KP") to the United Nations Framework Convention to Climate Change ("UNFCCC").

In order to expand biogas utilization in Bangladesh, GS plans to implement Programme of Activities (PoA) which promotes plant type commercial biogas digesters in provincial cities of Bangladesh to supply biogas for thermal usage of targeted households. The PoA will install numerous medium or large sized biogas digesters which consume municipal organic wastes that are otherwise disposed to landfills, emitting methane into the atmosphere. It is noted that this series of activities (programme) is the *first-of-its-kind* in Bangladesh.

The coordinating/managing entity (CME) of the PoA is GS. PEAR Carbon Offset Initiative, Ltd. is the CER buyer and the PoA developer. GS is responsible for coordinating the efforts of the different partners involved in the PoA to promote the biogas utility business in Bangladesh. Regional or branch offices of the GS are the operators and implementers of the CPAs under the PoA; however, they are not required to be project participants (as per Annex 29 to EB47 Report, paragraph 6, "the operators of individual CPAs are not required to be project participants"). The inclusions of new CPAs to the PoA will be requested by the CME to a Designated Operational Entity (DOE) during the lifetime of the PoA.

The first CPA is to be implemented in the Faridpur municipality and will install commercial biogas digesters with total biogas (methane content is around 60% as shown in AMS-I.I) production capacity of 500 m^3/day initially. The sludge from the biogas digesters will be dried before used as soil conditioner for the field application.

2. ***Policy/measure or stated goal of the PoA***

[1] Assessment of Existing Improved Cook Stove in Bangladesh, MA Quaiyum Sarkar *et al*, Environment, BRAC Research Report 2006.

The PoA contributes to the sustainable development of Bangladesh as explained below:

More than 60% of the total population in Bangladesh still heavily rely on fuel wood, dung, and crop residues for their cooking needs. The impacts of biomass reliance include deforestation, drudgery from needing to collect and prepare the biomass for use and also health impacts from indoor air pollution to rural women and children.

In order to prevent further environmental deterioration, it is necessary to promote new sources of energy technologies in this country. Biogas generated from animal manure or other organic wastes is undoubtedly one of the most appropriate sources of energy. And there has been domestic biogas digester promotion programme mainly targeted rural areas, however, population in provincial cities (although Bangladesh is a natural gas-rich country, most of the households are unable to access the natural gas supply) have not got merits from the programme due to lack of animal manures/wastes to feed biogas digesters.

Fortunately, municipal organic wastes are readily available in provincial cities and can be used to produce biogas through biogas digesters. The goal of the PoA is to provide biogas for households in provincial cities by promoting biogas digesters utilizing municipal organic wastes.

The PoA will contribute to reduce deforestation as the biogas generated will be used to replace mostly non-renewable biomasses consumed in households; and also improve the environment of target provincial cities and households through consuming municipal wastes and improving indoor air quality of the households.

As a result, the PoA will provide sustainable clean energy for households through replacing the non-renewable biomass that also reduces GHG emissions. For other/detailed consideration related to the contribution to sustainable development, please see section C.2.

3. ***Confirmation that the proposed PoA is a voluntary action by the coordinating/managing entity.***

So far, GS has conducted biogas digester promotion and a solar home system promotion programme in rural Bangladesh by using its micro-financing scheme. There is no any mandatory policy/regulation in Bangladesh for biogas promotion activities. GS has not obliged or mandated to implement such kind of programmes; nevertheless, the proposed programme is a voluntary action by GS. GS is willing to promote the programme as a coordinating entity with a condition of getting help from CDM carbon fund and other carbon fund investment.

A.3. Coordinating/managing entity and participants of SSC-POA:

>> The following information shall be included:

1. *Coordinating or managing entity of the PoA as the entity which communicates with the Board*
2. *Project participants being registered in relation to the PoA. Project participants may or may not be involved in one of the CPAs related to the PoA.*

Table 1: Participants of the PoA

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants(*) (as applicable)	Party involved wishes to be considered as project participant (Yes/No)
Bangladesh (host)	Grameen Shakti (coordinating, managing entity)	No

Japan	PEAR Carbon Offset Initiative, Ltd.	No
(*)In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

A.4. Technical description of the small-scale programme of activities:

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A.4.1. Location of the programme of activities:

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A.4.1.1. Host Party(ies):

>>

Bangladesh

A.4.1.2. Physical/ Geographical boundary:

>> Definition of the boundary for the PoA in terms of a geographical area (e.g., municipality, region within a country, country or several countries) within which all small-scale CDM programme activities (SSC-CPAs) included in the PoA will be implemented, taking into consideration the requirement that all applicable national and/or sectoral policies and regulations of each host country within that chosen boundary;

The PoA covers whole Bangladesh.

Figure 1: Boundary of the PoA

A.4.2. Description of a typical small-scale CDM programme activity (CPA):

>>

A typical CPA under the PoA consists of:

1) Installations of biogas digesters (fixed dome reinforced concrete structure or pre-fabricated steel/fiberglass/soft digesters) and related equipments, which consume municipal organic wastes as a principal feedstock.
2) A CPA targets a provincial city in Bangladesh, which is not covered by natural gas distribution networks and is not targeted by the waste management programme using composting.
3) A typical biogas digester system is composed of pre-treatment chambers, anaerobic digesters, gas storage tank and other relevant equipments such as desulphurization and dehumidification devices.
4) The size and number of biogas digesters depend on the number of households targeted and their spatial allocation, as well as taking into consideration the stability of the gas supply.
5) The generated biogas is supplied to households through distribution pipelines as thermal energy exclusively for their own cooking purposes.
6) The fuels currently used in households for cooking are non-renewable biomass and a small portion of renewable biomass[2] and a little portion of LPG.
7) The biogas is completely combusted in biogas stoves at the households.
8) GHG emission reductions can be attained through reducing non-renewable biomass combustions (along with a small portion of fossil fuels) and avoiding CH_4 emissions from municipal solid waste disposal sites.
9) The sludge and slurry soil application guarantees aerobic condition to not result in methane emissions.

A.4.2.1. Technology or measures to be employed by the SSC-CPA:

>>

The PoA will install plant-type biogas digester systems to provide biogas for households in provincial cities, utilizing municipal organic wastes. The size of digesters depends on the number of households involved and their spatial allocations. The whole project activity comprises installation of biogas digesters, collection of organic wastes, construction of biogas distribution lines, and generation of biogas and supply of biogas.

A typical biogas digester system consists of pre-treatment chamber, anaerobic digesters, gas storage tanks and other equipments/devices like desulphurization and dehumidification. The structure of the technology used in the proposed project activity is shown in Figure 2 below.

Each sub-system (one biogas digester) of the CPA has biogas generation capacity (specifications) of no more than 450 kW_{th} (around 1,600 m^3/day), which is less than 1% of the SSC threshold, with the aggregated rated capacity of cooking stoves is less than 15 MW_{th},

[2] It is noted that in city area, it is difficult for people to pick up trees or collect non-woody biomass. It is also noted that the forest in Bangladesh is decreasing mainly by tree-cutting activities.

Organic wastes collected from households (by GS, city government or others) are transported to digesters sites. The organic wastes from garbage collection sites are pretreated in the pre-treatment chambers. Other organic wastes, such as those from nearby villages, may be used additionally.

After appropriate pre-treatment, the organic wastes are fed into the anaerobic digesters to generate biogas through biological reactions occurred in the digesters.

Necessary post-treatments such as desulphurization and dehumidification are conducted before storing the biogas in the gas storage tanks and aerobic sludge treatment will be done before soil application.

All technologies utilized in the project activity are technologies in Bangladesh and there will be little international technology transfer involved in this project.

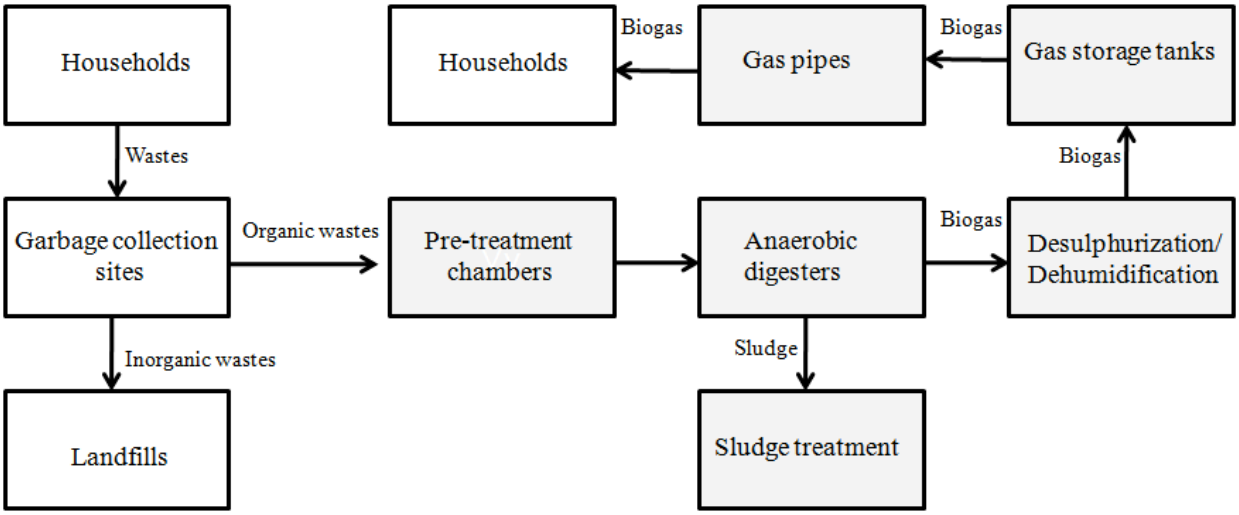

Figure 2: Technical Flowchart of a CPA

A.4.2.2. Eligibility criteria for inclusion of a SSC-CPA in the PoA:

>> Here only a description of criteria for enrolling the CPA shall be described, the criteria for demonstrating additionality of CPA shall be described in section E.5

Any CPA under the PoA shall meet the following criteria and means of checking by the DOE: [Tabular Form]

1) The CPA includes installation/construction of plant type biogas digesters, pre-treatment chambers, gas storage tanks, biogas distribution lines and their related equipments in provincial cities of Bangladesh.

   DOE is to check the technical design document of the biogas digester system of the CPA.

2) Generated biogas is supplied to households to replace biomass (mainly non-renewable biomass) and fossil fuel used in households.

   DOE is to check the survey of targeted households for their fuel use before delivery of the gas. In addition, DOE is to check the technical design document of the system that the biogas

network only supplies to the households, as well as the signed contracts of each household not to provide the gas to someone else and not to use the gas for other purposes than cooking/water heating.

3) Installations/operations of biogas digester shall be in compliance with related national and sectorial standards and regulations.

   DOE is to check whether the project participants provide all related documents. If all of them are provided for the first CPA and no changes from that time, this criterion is met.

4) A CPA is not a part of a registered CDM project or not a CPA under another PoA.

   DOE is to check whether the project participants provide information of all current registered CDM project activities and CPAs under PoAs in Bangladesh which cover the cooking energy use of targeted households and waste management of the targeted provincial city.

   It is noted that there is a PoA for installation of improved cooking stoves (ICS). The CPA cannot target the household covered by this PoA.

5) Each sub-system (one biogas digester) of the CPA has biogas generation capacity (specifications) of no more than 450 kW_{th} (around 1,600 m^3/day), which is less than 1% of the SSC threshold. In addition, the aggregated rated capacity of cooking stoves of targeted household is less than 15 MW_{th}, and annual aggregated emission reduction from all systems is estimated to be less than 60 kt CO_2e *ex ante*.

   DOE is to check the specification of the system and *ex ante* calculation of GHG emission reductions.

6) Feeding material for biogas digesters are principally municipal organic wastes that are otherwise disposed to landfills and emit methane into the atmosphere. The provincial city has no composting or any other city-wide alternative system for waste management.

   DOE is to check whether the project participants provide appropriate material or signed letter related to the waste management system of the provincial city.

7) CPA will be implemented in a provincial city where city-wide natural gas distribution network for households is not present.

   DOE is to check whether the project participants provide appropriate materials. Country-wide information is appropriate if the information is the latest one.

8) For additionality demonstration, "Guidelines for demonstrating additionality of renewable energy projects =< 5 MW and energy efficiency projects with energy savings <= 20 GWh per year (version 01)" is applied.

   DOE is to check the project participants' calculation whether the aggregated rated thermal energy output of the cooking stoves of the targeted households is less than 15 MW_{th}.

   [Note: If CDM EB does not allow applying this Guidelines to PoAs, this criterion is deleted.]

9) The geographical transportation distance of the source of waste and targeted market of the organic fertilizer is kept not to exceed 200 km.

   DOE is to check the project participants' plan to collect organic waste and targeted fertilizer market of the CPA.

A.4.3. Description of how the anthropogenic emissions of GHG by sources are reduced by a SSC-CPA below those that would have occurred in the absence of the registered PoA (assessment and demonstration of additionality):

>> The following shall be demonstrated here:

The information presented here shall constitute the demonstration of additionality of the PoA as a whole.

(i) The proposed PoA is a voluntary coordinated action;

There is no regulations, policies or mandatory requirements in Bangladesh stipulating the promotion of biogas digesters in municipalities. GS has no obligation and is not mandated to promote such kind of plant type biogas digesters in provincial cities. Therefore, the proposed programme can be seen as a voluntary coordinated action by GS.

(ii) If the PoA is implementing a voluntary coordinated action, it would not be implemented in the absence of the PoA;

This commercial biogas supply system targeting city households by using municipal waste as feedstock is the first-of-its-kind in Bangladesh. No other similar activities are found until the PoA. Therefore, prevailing practice barrier does not allow this activity to be implemented as an activity without CDM.

In addition, without the CDM benefit, the IRR calculation of the project seems to be [5.8%] for the first CPA. On the other hand, with the CDM benefit, the expected IRR rises to [19.6%] and thereby makes the project financially feasible. However, this study does not necessarily encourage Grameen Shakti to start this kind of activities since the proposed PoA, as a whole is commercially volatile and highly risky. This is due to the fact that the economic structure of every CPA varies depending on the prevailing municipal solid waste management practices and household energy consumption patterns of the project sites.

Moreover, as specified in E.5.1., additionality is demonstrated by using "Guidelines for demonstrating additionality of renewable energy projects =< 5 MW and energy efficiency projects with energy savings <= 20 GWh per year (version 01)" as each CPA satisfies all conditions mentioned in the Guidelines.

Therefore, without the PoA, the voluntary action of promoting plant type biogas digesters in provincial cities of Bangladesh would not occur.

(iii) If the PoA is implementing a mandatory policy/regulation, this would/is not enforced;

Not applicable.

(iv) If mandatory a policy/regulation is enforced, the PoA will lead to a greater level of enforcement of the existing mandatory policy/regulation.

Not applicable.

A.4.4. Operational, management and monitoring plan for the programme of activities (PoA):

A.4.4.1. Operational and management plan:

Operational and management scheme of the PoA is shown in the figure below.

Figure 3: Operational and management structure of the PoA

GS (headquarter) is in charge of coordinating all project participants and CPA operators of the PoA, collecting necessary data and information from each CPA for the purpose of monitoring, and also communicating with DOE and CDM Executive Board. GS is supported by PEAR for doing so.

GS's corresponding branch offices conduct the tasks of household recruiting, information survey, biogas digesters construction and inspection. GS headquarter ensures completion of the tasks through activating branch offices at the municipal/district level.

Each CPA operator, Grameen Shakti's regional/branch office supervised by Grameen Shakti's headquarter, will report monitored data to GS headquarter and GS headquarter will then check the data, record the probed data electronically and calculate emission reduction with the monitored data.

(i) A record keeping system for each CPA under the PoA,

A well-designed record keeping system in full compliance with all relevant guidelines and regulations of the CDM EB and the Bangladesh DNA[3] will be operated for a timely completion of all activities in line with the project schedule and in accordance with the project objectives. The record keeping system consists of the method of data survey, the duty and roles of each participants and the database including but not limited to schedule and serial number for each CPA, objective area, size of each CPA, all necessary information/data of every single household in each CPA including:

– name of targeted household representative, address and other household-related information,
– fuel consumptions (before and after reaching biogas),
– amount of biogas produced,
– status of operation of each bio-digester system,

[3] These include "General Guidelines to SSC CDM methodologies", "Guidelines on Assessment of Debundling for SSC Project Activities", "General Guidelines for Sampling and Surveys for Small-Scale CDM Project Activities" and related measures for operation and management of Clean Development Mechanism Projects in Bangladesh.

– status of compliance with related standards and regulations,
– status of sludge and slurry treatment, and
– serial number of bio-digesters.

The database is completed by CPA operators through *ex ante* and *ex post* sample or an entire survey of the targeted households. The database will be submitted to GS headquarter periodically. GS headquarter verifies the reported data with field check if necessary. GS has its internal MRV (monitoring, reporting, verification) management scheme for their current business. The PoA's MRV system is integrated to it.

For the sample survey, GS headquarter develops a random sample method for CPA operators with 90/10 confidence/precision as the criteria for reliability of sampling efforts. Key information collection for *ex ante* determination of baseline emission is conducted by CPA operators through a questionnaire which integrates application of voluntarily participation of a CPA and related information for *ex ante* determination of baseline emissions. Households who voluntarily apply to join a CPA are required to provide related information of fuel consumption, household income, and other household-related data with possible evidences.

Related responsibilities and tasks of participants under the record keeping system are described in the table 2 below.

Table 2: Responsibilities and tasks of the stakeholders of the PoA

	Operator(s)	Processes
Ex ante and *ex post* data survey/ collection	GS's branch offices at municipal/districts level (CPA operators)	The programme coordinator, GS headquarter develops survey methods based on circumstances of the CPAs. Branch offices conduct data collection. Recommendation and operation of any CPA is decided by GS headquarter has administration power over branch offices.
Data storage and management	GS headquarter is responsible for data storage and management in terms of: – Develop database format of CPA – Check the reported data from each CPAs – Calculate emission reductions based on the data reported by the CPA operators – Implement data management of PoA – Store and maintain records	All collected data/information by CPA operators are submitted to GS headquarter.
Communication and Reporting	– GS CPA operators	GS is responsible for coordinating between project participants and

	– Service – Households	communicating with DOE and CDM EB. CPA operators report collected information to GS headquarter. Households report all related information to data collectors during the surveys and report.
CDM training and capacity building	GS develops and establishes training program for the CPA operators and households	Implement simple training for staffs and households ensuring enabled to meet the needs of the monitoring plan.

(ii) A system/procedure to avoid double accounting e.g. to avoid the case of including a new CPA that has been already registered either as a CDM project activity or as a CPA of another PoA,

As specified in the eligibility criteria, it is checked at the time of CPA inclusion that any biogas digester system under the CPA does not belong to another CPA under this PoA, another registered CDM project activity nor another CDM PoA. It is checked whether CDM activities are implemented targeting the same households covered by the CPA. It is noted that this criterion is stronger than avoidance of double counting of CPA itself.

(iii) The SSC-CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity.

According to "Guidelines on Assessment of De-bundling for SSC Project Activities (ver. 03)",[4] it is specified that:

If each of the independent subsystems/measures (e.g., biogas digesters, residential solar energy systems, kerosene or incandescent lighting replacements) included in one or more CDM project activities is no greater than 1% of the small scale thresholds defined by the applied methodology and the subsystems/measures are indicated in the PDDs to be each implemented at or in multiple locations (e.g., installed at or in multiple homes) then these CDM project activities are exempted from performing a de-bundling check, i.e., considered as being not a de-bundled component of a large scale activity.

Since each CPA under the PoA is designed to produce no more than 10,000 m^3 of biogas per day and each CPA consists of one and several biogas digesters, the output of each independent subsystem (biogas digester) will equal to or be less than 2,780 kW_{th}. A 1% of the threshold of small scale (45 $MW_{thermal}$) is 4,500 kW_{th} and the number is larger than the output of biogas digesters in each CPA. Therefore, any CPA of the PoA is exempt from performing a de-bundling check.

(iv) The provisions to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA;

As explained in table 2 above, under the record keeping system, the operators of CPAs, all of them are GS branch offices, are well aware of and have agreed to their activity under the PoA.

[4] http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid17.pdf.

Furthermore, provisions speculated in the agreements that require mutual reporting between project participants ensure awareness and understanding of any project activities between project participants and CPA operators. For instance, any CPA under the PoA is recommended and planned by GS headquarter and PEAR. The CDM-related management system for MRV (measurement, reporting, verification) is integrated to the current management system of GS.

A.4.4.2. Monitoring plan:

>> The following information shall be provided here:

(i) Description of the proposed statistically sound sampling method/procedure to be used by DOEs for verification of the amount of reductions of anthropogenic emissions by sources or removals by sinks of greenhouse gases achieved by CPAs under the PoA.

Not applicable.

(ii) In case the coordinating/managing entity opts for a verification method that does not use sampling but verifies each CPA (whether in groups or not, with different or identical verification periods) a transparent system is to be defined and described that ensures that no double accounting occurs and that the status of verification can be determined anytime for each CPA;

Not applicable.

Project participant does not opt for the sampling of CPAs necessary for verification.

A.4.5. Public funding of the programme of activities (PoA):

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At the time of validation, it is not decided that ODA is to be utilized as a financial source of any CPAs.

On the other hand, there is a possibility for the use of public funds for the PoA (possibly dependent on each CPA), however, in case ODA is applied for future CPA(s), GS will obtain a signed letter from the Bangladesh Government to recognize that the fund is not result in the diversion of ODA and a signed letter from the Annex I Party government that such funding does not result in a diversion of its ODA and it will not obtain CERs in compensation for the ODA. These letters will be attached to the specific CDM-SSC-CPA-DD.[5]

[5] The Marrakech Accords (CDM Modalities and Procedures) does not assign the role to judge whether the funding does not result in a diversion of ODA to CDM Executive Board or any other entity. The only possibility is that the host government may reject approval of the CDM project activity if it recognizes that the funding of the project results in a diversion of ODA. In case of PoA, approval process by the Governments is not required for inclusion of CPAs. Therefore, a related procedure to obtain the affirmation letters is included to be checked by the DOE at the time of inclusion of CPAs.

SECTION B. Duration of the programme of activities (PoA)

B.1. Starting date of the programme of activities (PoA):

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The date on which contracts have been signed for equipment or construction/operation services required for the first CPA. This date is expected to be 01/07/2011.

B.2. Length of the programme of activities (PoA):

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28 (years) / 00 (months)

SECTION C. Environmental Analysis

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C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

1. Environmental Analysis is done at PoA level ☐
2. Environmental Analysis is done at SSC-CPA level ☑

Biogas digester promotion projects are seen to have no negative impacts on the environment; however, due to the nature of the individual CPA activities and the potential site-specific concerns, the Environmental Analysis will be carried out at the SSC-CPA level.

Please refer to specific CDM-SSC-CPA-DD which includes how the environmental analysis was done.

C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

Biogas is a reliable, easy and a very useful source of household energy; hence, it is also a stable source of energy. Biogas has several benefits. These benefits are the main motivating factors for households to adopt biogas.

Based on the findings of the survey by SNV/IDCOL, the assumed benefits from biogas are briefly discussed below[6]:

Gender benefits:

Biogas provides a direct benefit, especially to rural women, as a result of the reduction of the workload when shifting from cooking on conventional biomass to biogas.

[6] Implementation Plan National Domestic Biogas and Manure Programme in Bangladesh.

By Infrastructure Development Company Ltd (IDCOL) and Netherlands Development Organization (SNV)

Biogas is quicker and easier for cooking than biomass. Moreover, biogas is smokeless and does not require constant attention while cooking; therefore, women can do other activities simultaneously.

On average, biogas enables to save approximately 1 hour and 5 minutes per day per family due to the reduction of time used for collecting biomass, cooking and cleaning of utensils; this saved time can be used for childcare, income generating activities, education, recreation and other social works.

Environmental benefits:

From an individual perspective, the use of biogas significantly improves the indoor air quality by the avoidance of black carbon. In addition, construction of biogas plants results in better living condition due to appropriately treated solid wastes and avoiding bad smells in and around the community near landfills.

It reduces a considerable amount of greenhouse gases from two perspectives: the carbon released from burning of biomass is minimized; and the saved forest can act as a sink-basin to absorb carbon dioxide.

Health benefits:

A major problem for rural people especially for the housewives is indoor air pollution due to exposures to smoke inside the kitchen while cooking with biomass.

Poor indoor air quality (especially black carbon) is one of the major risks factors for acute respiratory infections especially with housewives and children. Biogas reduces the smoke exposures and significantly improves the air condition inside the kitchen which will ultimately improve the health conditions by reducing the incidences of eye infection, respiratory diseases, coughing, dizziness and headache.

C.3. Please state whether in accordance with the host Party laws/regulations, an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA),:

>>

In "The Environment Conservation Rules of Bangladesh" the industrial units and projects, in consideration of their site and impact on the environment, are classified into the following four categories:

(a) Green (Environmental Clearance Certificate will be issued to all existing industrial units and projects and to all proposed industrial units and projects falling in the Green Category);

(b) Orange – A (For industrial units and projects falling in this category firstly a Location Clearance Certificate and thereafter an Environmental Clearance Certificate shall be issued)

(c) Orange – B (Initial Environmental Examination (IEE) is need);

(d) Red (Environmental Impact Assessment (EIA) is needed).

Biogas digester promotion projects were not included in the list of any category that IEE or EIA will be done at a CPA level if required from municipal governments based on any local regulations. Grameen Shakti will responsible for conducting IEE or EIA to get Environmental Clearance Certificate for the CPAs.

SECTION D. Stakeholders' comments

>>

D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:

1. Local stakeholder consultation is done at PoA level ☐
2. Local stakeholder consultation is done at SSC-CPA level ☑

Note: If local stakeholder comments are invited at the PoA level, include information on how comments by local stakeholders were invited, a summary of the comments received and how due account was taken from any comments received, as applicable.

D.2. Brief description how comments by local stakeholders have been invited and compiled:

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Please refer to specific CDM-SSC-CPA-DD which includes how comments by local stakeholders have been invited.

D.3. Summary of the comments received:

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Please refer to specific CDM-SSC-CPA-DD in which stakeholders comments received are summarized.

D.4. Report on how due account was taken of any comments received:

>>

Please refer to specific CDM-SSC-CPA-DD which gives how comments were taken into account.

SECTION E. Application of a baseline and monitoring methodology

This section shall demonstrate the application of the baseline and monitoring methodology to a typical SSC-CPA. The information defines the PoA specific elements that shall be included in preparing the PoA specific form used to define and include a SSC-CPA in this PoA (PoA specific CDM-SSC-CPA-DD).

E.1. Title and reference of the approved SSC baseline and monitoring methodology applied to a SSC-CPA included in the PoA:

>>

NOTE: The approved SSC baseline and monitoring methodology should be approved for use in a PoA by the Board.

The following approved SSC baseline and monitoring methodologies are applied as a combination methodology to a SSC-CPA under the PoA:

(1) AMS-I.E. Switch from non-renewable biomass for thermal applications by the user, version 03.

(2) AMS-III.AO. Methane recovery through controlled anaerobic digestion, version 01.

E.2. Justification of the choice of methodology and why it is applicable to a SSC-CPA:

>>

NOTE: In the case of CPAs which individually do not exceed the SSC threshold, SSC methodologies may be used once they have first been reviewed and, as needed, revised to account for leakage in the context of a SSC-CPA.

In the proposed CPA, there are two elements that can reduce GHGs, one is replacing non-renewable biomasses with biogas and the other is avoiding methane emission from landfills. Therefore, the methodology which combines the methodologies of AMS-I.E. and AMS-III.AO is applied.

The combination complies with the paragraph 11 of "General Guidelines to SSC CDM methodologies, version 15" given as below. [Note: Combination issue will be clarified by the DOE]

11. Application of multiple methodologies for a programme of activities (PoA):

(a) The Board at its fifty-third meeting approved the combination of approved methodologies AMS-III.R with AMS-I.C for application in CPAs of a PoA.
Furthermore, the Board at its fifty-sixth meeting approved the combination of anyone of the Type III methodologies where activities lead to generation of methane, i.e. AMS-III.H, AMS-III.D, AMS-III.F and AMS-III.G, with any one of the Type I methodologies for utilising the methane generated for generation of renewable energy, i.e. AMS-I.A, AMS-I.C, AMS-I.D and AMS-I.F.
These combinations can be applied in PoAs without each PoA specifically requesting the approval of the combination of the Board;

Justification of applicability of the methodologies is given in the table below.

Table 3: Justification of applicability of Methodologies

Applicable conditions	Justifications
AMS-I.E.	
1. This category comprises activities to displace the use of non-renewable biomass by introducing renewable energy technologies.	1. The CPA is to employ biogas digesters to produce biogas and provide to households for thermal use through replacing non-renewable biomasses with renewable biogas.
2. If any similar registered CDM project activities exist in the same region as the proposed project activity, then it must be ensured that the proposed project activity is not saving the nonrenewable biomass accounted for by the existing registered project activities.	2. There are no other registered projects similar to the CDM project in Bangladesh. Moreover, the cost for fuel wood in households seems less adaptable to household incomes (increasing of income most probably renders fuel change rather than increasing consumption of the same fuel).
3. Project participants are able to show that non-renewable biomass has been used since the 31st of December 1989, using survey methods.	3. Since the 1980's Bangladesh has been facing steady population growth, placing pressure on the forest resources. A study conducted in Bangladesh between 1986 and 1998 published by the Federal Research Division of the Library of Congress, found that deforestation

	conditions, and thus the use of non-renewable biomass, existed in the 1980s[7].
4. The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 $MW_{thermal}$.	4. This is a designing point of each CPA. This condition will be confirmed by the DOE based on an eligibility criterion of the CPA.
AMS-III.AO	
1. This methodology comprises measures to avoid the emissions of methane to the atmosphere from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS), or in an animal waste management system (AWMS), or in a wastewater treatment system (WWTS).	1. The CPA contributes to prevent methane emissions by changing municipal waste management practices. In the absence of the project activity, the municipal waste would be disposed in landfill sites and anaerobically emit methane into the atmosphere or be treated differently than the project. In each CPA, controlled biological treatment of municipal organic wastes is introduced through anaerobic digestion in closed reactors equipped with a biogas recovery system.
(a) Digestion of biomass or other organic matter (excluding animal manure and sludge generated in the wastewater treatment works) as a single source of substrate is included;	(a) Not applicable.
(b) Co-digestion of multiple sources of biomass substrates, *e.g.* MSW, organic waste, animal manure, wastewater, where those organic matters would otherwise have been treated in an anaerobic treatment system without biogas recovery is also eligible;	(b) Co-digestion of MSW organic waste and animal manure is applied.
(c) If for one or more sources of substrates, it can not be demonstrated that the organic matter would otherwise been left to decay anaerobically, baseline emissions related to such organic matter shall be accounted for as zero, whereas project emissions shall be calculated according to the procedures presented in this methodology for all co-digested substrates;	(c) Organic city waste is monitored separately and it is the only source to claim methane emission reductions. While project emissions include all related GHG emissions specified in this methodology associated with the operation of each CPA.
(d) Project participants shall apply the procedures related to the "competing use for the biomass" according to the latest "General guidance on leakage in biomass project activities";	(d) Not applicable but related argument is provided in the leakage section.

[7] http://www.countrystudies.us/bangladesh/72.htm

(e) Project activities treating animal manure as single source substrate shall apply AMS-III.D "Methane recovery in animal manure management systems", similarly projects only treating wastewater and/or sludge generated in the wastewater treatment works shall apply AMS-III.H "Methane recovery in wastewater treatment";	(e) Not applicable. Emission reductions is not claimed for the use of other organic materials than city waste.
(f) The project activity does not recover or combust landfill gas from the disposal site (unlike AMS-III.G "Landfill methane recovery"), and does not undertake controlled combustion of the waste that is not treated biologically in a first step (unlike AMS-III.E "Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment"). Project activities that recover biogas from wastewater treatment shall use methodology AMS-III.H.	(f) Not applicable. The CPA only utilizes biogas from digesters.
2. Measures are limited to those that result in emission reductions equivalent to less than or equal to 60 kt CO_2 annually.	2. Each CPA is designed to keep the amount of emission reductions lower than the SSC threshold (60 kt CO_2e/yr) as specified in an eligibility criterion. In case it exceeds the threshold after implementation of the CPA, that excess amount will not be claimed for CERs.
3. In defining the geographical boundary of the region, project participants should take into account the source of waste, i.e. if waste is transported up to 50 km, the region may cover a radius of 50 km around the project activity. In addition, it should also consider the distances to which the final product after digestion will be transported. In either case, the region should cover a reasonable radius around the project activity that can be justified with reference to the project circumstances but in no case it shall be more than 200 km.	3. Each CPA under the PoA will target a provincial city in Bangladesh. There is a possibility of transporting organic wastes from its vicinity within the same district; however, the CPA is designed to keep the distance not to exceed 200 km. In addition, the fertilizer is sold in the nearby market which does not exceed 200 km also. There are specified in an eligibility criterion.
4. In case residual waste from the digestion is handled aerobically and submitted for soil application, the proper conditions and procedures (not resulting in methane emissions) for storage and transportation and soil application must be ensured.	4. The sludge from the digesters will be dried thoroughly (in dry season) before storage, transportation and soil application.

Therefore, the methodologies are applicable.

It is noted that in case the CPA exceeds the threshold after its implementation, that excess amount will not be claimed for CERs. For Type I part, it can be ensured *ex ante*.

E.3. Description of the sources and gases included in the SSC-CPA boundary

>>

The project boundary is the geographical areas where biogas digester systems are installed, locations of targeted households are included and other related project activities occur.

Table 4: Emission sources included in or excluded from the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline emissions	Emissions from non-renewable biomasses consumption	CO_2	Yes	Major emission source
		CH_4	No	Not significant. Excluded for simplification and conservativeness
		N_2O	No	Not significant. Excluded for simplification and conservativeness
	Emissions from landfills	CO_2	No	Not significant. Excluded for simplification and conservativeness
		CH_4	Yes	Major emission source
		N_2O	No	Not significant. Excluded for simplification and conservativeness
Project emissions	Emissions non-renewable biomasses consumptions	CO_2	Yes	Major emission source
		CH_4	No	Not significant. Excluded for simplification
		N_2O	No	Not significant. Excluded for simplification
	Emissions from physical leakages from biogas digesters	CO_2	No	Not significant. Excluded for simplification
		CH_4	Yes	Major emission source
		N_2O	No	Not significant. Excluded for simplification
	CO_2 emissions due to incremental transportation distances;	CO_2	Yes	Major emission source
		CH_4	No	Not significant. Excluded for simplification
		N_2O	No	Not significant. Excluded for simplification
	CO_2 emissions from electricity and/or fossil fuel consumption by the project activity facilities;	CO_2	Yes	Major emission source
		CH_4	No	Not significant. Excluded for simplification
		N_2O	No	Not significant. Excluded for simplification
	The methane emissions from the disposal/storage/treatment of these residual waste;	CO_2	No	Not significant. Excluded for simplification
		CH_4	Yes	Major emission source
		N_2O	No	Not significant. Excluded for simplification

E.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

>>

The methodology utilizes the following baseline scenario for calculation of emission reductions:

– It is *assumed* that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs (Paragraph 5 of AMS- I.E, ver.03)

– The baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter (including manure where applicable) are left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass and other organic matter. (Paragraph 12 of AMS- III.AO, ver.01)

Baseline determination for AMS-I.E.

The baseline scenario for AMS-I.E can be determined as follows.

All possible options (for thermal energy demand mainly for cooking) those are technically feasible and accessible for households as the main energy source include:

(a) Continuation of current practice (use of fuel wood as the main fuel);

(b) Fossil fuels currently not used mainly (LPG, coal, fuel oil, kerosene, *etc*.);

(c) Grid electricity;

(d) Renewable biomass use: picking up dead biomass, *etc*;

(e) Use of renewable energy from biogas digester installed by with households themselves.

(f) Use of other renewable energies.

(g) Use of renewable energy from biogas digester promotion project without the CDM

Options (b)–(g) implies *fuel switch* from the current practice. Through the sample survey for households covered by the first CPA, households currently use mainly biomass (non-renewable and renewable, and a small portion of LPG), because these fuels are the only accessible fuels in the region.

The sample survey shows that most households have not used fuel oil or kerosene for cooking, because the fuels are expensive to access and moreover the fuels are not suitable for cooking. Therefore, in option (b) switching to coal, fuel oil or kerosene cannot be an applicable scenario as a baseline.

Electricity has not been a dominant energy for cooking at households in local cities of Bangladesh due to the costs of electronic cooking appliances and the use of electricity itself. Therefore, due to the lack of incentive to *switch* to electricity, option (c) cannot be a credible scenario for a baseline.

Renewable biomass is used as supplemental fuel, and it cannot be a main energy source for cooking, especially as a switched fuel, because of the lack of supply and difficult accessibility in local cities. Therefore, option (d) also cannot be a baseline scenario.

It is difficult for households in local cities to install biogas digesters by themselves due to lack of feeding materials like livestock manures and organic waste enough. Therefore, option (e) cannot be a baseline scenario.

Because of the high cost to install solar energy or wind energy, and also unsuitable for cooking purposes, it is difficult for rural households to switch to them. Therefore, option (f) cannot be a baseline scenario.

Being CDM is the precondition for the implementation of the project. Without the CDM income, the project seems infeasible with an IRR of 3.4%; on the other hand, with the CDM income CER, the IRR is 18% and the project becomes viable. Thus the option (g) is not a baseline scenario.

The survey showed that even at present, households use LPG in some portion for cooking. LPG (an option in option (b)) seems to be the most plausible and credible alternative fossil fuel to current biomass The baseline scenario for AMS-I.E can be determined as follows.

All possible options (for thermal energy demand mainly for cooking) those are technically feasible and accessible for households as the main energy source include:

(a) Continuation of current practice (use of fuel wood as the main fuel);

(b) Fossil fuels currently not used mainly (LPG, coal, fuel oil, kerosene, *etc*.);

(c) Grid electricity;

(d) Renewable biomass use: picking up dead biomass, *etc*;

(e) Use of renewable energy from biogas digester installed by with households themselves.

(f) Use of other renewable energies.

(g) Use of renewable energy from biogas digester promotion project without the CDM

Options (b)–(g) implies *fuel switch* from the current practice. Through the sample survey for households covered by the first CPA, households currently use mainly biomass (non-renewable and renewable, and a small portion of LPG), because these fuels are the only accessible fuels in the region.

The sample survey shows that most households have not used fuel oil or kerosene for cooking, because the fuels are expensive to access and moreover the fuels are not suitable for cooking. Therefore, in option (b) switching to coal, fuel oil or kerosene cannot be an applicable scenario as a baseline.

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Renewable biomass is used as supplemental fuel, and it cannot be a main energy source for cooking, especially as a switched fuel, because of the lack of supply and difficult accessibility in local cities. Therefore, option (d) also cannot be a baseline scenario.

It is difficult for households in local cities to install biogas digesters by themselves due to lack of feeding materials like livestock manures and organic waste enough. Therefore, option (e) cannot be a baseline scenario.

Because of the high cost to install solar energy or wind energy, and also unsuitable for cooking purposes, it is difficult for rural households to switch to them. Therefore, option (f) cannot be a baseline scenario.

Being CDM is the precondition for the implementation of the project. Without the CDM income, the project seems infeasible with an IRR of 3.4%; on the other hand, with the CDM income CER, the IRR is 18% and the project becomes viable. Thus the option (g) is not a baseline scenario.

The survey showed that even at present, households use LPG in some portion for cooking. LPG (an option in option (b)) seems to be the most plausible and credible alternative fossil fuel to current biomass used at households. Therefore, "LPG" is used for calculation of the emission reductions as specified in the methodology AMS-I.E.[8]

As specified, the amount of current fuel consumption at households is determined by sample survey to targeted households.

Baseline determination for AMS-III.AO.

All possible options for municipal waste treatment that are technically feasible and economically reasonable include:

(a) Continuation of current practice (municipal wastes are treated at managed or semi-managed solid waste disposal sites).

(b) Municipal wastes are treated in other ways than the project such as composting

(c) Implementation of the project without CDM

Option (c) is not the most plausible scenario for baseline due to without CDM consideration, both the GS and municipal governments would not implement such a kind of programme or project. Regarding option (b), there is an ongoing government support for municipal waste composting programme to cover all 24

[8] The most plausible baseline fuel is continuation of current practice, *i.e.*, non-renewable biomass (fuel wood). Therefore, *theoretically* it is correct to use the CO_2 emission factor of the non-renewable biomass in the calculation of emission reductions. However, the methodology does not allow to use such emission factor but requests to use that of (most plausible) fossil fuel by *assuming* that the use of such fossil fuel is the baseline scenario (para. 5 of the methodology). Therefore, the emission factor of LPG is applied for calculation. In reality, some (not main) portion of LPG would be introduced because of the scarcity of biomass.

Historical background of this un-theoretical treatment is the requirement by the Marrakech Accords (Modalities and Procedures for CDM; Decision 17/CP.7): "(CMP) decides: (a) That the eligibility of land use, land-use change and forestry project activities under the clean development mechanism is limited to afforestation and reforestation" (para. 7). Switching from non-renewable biomass to renewable energy is to reduce CO_2 but it may be recognized also as a "land use, land-use change and forestry"-type project activity.

After two years' negotiations, CMP 3 decides that "24. (CMP) *Requests* the Executive Board to approve, at its first meeting in 2008, the simplified methodologies for "Switch from non-renewable biomass for thermal application by the user" and "Energy efficiency measures in thermal applications of non-renewable biomass", as recommended by the Executive Board, for use for clean development mechanism project activities, as contained in annexes 3 and 4 to document FCCC/KP/CMP/2007/3 (Part II), incorporating the necessary changes to ensure that the application of these methodologies introduces new or improves existing end-user technologies and that, in the case of the methodology "Energy efficiency measures in thermal applications of non-renewable biomass", the baseline energy efficiency is measured or is based on referenced literature values" (Decision 2/CMP.3).

Therefore, a *skewed* treatment is incorporated in the methodology such as "It is *assumed* that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs (Paragraph 5 of AMS- I.E, ver.03)" even if the real baseline scenario is continuation of use of non-renewable biomass. The "CDM methodology booklet" prepared by the CDM Secretariat also shows that the real baseline is continuation of non-renewable biomass use.

It is noted that the CO_2 emission factor of the (non-renewable) biomass is around twice of that of LPG. Therefore, this treatment is very conservative.

districts. However, the government programme can be considered as "Type E−" measure and need not be taken into account in developing the baseline scenario. In addition, as shown in the eligibility condition, the CPA will be implemented in a municipality which has no such city-wide system.

"Type E−" was defined in EB 22 Report Annex 3 as follows:

Paragraph 7.(b) National and/or sectoral policies or regulations under paragraph 6 (b) that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) need not be taken into account in developing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place).

Paragraph 6.(b) National and/or sectoral policies or regulations that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (e.g. public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs).

Thus, it is not necessary to consider this option (b) into account on baseline setting.

Option (a), continuation of current practice, is seen to be the most credible scenario for municipal governments; thus, the baseline scenario for manure treatment is the continuation of current practices.

In summary, the baseline scenario of the CPA is the continuation of current practices, *i.e.*,

– Non-renewable and renewable biomass are used in individual households as thermal energy,
– Municipal waste is left to decay anaerobically in solid waste disposal sites within the project boundary and methane is emitted to the atmosphere,

E.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the SSC-CPA being included as registered PoA (assessment and demonstration of additionality of SSC-CPA): >>

E.5.1. Assessment and demonstration of additionality for a typical SSC-CPA:

>> Here the PPs shall demonstrate, using the procedure provided in the baseline and monitoring methodology applied, additionality of a typical CPA.

If a CPA that employs renewable energy under the PoA is up to 5 MW, then the CPA is demonstrated to be additional by following the guidelines specified in "Guidelines for demonstrating additionality of renewable energy projects =< 5 MW and energy efficiency projects with energy savings <= 20 GWh per year (version 01)" approved in the 54th meeting of EB.

The Guidelines states:

Paragraph 2. Project activities up to 5 megawatts that employ renewable energy as their primary technology[9] are additional if any one of the below conditions are satisfied:

(a) The geographic location of the project activity is in LDCs/SIDs or in a special underdeveloped zone of the host country identified by the Government before 28 May 2010;

Each CPA under the PoA is designed as to keep the aggregated cooking stoves' rated capacity lower than 15 MW_{th} as specified in an eligibility criterion.

Bangladesh is a LDC (least developing country) that each CPA satisfy the condition stipulated in the "Guidelines for demonstrating additionality of renewable energy projects =< 5 MW and energy efficiency projects with energy savings <= 20 GWh per year".

Therefore, according to the guidelines mentioned above, any CPA under the PoA is additional.
[Note: Applicability of the Guidelines to PoAs will be confirmed.]

For consideration of CDM, the timetable is shown in Annex 3.

E.5.2. Key criteria and data for assessing additionality of a SSC-CPA:

>> Here the PPs shall provide the key criteria for assessing additionality of a CPA when proposed to be included in the registered PoA. The criteria shall be based on additionality assessment undertaken in E.5.1 above. The project participants shall justify the choice of criteria based on analysis in above section.
It shall be demonstrated how these criteria would be applied to assess the additionality of a typical CPA at the time of inclusion.

NOTE: Information provided here shall be incorporated into the PoA specific CDM-SSC-CPA-DD that shall be included in documentation submitted by project participants at registration of PoA.

Key data or information and criteria in assessing additionality are also provided in the table 5 below.

Table 5: Key Criteria for Assessing Additionality of a CPA

Steps	Key data/information	Key criteria
Step1. Check thermal capacity of a CPA	Aggregated rated capacities of cooking stoves	Less than 15 MW_{th}

E.6. Estimation of Emission reductions of a CPA:

E.6.1. Explanation of methodological choices, provided in the approved baseline and monitoring methodology applied, selected for a typical SSC-CPA:

>>
Methodological choices selected for a typical SSC-CPA are as follows:

[9] All technologies/measures included in approved Type I Small-Scale CDM methodologies are eligible to be considered.

(1) AMS-I.E. Switch from non-renewable biomass for thermal applications by the user / version 03

According to the methodology, the baseline is defined as the absence of the project activity; the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs (Paragraph 5). And emission reduction is calculated based on the equation as below as for paragraph 6.

$$ER_y = B_y * f_{NRB,y} * NCV_{biomass} * EF_{projected\_fossilfuel}$$

Where:

ER_y	Emission reductions during the year y in tCO_2e
B_y	Quantity of woody biomass that is substituted or displaced in tonnes
$f_{NRB,y}$	Fraction of woody biomass used in the absence of the project activity in year y that can be established as non renewable biomass using survey methods
$NCV_{biomass}$	Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.015 TJ/tonne)
$EF_{projected\_fossilfuel}$	Emission factor for substitution of non renewable woody biomass by similar consumers. The substitution fuel likely to be used by similar consumers is taken: 71.5 tCO_2/TJ for Kerosene, 63.0 tCO_2/TJ for Liquefied Petroleum Gas (LPG) or the IPCC default value of other relevant fossil fuel

B_y is determined by using one of the following options.

(a) Calculated as the product of the number of appliances multiplied by the estimate of average annual consumption of woody biomass per appliance (tonnes/year); This can be derived from historical data or estimated using survey methods; or

(b) Calculated from the thermal energy generated in the project activity as:

$$B_y = HG_{p,y} / (NCV_{biomass} * \eta_{old})$$

Where:

$HG_{p,y}$	Quantity of thermal energy generated by the new renewable energy technology in the project in year y (TJ)
η_{old}	1. Efficiency of the system being replaced, measured using representative sampling methods or based on referenced literature values (fraction), use weighted average values if more than one type of systems are encountered; 2. 0.10 default value may be optionally used if the replaced system is the three stone fire or a conventional system lacking improved combustion air supply mechanism and flue gas ventilation system i.e. without a grate as well as a chimney; for the rest of the systems 0.2 default value may be optionally used

Option (b) is applied to the CPAs under the PoA.

For evaluation of $HG_{p,y}$, we apply supply-side accounting, *i.e.*, net calorific value of the biogas supplied. It is apparent (in the sense of material balance) that all of biogas is used by cooking stoves of the households, except for some physical leakage of the biogas.[10] A technological procedure is introduced to avoid this physical leakage from the gas distribution network as a maintenance process of the system. [Note: Clarification and explanation of the procedure is needed]

A result of questionnaire survey toward 100 households in the Faridpur municipality, helped identify where the first CPA will be implemented, as concluded in the table 6 below.

Table 6: Households Energy Consumption Structure

	Fuelwood	Other biomass	Kerosene	LPG
Weight(kg)/Month	133.4	39.6	0.5	5.3

Table 6 above showed the average energy consumption of households in Faridpur. From the data, fuel wood fraction among the total biomass used at households is calculated to be 77%.[11]

Based on the data, the woody biomass consumed at a household is 133.4 kg per month.

For CPAs in another municipality, household energy consumption structure is measured by sampling and fixes the value before implementation of the CPA.[12]

The majority of biomass consumed at households in municipalities is commercial biomass; particularly, fuel woods used in households are purchased from markets where fuel woods are provided by forested and wooded lands.

According to a unanimous agreement from a range of experts, there are no examples of sustainably managed forest areas, despite the existence of formally Protected Areas in Bangladesh. From a study,[13] commissioned by JPMorgan Climate Care conducted in Bangladesh on non-renewable biomass, interviews with wood sellers indicated how collection distances have been increasing radically, with many trucks nowadays travelling more than 100 km with wood fuel cargo. The study also found that wood fuel prices have been rising sharply in recent years, and that the mixing in of secondary fuels (dung, leaves, and crop residue) is partly a result of difficulties in procuring wood. With the strong evidence that land across the country is deforesting rapidly and the absence of any evidence for renewable resources sustainably managed, all wood biomass used in households can be seen as non-renewable biomass (NRB).

[10] In addition, there may be a possibility that the biogas would be resold to some other facility. This is banned by contractual agreement between GS and the households as specified in an eligibility criterion.

[11] This fraction is larger than that of Bangladesh as a whole or of rural villages. People in municipalities are difficult to collect non-woody biomass.

[12] The methodology states,"15. Monitoring should confirm the displacement or substitution of the non-renewable woody biomass at each location. In the case of appliances switching to renewable biomass the quantity of renewable biomass used shall be monitored." The biogas digester does not switch from biomass to biomass, time-dependence is not needed to be monitored for this project type.

[13] "Non-Renewable Biomass (NRB) Assessment Report—A Component of Bangladesh Stoves Baseline Study 2008–9" (20 March 2009).

Another study "Restoring Balance—Bangladesh's Rural Energy Realities"[14] by the World Bank shows as follows:

> [P.57] With regard to fuel wood, the opinions expressed varied markedly, reflecting the widespread problem of deforestation and thus uneven resource availability. Because of scarcity and moderate shortages, about 50 percent considered fuel wood expensive. At the same time, many rural entrepreneurs perceived fuel wood as a readily available resource. More than 90 percent expressed concern with regard to deforestation. Rural entrepreneurs preferred fuel wood to straw, dung, and other biofuels, which were used sparingly. But about 85 percent of respondents were aware that the smoke emitted from fuel wood could cause respiratory problems, and some 50 percent agreed that it may cause other health problems (see Table 5.8).
>
> [P.80] Given the extensive commercialization and increasing scarcity of quality biomass energy in rural areas, there appears to be a market for liquefied petroleum gas (LPG), with the right marketing strategies. Currently, the reach of LPG into rural areas is low compared to other South Asian countries.
>
> [P.80–81] As the survey findings illustrate, beneath this biomass dependence, an energy crisis is simmering. In regions experiencing a continuing decline in the availability of quality biomass, many people seem to be turning from fuel wood to dung, straw, tree leaves, and grass. As the previous chapter discussions underscore, quality biomass in the form of wood is fast becoming monetized, a reflection of its scarcity. In areas where wood is not purchased, all family members, but especially women, spend significant amounts of time (nearly 200 hours annually) collecting all forms of biomass. Such arduous chores divert time from competing tasks and important human-development activities. Moreover, poorly designed biomass-burning stoves without chimneys have low energy efficiency. Used indoors, such stoves emit high levels of smoke and other products of incomplete combustion that are concentrated at high levels indoors. The result is significant health problems for all family members, especially women and children, who spend many hours in a day indoors within the vicinity of the stoves.

Therefore, we can determine that all fuel wood is considered as non-renewable in Bangladesh.

Based on the methodology, the fraction of fuel wood which is seen as non-renewable biomass is calculated by the equation given below (DRB denotes the amount of "demonstrably renewable woody biomass" and NRB denotes "non-renewable woody biomass").

$$f_{NRB} = \frac{NRB}{NRB + DRB}$$

This is 1.0 in Bangladesh as shown above.

For the baseline cook stoves' efficiency (η_{old}), the methodology specifies

[14] http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2010/04/07/000333037_20100407004249/Rendered/PDF/538770PUB0 Bang101Official0Use0Only1.pdf.

"0.10 default value may be optionally used if the replaced system is the three stone fire or a conventional system lacking improved combustion air supply mechanism and flue gas ventilation system *i.e*. without a grate as well as a chimney; for the rest of the systems 0.2 default value may be optionally used".

In Bangladesh, most cooking stoves are fixed low-efficient clay type without a flue gas ventilation system. This is the reason why Grameen Shakti is encouraging improved cooking stoves (ICS) with ventilation system in whole Bangladesh. In addition, the households with ICS covered by another PoA are not targeted by this PoA as described in an eligibility criterion.

"A Technical Manual of Improved Cooking Stoves[16] " prepared by Bangladesh Government states (p.4):

2.1 Traditional Stoves

Traditional stoves in Bangladesh are usually a mud-built cylinder with three raised upper ends on which cooking utensils rest. One of the three spaces in between these raised points is used as fuel gases feed hole and the other two for flue gases exits. These stoves may be built underground or over ground. In some cases, two stoves are joined together laterally using a single fuel feeding hole. These stoves cause unnecessary loss of heat for the following reasons:

a) These stoves are too deep, their depths ranging from 12 inches to 18 inches. Because of the large distance between the pot and fuel bed, heat transfer to the cooking pot is considerably reduced resulting in low efficiency.

b) Because of large size of the flue gases exits between the cooking pots and the stove, much of the flue gases get out of the stove without coming in contact with the cooking pot and thus lower convective heat transfer.

c) Since air cannot reach the bottom of the stove, considerable amount of cooking fuel accumulate at the bottom as charcoal. The efficiencies of these stoves vary from 5–15% depending on the depth of the stove and size of the flue gases exits.

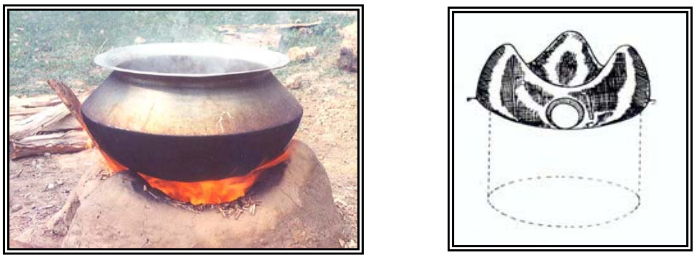

Fig. No.-1 : Traditional stove commonly used in the country.

Therefore we can set the fixed value 0.1 for the baseline cooking stoves' efficiency (η_{old}).

For leakage estimation, AMS-I.E states that:

[16] http://www.lged-rein.org/ics/ICS_Technical_Manual-14.5.08.pdf

11. Leakage relating to the non-renewable woody biomass shall be assessed from ex post surveys of users and areas from where woody biomass is sourced (using 90/30 precision for selection of samples). The following potential source of leakage shall be considered:

(a) Use/diversion of non-renewable woody biomass saved under the project activity by non-project households/users that previously used renewable energy sources. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass used by the non-project households/users attributable to the project activity then B_y is adjusted to account for the quantified leakage.

12. If the equipment currently being utilised is transferred from outside the boundary to the project boundary, leakage is to be considered.

For para. 12 concern, the project does not utilize equipment transferred to non-supply areas. Therefore this concern is irrelevant.

For para. 11 (a) concern, first, we must say that a simple sampling method is not appropriate method. It is theoretically almost impossible to identify the gap between with and without project cases even if we undertake the sampling. As well known, 'without-case' is counterfactual and cannot be monitored directly. For calculation of the gap, we need to estimate the other factors than the project activities to estimate the true gap *attributed* to the project activity. Other factors may include those which influence the market price of fuel wood. It is almost impossible to differentiate the factors comes from the project and others.

Therefore, here we undertake theoretical consideration. The reason why the leakage may occur is that due to the lack of demand by the project, the fuel wood market price will be lower (than the case without the project). This may cause incremental use of the fuel wood.

For the typical CPA under the PoA, the CPA covers only a few percent of the city people.[17] Therefore, the impact on the fuel-wood market is very limited. In addition, fuel-wood demand is a basic-human-needs type commodity and lower price elasticity than other commodities.

Although it needs fuel market study as well as price elasticity study of the users for quantification analysis, we can apply CDM EB's Guidelines below.

This paragraph 11 and 12 of AMS-I.E. is recognized as "C. competing use for the biomass" in the section of leakage of the "General guidance on leakage in biomass project activities" (ver. 03) where the project utilizes biomass.

The Guidelines specifies the thershold that

18. The project participant shall evaluate ex ante if there is a surplus of the biomass in the region of the project activity, which is not utilised. If it is demonstrated (e.g., using published literature, official reports, surveys etc.) at the beginning of each crediting period that the quantity of available biomass in the region (e.g., 50 km radius), is at least 25% larger than the quantity of

[17] The PoA utilizes municipal organic waste as its main feedstock. The energy content of the waste is limited, each CPA can cover very limited households. For example, the first CPA is scheduled to supply biogas only to 250–300 households.

biomass that is utilised including the project activity, then this source of leakage can be neglected otherwise this leakage shall be estimated and deducted from the emission reductions.

As we apply the concept of this Guidelines for our project activity, 'surplus' issue is not relevant because the project activity causes the less biomass use (*i.e.*, provides biomass in comparison to without project case additionally). Then we can rewrite this concept as

If it is demonstrated at the beginning of each crediting period that the quantity of available biomass in the region is at least 25% larger than the quantity of biomass that is saved by the project activity, then this source of leakage can be neglected.

suitable to our PoA. [Clarification]

As shown above, the CPA only covers only a few percent of total population of the city area (*i.e.*, a few percent of fuel wood consumption), the leakage effect can be neglected.

(2) AMS-III.AO. Methane recovery through controlled anaerobic digestion / version 01

According to paragraph 12 of the methodology, the baseline scenario is defined that the baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter (including manure where applicable) are left to decay within the project boundary and methane is emitted into the atmosphere.

And baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass and other organic matter. Baseline emissions shall exclude emissions of methane that would have to be captured, fuelled or flared or gainfully used to comply with national or local safety requirement or legal regulations.

The baseline emissions are calculated through the equation given in the methodology as below.

$$BE_y = BE_{SWDS,y} + BE_{ww,y} + BE_{manure,y} - MD_{reg,y} * GWP_{CH_4}$$

Where:

$BE_{SWDS,y}$	Where applicable, yearly methane generation potential of the solid waste anaerobically digested by the project activity during the year x from the beginning of the project activity (x=1) up to the year y estimated as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" (tCO_2e). The tool may be used with the factor "f=0.0" assuming that no biogas is captured, flared or used. With the definition of year x as the base year since the project activity started diverting wastes from the SWDS/landfill site. x runs from the first year of the crediting period (x=1) to the year for which emissions are calculated (x=y). Where applicable, baseline emission determination of digested waste that would otherwise have been disposed in stockpiles shall follow relevant procedures in AMS-III.E
$BE_{manure,y}$	Where applicable, baseline emissions from the manure co-digested by the project activities, calculated as per the relevant procedures of AMS-III.D
$BE_{ww,y}$	Where applicable, baseline emissions from the wastewater co-digested, calculated as per the procedures of AMS-III.H
$MD_{reg,y}$	Amount of methane that would have to be captured and combusted in the year y to comply with the prevailing regulations (tonne)
GWP_{CH_4}	GWP for CH_4 (value of 21 is used)

For the CPAs concerned, $B_{ww,y}$, $BE_{manure,y}$ and $MD_{reg,y}$ are not applicable.

As for paragraph 13, project emission consists of:

(a) CO_2 emissions due to incremental transportation distances;

(b) CO_2 emissions from electricity and/or fossil fuel consumption by the project activity facilities;

(c) In case the residual waste from the digestion is stored under anaerobic conditions and/or delivered to a SWDS, or treated in a WWTS: the methane emissions from the disposal/storage/treatment of these residual wastes;

(d) Methane emissions from physical leakages of the anaerobic digester;

(e) Methane emissions due to flare inefficiency;

The project emissions can be calculated by the equation as follows.

$$PE_y = \begin{Bmatrix} PE_{transp,y} + PE_{power,y} + PE_{res\ waste,y} \\ + PE_{phy\ leakage,y} + PE_{flaring,y} \end{Bmatrix}$$

Where:

PE_y	Project activity emissions in the year y (tCO_2e)
$PE_{transp,y}$	Emissions from incremental transportation in the year y (tCO_2e)

$PE_{power,y}$	Emissions from electricity or fossil fuel consumption in the year y (tCO_2e)
$PE_{res\ waste,y}$	In case residual wastes are subjected to anaerobic storage, or disposed in a landfill: methane emissions from storage/disposal/treatment of waste (tCO_2e)
$PE_{phy\ leakage,y}$	Methane emissions from physical leakages of the anaerobic digester in year y (tCO_2e)
$PE_{flaring,y}$	Methane emissions due to incomplete flaring in year y as per the "Tool to determine project emissions from flaring gases containing methane"(tCO_2e)

Project emissions due to incremental transport distances ($PE_{transp,y}$) are calculated based on the incremental distances between (paragraph 14):

(i) The collection points of biomass and/or manure and the digestion site as compared to the baseline solid waste disposal site or manure treatment site;

(ii) When applicable, the collection points of wastewater and treatment site as compared to baseline wastewater treatment site;

(iii) Treatment sites and the sites for soil application, landfilling and further treatment of the residual waste.

$$PE_{transp,y} = (Q_y / CT_y) * DAF_w * EF_{CO2,transport} + (Q_{res\cdot waste,y} / CT_{res\cdot waste,y}) * DAF_{res\cdot waste} * EF_{CO2,transport}$$

Where:

Q_y	Quantity of raw waste/manure treated and/or wastewater co-digested in the year y (tonnes)
CT_y	Average truck capacity for transportation (tonnes/truck)
DAF_w	Average incremental distance for raw solid waste/manure and/or wastewater transportation (km/truck)
$EF_{CO2,transport}$	CO_2 emission factor from fuel use due to transportation ($kgCO_2$/km, IPCC default values or local values may be used)
$Q_{res\cdot waste,y}$	Quantity of residual waste produced in year y (tonnes)
$CT_{res\cdot waste,y}$	Average truck capacity for residual waste transportation (tonnes/truck)
$DAF_{res\cdot waste}$	Average distance for residual waste transportation (km/truck)

For the calculation of project emissions from electricity and/or fossil fuel consumption by the project activity facilities ($PE_{power,y}$) all the energy consumption of all equipment/devices installed by the project activity shall be included e.g. energy used for chopping of biomass for size reduction and "Tool to calculate the emission factor of an electricity system" and/or "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" shall be followed, respectively. If recovered biogas is used to provide power for auxiliary equipment of the project, it should be taken into account accordingly, using zero as its emission factor (paragraph 15).

Methane emissions from anaerobic storage and/or disposal in a landfill of the residual waste from the digestion ($PE_{res\ waste,y}$) are calculated as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" (paragraph 16).

Methane emissions due to physical leakages from the digester and recovery system ($PE_{phy\ leakage,y}$) shall be estimated using a default factor of 0.05 m³ biogas leaked/m³ biogas produced. For *ex ante* estimations, the expected biogas production of the digester may be used, for *ex post* calculations the effectively recovered biogas amount shall be used (paragraph 17).

Regarding leakages, the methodology defines that if the project technology is the equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage effects are to be considered (LE_y) (paragraph 18).

E.6.2. Equations, including fixed parametric values, to be used for calculation of emission reductions of a SSC-CPA:

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The equations are as summarized below:

(1) AMS-I.E

(a) Emission Reductions by Fuel Switching ($ER_{FS,y}$)

$ER_{FS,y} = B_y * f_{NRB} * NCV_{biomass} * EF_{projected\_fossilfuel}$

B_y: Quantity of woody biomass that is substituted or displaced in tonnes (calculated by the formula below)

f_{NRB}: Fraction of non-renewable woody biomass used among the whole woody biomass in the absence of the CPA . This is set as 1.0 in Bangladesh.

$NCV_{biomass}$: Net Calorific Value of the non-renewable woody biomass that is substituted. IPCC default for wood fuel is applied (0.015 TJ/tonne).

$EF_{projected\_fossilfuel}$: Emission factor for substitution of non-renewable woody biomass by similar consumers. The substitution fuel likely to be used by similar consumers is taken: 63.0 t CO_2/TJ for LPG.

$B_y = HG_{p,y} / (NCV_{biomass} * \eta_{old})$

$HG_{p,y}$: Quantity of thermal energy generated by the biogas digester by the CPA in year *y* (TJ/year)

η_{old}: Efficiency of the system being replaced (0.1)

$NCV_{biomass}$: Net Calorific Value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel (0.015 TJ/tonne)

Inserting the fixed parameter values, and taking into account the null leakage (see below), the Emission Reductions by Fuel Switching ($ER_{FS,y}$) can be expressed as:

$ER_{FS,y} = HG_{p,y} * f_{NRB} * EF_{projected\_fossilfuel} / \eta_{old}$

$= 630 * HG_{p,y}$ (t CO_2)

This is equivalent to the associated baseline emissions.

(b) Leakage

Leakage = 0

(2) AMS-III.AO

(a) Baseline Emission of methane from Land-Filling ($BE_{LF,y}$)

As discussed in E.6.1., $BE_{LF,y}$ is expressed as:

$BE_{LF,y} = BE_{CH4,SWDS,y}$

The amount of methane produced in the year *y* is calculated as "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site (ver. 05)", as follows:

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j (y-x)} \cdot \left(1 - e^{-k_j}\right)$$

Where:

$BE_{CH4,SWDS,y}$	=	Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
φ	=	Model correction factor to account for model uncertainties (0.9)
f	=	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	=	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	=	Fraction of degradable organic carbon (DOC) that can decompose
MCF	=	Methane correction factor
$W_{j,x}$	=	Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
DOC_j	=	Fraction of degradable organic carbon (by weight) in the waste type *j*
k_j	=	Decay rate for the waste type *j*
j	=	Waste type category (index)
x	=	Year during the crediting period: x runs from the first year of the first crediting period (x = 1) to the year y for which avoided emissions are calculated (x = y)
y	=	Year for which methane emissions are calculated

Where different waste types j are prevented from disposal, determine the amount of different waste types through sampling and calculate the mean from the samples, as follows:

$$W_{j,x} = W_x \cdot \frac{\sum_{n=1}^{z} p_{n,j,x}}{z}$$

Where:

$W_{j,x}$ = Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
W_x = Total amount of organic waste prevented from disposal in year *x* (tons)
$p_{n,j,x}$ = Weight fraction of the waste type *j* in the sample *n* collected during the year *x*
z = Number of samples collected during the year *x*

For the CPAs under the PoA, $f = 0$ (eligibility condition 6). Other parameters, not specifying a concrete value above, are monitored before implementation of the CPA.

Calculating the values of φ, F, DOC_f, associated baseline emissions can be given as:

$$BE_{CH4,SWDS,y} = 0.3 \cdot GWP_{CH4} \cdot (1 - OX) \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1 - e^{-k_j})$$

(b) Project Emission

$$PE_y = \begin{Bmatrix} PE_{transp,y} + PE_{power,y} + PE_{res\ waste,y} \\ + PE_{phy\ leakage,y} + PE_{flaring,y} \end{Bmatrix}$$

In the equation above, $PE_{flaring,y}$ is not applicable for the CPA.

For the Energy Consumption portion, $PE_{power,y}$ is given by:

$$PE_{power,y} = EC_{elec} * EF_{grid} + FC_y * EF_{fossil}$$

where,

$EC_{elec,y}$: Electricity Consumption in year *y* in MWh
EF_{grid}: Grid Emission Factor in ton CO_2e/MWh
$FC_{fossil,y}$: Fossil Fuel Consumption in year *y* in physical unit
EF_{fossil}: Emission Factor of respective Fossil Fuel in tonne CO_2/physical unit

$PE_{phy,leakage,y}$ is estimated using a default factor of 0.05 m³ biogas leaked/m³ biogas produced:

$$PE_{phy,leakage,y} = 0.05 * HG_{p,y} / Q_{CH4} * GWP_{CH4}$$
$$= 1.00 * HG_{p,y} * GWP_{CH4}$$

Where Q_{CH4} = 0.0500 [TJ/t CH_4] is the energy content of methane per ton.

(c) Leakage

Given that the project does not use equipments transferred from other activities, then the leakage = 0.

(3) Overall Emission Reduction

$$ER_y = (ER_{FS,y} + BE_{LF,y}) - PE_y - \text{Leakage}$$

$$= 630 * HG_{p,y} + BE_{CH4,SWDS,y} - [\ PE_{transp,y} + (EC_{elec} * EF_{grid} + FC_y * EF_{fossil}) + PE_{res\ waste,y} + 0.0024 * HG_{p,y} * GWP_{CH4}\ ]$$

E.6.3. Data and parameters that are to be reported in CDM-SSC-CPA-DD form:

Data / Parameter:	$NCV_{biomass}$
Data unit:	TJ/tonne
Description:	Net calorific value of the non-renewable woody biomass
Source of data used:	IPCC
Value applied:	0.015
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Chapter 1, Table 1.2 This value does not appear explicitly in the final form of emission reductions.
Any comment:	–

Data / Parameter:	$EF_{projected\_fossilfuel}$
Data unit:	tonne CO_2 e/TJ
Description:	Emission factor for substitution of non renewable woody biomass
Source of data used:	IPCC
Value applied:	63.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value for LPG from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Chapter 1, Table 1.2 is applied.
Any comment:	–

Data / Parameter:	η_{old}
Data unit:	TJ
Description:	Efficiency of the system being replaced
Source of data used:	AMS-I.E. and "A Technical Manual of Improved Cooking Stoves"
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Please see E.6.1.
Any comment:	–

Data / Parameter:	φ
Data unit:	No dimension
Description:	Model correction factor to account for model uncertainties
Source of data used:	Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site
Value applied:	0.9

Justification of the choice of data or description of measurement methods and procedures actually applied :	Oonk et el. (1994) have validated several landfill gas models based on 17 realized landfill gas projects. The mean relative error of multi-phase models was assessed to be 18%. Given the uncertainties associated with the model and in order to estimate emission reductions in a conservative manner, a discount of 10% is applied to the model results.
Any comment:	–

Data / Parameter:	*OX*
Data unit:	No dimension
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other materials covering the waste)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	Described in each CPA-DD; for the first CPA under the PoA, the value is 0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Use 0.1 for managed solid waste disposal sites that are covered with oxidizing materials such as soil or compost. Use 0 for other types of solid waste disposal sites. Determined before implementation of the CPA.
Any comment:	–

Data / Parameter:	*F*
Data unit:	No dimension
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC.
Any comment:	–

Data / Parameter:	DOC_f
Data unit:	No dimension
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	–
Any comment:	–

Data / Parameter:	*MCF*

Data unit:	No dimension
Description:	Methane correction factor
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	Described in each CPA-DD; for the first CPA under the PoA, the value is 0.4
Justification of the choice of data or description of measurement methods and procedures actually applied :	Use the following values for MCF: • 1.0, for anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste; • 0.5, for semi-aerobic managed solid waste disposal sites. These must have controlled placement of waste and will include all of the following structures for introducing air to waste layer: (i) permeable cover material; (ii) leachate drainage system; (iii) regulating pondage; and (iv) gas ventilation system; • 0.8, for unmanaged solid waste disposal sites – deep and/or with high water table. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters and/or high water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste; • 0.4, for unmanaged-shallow solid waste disposal sites. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 metres
Any comment:	The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS. This value is determined before implementation of the CPA.

Data / Parameter:	DOC_j
Data unit:	%
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value applied:	Described in each CPA-DD; for the first CPA under the PoA, the value is 15
Justification of the choice of data or description of measurement methods and procedures actually applied :	Apply the following values for the different waste types *j*:

Waste type *j*	**DOC_j (% wet waste)**	**DOC_j (% dry waste)**
Wood and wood products	43	50
Pulp, paper and cardboard (other than sludge)	40	44
Food, food waste, beverages and tobacco (other than sludge)	15	38
Textiles	24	30
Garden, yard and park waste	20	49
Glass, plastic, metal, other inert waste	0	0

If a waste type, prevented from disposal by the proposed CPA, can not clearly be attributed to one of the waste types in the table above, project participants

	should choose among the waste types that have similar characteristics that waste type where the values of DOC_j and k_j result in a conservative estimate (lowest emissions), or request a revision of / deviation from this methodology. In the case of Empty Fruit Bunches (EFB), as their characteristics are similar to garden waste, the parameter value correspondent of garden shall be used. In the case of industrial sludge, a value of 9% (% wet sludge) shall be used assuming an organic dry matter content of 35 percent[18]
Any comment:	This value is determined before implementation of the CPA.

Data / Parameter:	k_j
Data unit:	No dimension
Description:	Decay rate for the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value applied:	Described in each CPA-DD; for the first CPA under the PoA, the value is 0.6
Justification of the choice of data or description of measurement methods and procedures actually applied :	Apply the following default values for the different waste types *j*:

Waste type *j*		**Boreal and Temperate (MAT≤20°C)**		**Tropical (MAT>20°C)**	
		Dry (MAP/PET <1)	Wet (MAP/PET >1)	Dry (MAP< 1000mm)	Wet (MAP> 1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
Slowly degrading	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.10	0.065	0.17
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.40

NB: MAT – Mean Annual Temperature, MAP – Mean Annual Precipitation, PET Potential Evapotranspiration. MAP/PET is the ratio between the mean annual precipitation and the potential evapotranspiration.

If a waste type, prevented from disposal by the proposed CDM project activity, can not clearly be attributed to one of the waste types in the table above, project participants should choose among the waste types that have

[18] This value must be adjusted for other percentages of organic dry matter content as follows:

DOC (% wet sludge) = 9 * (% organic dry matter content/35).

	similar characteristics that waste type where the values of DOC_j and k_j result in a conservative estimate (lowest emissions), or request a revision of / deviation from this methodology. In the case of Empty Fruit Bunches (EFB), because their characteristics are similar to garden waste, the parameter values correspondent of garden waste shall be used. In case of sludge from pulp and paper industry, a conservative value of 0.03 shall be used for all precipitation and temperature combinations
Any comment:	Document in the CDM-PDD the climatic conditions at the SWDS site (temperature, precipitation and, where applicable, evapotranspiration). Use long-term averages based on statistical data, where available and provide reference. This value is determined before the implementation of the CPA.

Data / Parameter:	GWP_{CH4}
Data unit:	
Description:	Global Warming Potential of Methane
Source of data used:	IPCC 2nd Assessment Report, WG-I Report.
Value applied:	21 (for –2012)
Justification of the choice of data or description of measurement methods and procedures actually applied :	–
Any comment:	–

Data / Parameter:	$EF_{CO2\ transport}$
Data unit:	kg CO_2/km
Description:	CO_2 emission factor from fuel use due to transportation
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	Described in each CPA-DD.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default values or local values may be used.
Any comment:	–

Data / Parameter:	EF_{grid}
Data unit:	tonne CO_2e/MWh
Description:	Grid emission factor for Bangladesh
Source of data used:	Calculated by project participants
Value applied:	0.584
Justification of the choice of data or description of measurement methods and procedures actually	Please see CPA-DD for the first CPA.

applied :	
Any comment:	–

Data / Parameter:	f_{NRB}
Data unit:	%
Description:	Fraction of non-renewable woody biomass used among whole woody biomass in the absence of the project activity, defined as $f_{NRB} = \frac{NRB}{NRB + DRB}$ where NRB is the non-renewable woody biomass and DRB is the demonstrable renewable woody biomass.
Source of data to be used:	JPMorgan Climate Care report and World Bank "Restoring Balance—Bangladesh's Rural Energy Realities"
Value applied:	1.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Because Bangladesh is a LDC, the available official documents are limited. Therefore, JPMorgan conducted a comprehensive study for another PoA. In addition, the World Bank Report supports this result.
Any comment:	

E.7. Application of the monitoring methodology and description of the monitoring plan:

E.7.1. Data and parameters to be monitored by each SSC-CPA:

Data / Parameter:	$HG_{p,y,}$
Data unit:	TJ
Description:	Quantity of thermal energy supplied by the biogas digester(s) in the CPA in year *y*
Source of data to be used:	Calorimeter and flow meter or gas tank gauge
Value of data applied for the purpose of calculating expected emission reductions in section B.5	<This column may not be needed (no B.5. in the template)> Described in each CPA-DD.
Description of measurement methods and procedures to be applied:	Calorific value as well as supplied gas amount is checked and recorded on a daily basis or more. For CDM purpose, only the aggregated amount for a year is needed.
QA/QC procedures to be applied:	Calibrated based on the operational manuals of the calorimeter and flow meter (if used) for volume of gas. This process is integrated to the gas utility management system, *e.g.*, by measuring the amounts of generated gas, gas storage and supplied gas with a regular interval (at least daily basis) for stable supply of biogas.

	Supplied amount of checked against the generated amount.
Any comment:	–

Data / Parameter:	$p_{n,j,x}$
Data unit:	%
Description:	Weight fraction of the waste type *j* collected during the year *x*
Source of data to be used:	Measurements by project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Described in each CPA-DD.
Description of measurement methods and procedures to be applied:	Sample the waste prevented from disposal, using the waste categories as provided in the table below and weight of each of them.
QA/QC procedures to be applied:	The size and frequency of sampling should be statistically significant with a maximum uncertainty range of 20% at a 95% confidence level. As a minimum, sampling should be undertaken four times a year.
Any comment:	This parameter only needs to be monitored if the waste prevented from disposal includes several waste categories as categorized in the tables above.

Waste type *j*	**DOC_j (% wet waste)**	**DOC_j (% dry waste)**
Wood and wood products	43	50
Pulp, paper and cardboard (other than sludge)	40	44
Food, food waste, beverages and tobacco (other than sludge)	15	38
Textiles	24	30
Garden, yard and park waste	20	49
Glass, plastic, metal, other inert waste	0	0

Data / Parameter:	W_x
Data unit:	tonne
Description:	Total amount of organic waste prevented from disposal in year *x* (tons)
Source of data to be used:	Measured and archived by project operators (GS regional or branch offices) using weight scale at the biogas digester site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Described in each CPA-DD.
Description of measurement methods and procedures to be applied:	Measured daily, aggregated at least annually
QA/QC procedures to be applied:	Cross-check with number of trucks with capacity recorded. Calibration toward the weight scale is to be conducted in accordance with the specifications of the local/national standards, or as per the manufacturer specification.

Any comment:	–

Data / Parameter:	z
Data unit:	
Description:	Number of samples collected during the year x
Source of data to be used:	Database of collected waste
Value of data applied for the purpose of calculating expected emission reductions in section B.5	–
Description of measurement methods and procedures to be applied:	Counted by project participants
QA/QC procedures to be applied:	Continuously, aggregated annually
Any comment:	This parameter only needs to be monitored if the waste prevented from disposal includes several waste categories j, as categorized in the tables for DOC_j and k_j

Data / Parameter:	CT_y
Data unit:	tonnes/truck
Description:	Average truck capacity for transportation
Source of data to be used:	Catalogue spec of the trucks
Value of data applied for the purpose of calculating expected emission reductions in section B.5	–
Description of measurement methods and procedures to be applied:	Once a year, and at a time when truck(s) are introduced/replaced.
QA/QC procedures to be applied:	Plot numbers of trucks and travel time to site are recorded for every transport for cross checking.
Any comment:	

Data / Parameter:	DAF_w
Data unit:	km/truck
Description:	Average incremental distance for raw solid or product transportation
Source of data to be used:	Project participants' measurement
Value of data applied for the purpose of calculating expected emission reductions in	–

section B.5	
Description of measurement methods and procedures to be applied:	Annually, if some differences are seen.
QA/QC procedures to be applied:	Cross-checked by local governmental staff.
Any comment:	–

Data / Parameter:	EC_y
Data unit:	MWh
Description:	Electricity consumption in the year of the project
Source of data to be used:	Power purchase receipt
Value of data applied for the purpose of calculating expected emission reductions in section B.5	–
Description of measurement methods and procedures to be applied:	Measured monthly by project participants
QA/QC procedures to be applied:	Plot monthly consumptions/payments to find irregular months.
Any comment:	–

Data / Parameter:	FC_y
Data unit:	tonne/year
Description:	Fossil fuel consumption in year *y*
Source of data to be used:	Fuel purchase record/receipt
Value of data applied for the purpose of calculating expected emission reductions in section B.5	–
Description of measurement methods and procedures to be applied:	Monthly
QA/QC procedures to be applied:	Plot monthly consumptions/payments to find irregular months.
Any comment:	–

E.7.2. Description of the monitoring plan for a SSC-CPA:

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1. Monitoring framework

The operation and management structure for monitoring involves both the roles of the program coordinator and the CPA operators.

The program coordinator (supported by PEAR) will act as the overall supervisor of the PoA, and undertake data checking reported by each CPA operator, aggregating the data, conducting necessary calculations of emission reductions and preparing a monitoring report periodically (typically annually) to the DOE.

The CPA operators will undertake the monitoring of the CPA operations including household surveys based on the operation and monitoring manual prepared by the program coordinator. Results will be reported to the program coordinator. The CPA operators have the responsibility to manage and operate the CPA.

2. The role of the CPA operators

The following table shows the role of CPA operators.

Table 7: Functions of CPA Operators

	GS Headquarter (supported by PEAR)	The CPA operators
Monitoring management	- Develop the operation and monitoring manual for CPAs. - Develop and establish data collection and reporting system for parameters monitored in every CPAs. - Implement and manage monitoring of CPAs.	- Implement and manage monitoring of CPAs.
Data collection	- Establish and maintain data collection systems for parameters monitored. - Check data quality and collection procedures of each CPAs regularly.	- Implement data collection including the entire household survey before the CPA starts and sample household survey after the CPA starts. - Check data quality and collection procedures regularly.
Data storage and management	- Develop database format of CPA. - Check the reported data from each CPAs. - Calculate emission reductions based on the data reported by the CPA implementers. - Implement data management of PoA. - Store and maintain records.	- Enter collected data to a computer. - Implement data management of CPA. - Store and maintain records.

Reporting	- Analyze data and compare project performances. - Prepare and forward monthly or annual reports.	- Report electronic data to the program coordinator.
CDM training and capacity building	- Develop and establish training program for the CPA implementers and households.	- Implement simple training for households, ensuring enabled to meet the needs of the monitoring plan.
Quality assurance and verification	- Establish and maintain quality assurance system with a view to ensuring transparency and allowing for verification. - Prepare for, facilitate and co-ordinate verification process.	- Undertake regular maintenance of biogas digesters. - On-site verifications of household questionnaire survey.

3. Monitored data

The data to be monitored are described in section E.7.1.

4. Data collection

Baseline emissions are calculated based on the *ex ante* survey; on the other hand, project emissions and leakages are calculated based on the *ex post* survey and monitoring. Therefore, all the necessary monitoring data are to be used for project emissions and leakage calculations.

Data collection regarding households will mainly be carried out by CPA operators. The role of program coordinator in data collection is checking the quality of the data collected by CPA operators.

Each CPA operator shall undertake an annual questionnaire or interview survey to collect data, including fuel consumptions in the baseline and the project.

Sample household survey

The sample household survey is conducting a questionnaire or interview survey by sampling the number of households included in a CPA. The major data in the survey includes fuel consumptions, amount of organic waste, household income, and related information of each household including name of representative and address. The sampling method is described in Annex 5.

5. Data management

Data management is the most important step in the monitoring process to ensure transparent and credible emission reduction calculations.

Each CPA operator shall collect data described in section E.7.1 and archive these electronically using the common template developed by the program coordinator. Data will be archived as soon as the entire/sample household survey is finished. The electronic files will be stored in hard disks as well as a hard copy printout. The electronic files and the hard copy shall be sent to the program coordinator.

The program coordinator will develop an appropriate electronic template for archiving all data of every CPA. After reporting data from each CPA, the program coordinator shall verify and certify the data. If

there are any errors found, they will be checked against original data and carry out interview with farmers if necessary. All the responses to these errors will be documented and compiled.

GS Headquarter will calculate emission reductions for each CPA and store the outputs in hard disks as well as hard copy printouts.

E.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

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02/03/2011

Dr. Naoki Matsuo: PEAR Carbon Offset Initiative, Ltd.
Dr. Wutikuer Hujiaxi: PEAR Carbon Offset Initiative, Ltd.
Mr. Ken Moriyama: PEAR Carbon Offset Initiative, Ltd.

Annex 1

CONTACT INFORMATION ON COORDINATING/MANAGING ENTITY and PARTICIPANTS IN THE PROGRAMME of ACTIVITIES

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

At the time of validation, it is not decided that ODA is to be utilized as a financial source of any CPAs.

On the other hand, there is a possibility for the use of public funds for the PoA (possibly dependent on each CPA), however, in case ODA is applied for future CPA(s), GS will obtain a signed letter from the Bangladesh Government to recognize that the fund is not result in the diversion of ODA and a signed letter from the Annex I Party government that such funding does not result in a diversion of its ODA and it will not obtain CERs in compensation for the ODA. These letters will be attached to the specific CDM-SSC-CPA-DD.

Annex 3

BASELINE INFORMATION

The timetable for the PoA until now is shown below:

September 2010	Formal discussion with GS on the programme implementation with PEAR
November 2010	Signed an MOU by GS and PEAR on the programme implementation
January 2011	Stakeholder consultation was conducted
End of January 2011	Global stakeholder consultation started
End of February 2011	Site visit by DOE was conducted

Annex 4

MONITORING INFORMATION

Please refer to B.6.1.

Annex 5

Determination of the sample of household survey

Sample households of baseline and project household surveys are determined by the following:

1. Calculate the sample size

The sample size *n* can be calculated by the following formulae for simple random sampling if the population size is known.[19] According to the EB decision (EB 22 report, Annex 2; EB 50 report, Annex 30) and in order to fit the Gold Standard requirement,[20] a 90% confidence level with error margin of ±10% (90/10 confidence/precision) is applied to the PoA.

Sample statistic	Population size	Sample size
Mean (1)	Known	$n = \{ z^2 * \sigma^2 * [N / (N-1)] \} / \{ ME^2 + [z^2 * \sigma^2 / (N-1)] \}$
Proportion (2)	Known	$n = [(z^2 * p * q) + ME^2] / [ME^2 + z^2 * p * q / N]$

The sample size can either be calculated based on the variance through preliminary survey/analysis (for "Mean" (1)) or based on the default value of population portion (for "Proportion (2)").

Example: In the case that the CPA includes 10,000 households, the sample size is 68.2 by using the formula for proportion sample statistics (2). (Even if *N* is set as infinity, $n < 69$ for 90/10)

Where:

n : Sample size
N : The number of households included in a CPA
ME : Margin of error = ±10%
p : Population proportion (= 0.5 for a conservative estimation)
q : 1–*p*
z : Standard score (= 1.645 for confidence level = 90%)

This approach works when the sample size is relatively large (greater than or equal to 30). For proportions, the sample size requirements vary based on the value of the proportion. Set *p* equal to 0.5, if the right value is unknown. This will produce a conservative sample size estimate; that is, the sample size will produce at least the precision called for and may produce better precision.

2. Choose sample households

The number of sample households determined should be chosen randomly among target households of a CPA.

[19] http://stattrek.com/Lesson6/SampleSize.aspx

[20] http://www.cdmgoldstandard.org/fileadmin/editors/files/6_GS_technical_docs/manuals_and_methodolgies/GS_Methodology_Biodigester.pdf