Project design document form for small-scale CDM project activities

(Version 08.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for small-scale CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Micro Scale Biogas CDM Project of CROSS
Version number of the PDD	3
Completion date of the PDD	12/07/2017
Project participant(s)	Community Reconstruction of Social Service (CROSS)
Host Party	India
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	1. TYPE I - Renewable Energy Projects CATETORY- I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04, EB 60. 2. Conditional Sectoral Scope 13; Waste Handling and Disposal
Sectoral scope(s) linked to the applied methodology(ies)	SECTORAL SCOPE - 01 Energy industries (Renewable/Non-Renewable Sources)
Estimated amount of annual average GHG emission reductions	16,456 tCO_2

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Community Reconstruction of Social Service (CROSS) is located in Chittoor District of Andhra Pradesh State. Established in 1994, they work for the upliftment of economically backward section of the district. CROSS have programs for economically backward communities, especially for women and children focussing on education, environment, heath, human rights, gender justice, and women and youth empowerment. Skill training is also part of the programme towards achieving economic development.

Purpose of the project activity: The purpose of the project activity is to set up 5,000 biogas plants (digesters) of $2m^3$ capacity each for single households having minimum of two cows and place to build biogas digester in Chittoor district where the NGOs is working, and in this way replace Non-Renewable Biomass with biogas for cooking and heating water. This will contribute strongly to sustainable development of the rural households involved in the project. A biogas plant of 2 m^3 capacity is sufficient to provide cooking fuel to a family of four to five[1]. Chittoor is a biomass deficit region[2] which has relatively low per capita forest area and is a drought prone area. The district is dominated by dry deciduous and scrub forest with low forest cover. The climatic conditions are very dry during large part of the year and the forests are subjected to high anthropogenic pressure[3]. Fuel wood scarcity has an impact directly on rural households, which are highly dependent on this fuel. Demand for fuel wood and logs from commons and forests have caused resource degradation to the extent that collection exceeds sustainable yield[4]. The project activity will attenuate the rural thermal energy needs used for cooking and water heating.

Each household will install a 2 m^3 biogas plant and feed cattle dung, into the anaerobic digester. The technology is tried and tested in India[5], and has been in use for many years. By utilizing cattle dung in a controlled anaerobic digestion and combustion system, biogas will be available for cooking energy and heat water for bath. Biogas will be used on a two-ring gas stove having 4" burner with a flame temperature of 870^o C[6], supplied as part of the project activity. The biogas slurry will be used as bio-manure. Implementation of the project depends on the successful validation and registration of the project as a CDM project activity since the project will be financed completely from carbon revenues. After the project is registered as a CDM activity, carbon forward funding will enable the construction of domestic bio-digesters.The project will be implemented in phases over a 4-year period. First year 700 biogas units, second year 1,400 units, third year 1,400 units and fourth year 1,500 units will be built. Thus, all the 5,000 biogas units would be constructed by 31st December 2016, wherein the start date of construction is 1st April 2013. An end user agreement will be signed between the NGO CROSS and the end user after construction, wherein the end user is aware of emission reductions from the use of biogas, and are willing to give up their rights and transfer the credit ownership to CROSS. No government subsidies will be availed for the project activity.

Sustainable Development of the project activity: There are social, environmental, economic and technological benefits which contribute to sustainable development.

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[1] http://www.techno-preneur.net/technology/new-technologies/Energy/biogas.htm , http://pubs.iied.org/pdfs/G02989.pdf

[2] FSI, 2011. Chapter 7: Socio-economic contribution of forests: Production and consumption of forest resources in India. State of Forest Report. Forest Survey of India, Ministry of Environment and Forests, Government of India. Page numbers 72, 74 and 77.

[3] http://forest.ap.nic.in/JFM%20CFM/CFM/Special%20Reports/NTFPs%20in%20AP%20%20by%20TERI/NTFP%20Final%20Report%20July-04.pdf (Pg no 46 and 55)

[4] http://fes.org.in/download.php?file=ZG93bmxvYWQvd3AxMC5wZGY=

[5] http://www.mnre.gov.in/schemes/decentralized-systems/schems-2/

[6] B.T. Nijaguna. 2002. Biogas Technology, New Age International Publishers, New Delhi.(Page no 36)

Social benefits:

- ✓ Reduces drudgery to women and children who spend long hours and travel long distances to collect fuel wood.
- ✓ Reduces indoor air pollution, thus eliminating health hazards for women and children.
- ✓ The project provides security of energy supply
- ✓ It leads to better manure management thus keeping the surroundings clean and reduce some of the disease causing pathogens
- ✓ Children will be able to attend school in time as food will be cooked in time.

Environmental benefits:

- ✓ Improves the local environment by reducing uncontrolled deforestation in the project area
- ✓ Avoids local environmental pollution through better waste management
- ✓ Will lead to soil improvement by providing high quality manure
- ✓ Avoided global and local environmental pollution and environmental degradation by switching from non-renewable biomass to renewable energy, leading to reduction of GHG emissions
- ✓ Reduces deforestation, reduces indoor air pollution, and increases use of manure rather than chemical fertilizers.

Economic benefits:

- ✓ Higher productivity of family members as they have adequate cooking fuel supply
- ✓ Will provide employment to local communities through construction and maintenance of biogas units.
- ✓ The project will reduce cooking time, thus providing women to take up income generating activities.

Technological benefits:

- ✓ Better technology for cooking compared to currently used traditional mud/clay/3-stone stoves.
- ✓ Better biogas digester models.
- ✓ Training of local masons for construction of biogas units for the project activity.
- ✓ Demonstrations and training programs will be carried out for the masons and end users on maintenance and other related aspects of biogas units.

A.2. Location of project activity

A.2.1. Host Party

>>
India.

A.2.2. Region/State/Province etc.

>>
Chittoor District, Andhra Pradesh State.

A.2.3. City/Town/Community etc.

>>
All the Mandals of Chittoor district.

The beneficiaries that showed interest and were identified upfront for the project activity during the survey in 4 Mandals of Chittoor. During the course of implementation many households from other Mandals showed interest to implement the technology. Thus, interested end users from within the project boundary of the all the Mandals in Chittoor District will be identified and provided with biogas units.

The PRC is submitted under the issuance track.

According to the Appendix 1 of the CDM Project Standard, a request for approval of a post-registration change may be suitable to be submitted under the issuance track. As per para (6) of the appendix 1 of CDM PS, version 09;

- Changes to the project design of a registered CDM project activity that do not adversely impact any of the following: (i) The applicability and application of the applied methodologies and, where applicable, the applied standardized baselines with which the project activity has been registered; (ii) The additionality of the project activity; (iii) The scale of the project activity.

The actual change to the registered CDM project activity does not have any impact to the following:

(a) The applicability and application of the applied methodology under which the project activity has been registered;

- The project activity has been registered under AMS.I.E. Version 4. The changes will not impact the applicability criteria of the project activity and hence the applicability and application of the applied methodology.
  - The project activity will continue to comprise of biogas units that displaces the use of non-renewable biomass by introducing new renewable end-user technology, the biogas stoves.
  - The proposed project activity will continue to save non-renewable biomass which is currently being used in the baseline by the beneficiaries.
  - As shown in section B.4, the communities are using non-renewable biomass since 31st December 1989.
  - The capacity of the project activity will remain below 45 MW_{th} and under the limits of small-scale project activity during every year of the crediting period as the number of units are the same.

(b) Compliance of the monitoring plan with the applied methodology;

- There will not be changes to the monitoring plan. The monitoring plan remains the same and is in compliance with the applied methodology.

(c) The level of accuracy and completeness in the monitoring of the project activity;

- The level of accuracy and completeness in the monitoring of the project activity is not going to be altered. The parameters monitored will be as done mentioned in the methodology.

(d) The additionality of the project activity;

- There are no changes to the additionality of the project activity, as it has been deliberated upon at the State/District level. In addition, there is no investment analysis and the barriers as discussed in section B.5 is still valid under the circumstances.

(e) The scale of the project activity.

- The scale of the project activity remained unaltered, as the number of biogas units will remain the same at 5,000 units.

A.2.4. Physical/Geographical location

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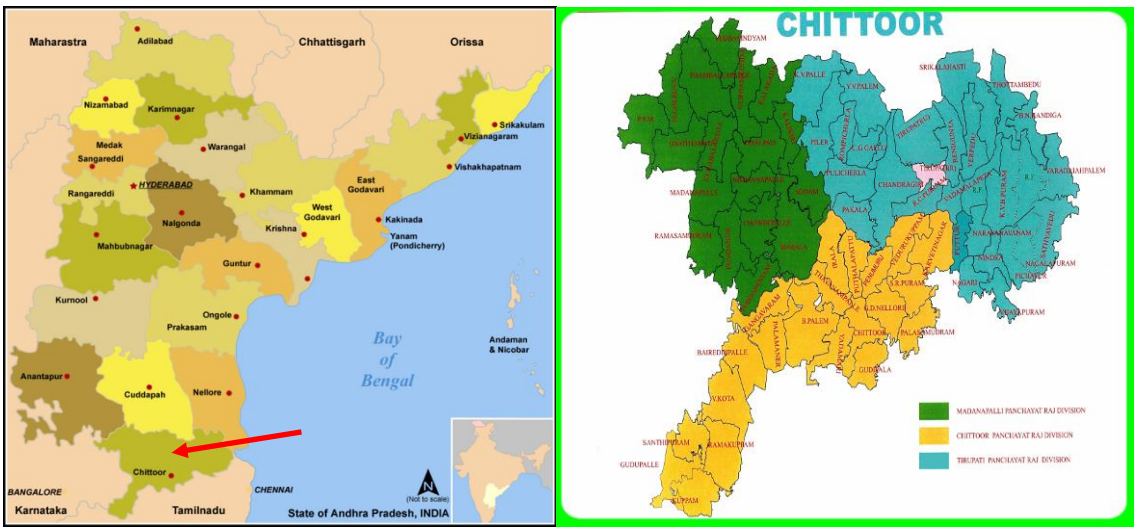


Fig 1: Map of Andhra Pradesh State showing Chittoor District and District Map showing all the Mandals where the project will be implemented

Chittoor district is located in the extreme South of Andhra Pradesh, between 12°37' - 14°8' North latitudes and 78°33' - 79°55' East longitudes. It is bound by Anantapur District to the northwest, Cuddapah District to the north, Nellore District to the northeast, Vellore & Tiruvallur districts of Tamil Nadu state to the south, and Karnataka state to the southwest[7]. The coordinates of Mandals[8] in which the project will be implemented are as follows[9]:

A.3. Technologies and/or measures

>>
The chosen type and category is as follows:-

SECTORAL SCOPE - 01 Energy industries (Renewable/Non-Renewable Sources)
TYPE I - Renewable Energy Projects
CATETORY- I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04, EB 60.

The chosen technology is a domestic biogas plant. It is a small thermal appliance that displaces the use of non-renewable biomass by introducing a system for utilising cattle dung and converting it into renewable energy by means of a digester in which the substrate undergoes acidification and methanation. Biogas is included in the specified methodologies as an example of a suitable end user technology.

Technology/measure

Biogas is a mixture of methane and carbon dioxide. It also has traces of hydrogen sulphide (3%), ammonia, oxygen, hydrogen, water vapour etc., depending upon feed materials and other conditions. Biogas is generated by fermentation of cellulose rich organic matter under anaerobic conditions. In anaerobic conditions, the methane-producing bacteria become more active. Thus, the gas produced becomes rich in methane. The optimum utilization depends upon the successful physical installations, which in turn depend upon plant design and its selection. The basic conversion principle is that when a non-ligneous biomass is kept in a closed chamber for a few

[7] http://en.wikipedia.org/wiki/Chittoor

[8] Mandal: Administrative unit below the district consisting of a group of villages with administrative and local government functions

[9] Handbook of Statistics, 2009, Chittoor District, Chief Planning Officer, Government of Andhra Pradesh. 2010.

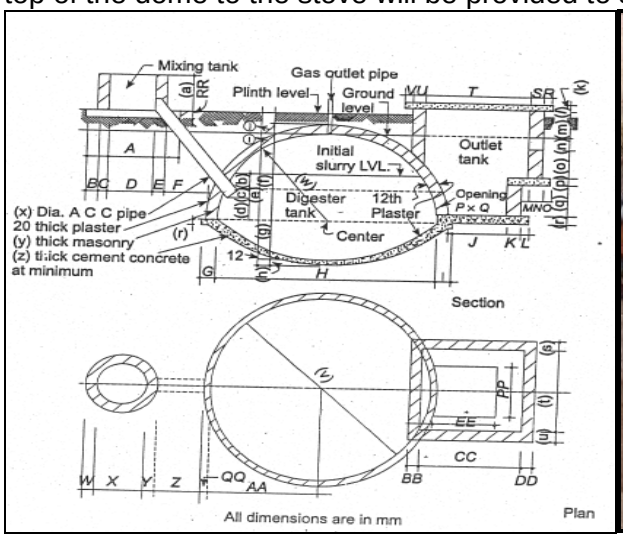
days, it ferments and produces an inflammable gas. The anaerobic digestion consists of three stages: I Hydrolysis; II Acid formation and III Methane fermentation.

The processes are carried out by two sets of bacteria namely acid forming bacteria and methane formers. The acidogenic phase I is the combined hydrolysis and acid formation stages in which the organic wastes are converted mainly into acetate, and phase II is the methanogenic phase in which methane and carbon dioxide are formed. The better the three stages merge with each other, the shorter the digestion process.

The technical specifications of the Deenabandhu model bio-digester are as follows[10]

Specification	Value
Capacity	2 m^3
Mixing Proportion (Water: Dung)	1:1
Feed Material	Cattle Dung
Biogas Flow rate	0.47 m^3/hr
Number and size of burners	2 burners of 4" size

In the project activity users prepare batches of slurry in the mixing tank, before allowing the final mixture to flow into the digester for methane formation phase. After digestion, evacuated spent slurry will be used as manure in the agriculture fields. The recovered gas is combusted and used for cooking and water heating. The chosen methane recovery and combustion system is the time tested Deenabandhu model biogas technology which is well-known in India[11]. The project activity will organize the 5,000 users to use cattle dung and organic wastes in individual household methane recovery systems of biogas for cooking and water heating. The 5,000 individual plants consist of a mixing chamber where water and cattle dung are mixed in 1:1 ratio, an inlet pipe to feed the slurry into the reactor, the main biogas reactor / digester where methane formation / recovery takes place, a slurry outlet pipe, an outlet chamber, and a slurry platform. The outlet pipe and tank are provided to remove the digested / treated sludge or fermentation residue and the slurry platform is provided to maintain the treated slurry in clean condition. A pipe leading from the top of the dome to the stove will be provided to supply biogas to a 2-ring stove inside the house.



Plan of Deenabandhu Model Biogas Plant

Construction of Biogas Plant

[10] B.T. Nijaguna. 2002. Biogas Technology, New Age International Publishers, New Delhi.

[11] Approved design by the Ministry of New and Renewable Energy. National Biogas and Manure Management Programme (NBMMP), Section 3, Technology. http://www.mnre.gov.in/schemes/decentralized-systems/schems-2

Constructed Deenabandhu Biogas Unit

Biogas Stove used for Cooking

Fig 2: Biogas Plant (Plan and constructed biogas plant)

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (host)	Private Entity - **Community Reconstruction of Social Service (CROSS)**	No

A.5. Public funding of project activity

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There will be no public funding involved in the project activity. The project would be financed completely with carbon revenues.

A.6. Debundling for project activity

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This is a micro-scale project activity. According to the **"Guidelines for demonstrating additionality of micro scale project activities"** Version 04, EB 68, Annex 26, micro-scale CDM project activities shall demonstrate that they are not a debundled component of a small-scale (SSC) CDM project activity by applying the criteria in the Guidelines on assessment of debundling for SSC project activities, for example by suitably considering micro-scale thresholds in the place of SSC thresholds (EB 62, Para 48).

Applying micro-scale thresholds in place of SSC thresholds, for the "Guidelines on assessment of debundling for SSC project activities" Version 3, Para 2, Annex 13, EB 54, a proposed micro-scale project activity shall be deemed to be a debundled component of a small scale project activity if there is a registered micro-scale CDM project activity or an application to register another micro-scale CDM project activity:

(a) With the same project participants;
(b) In the same project category and technology/measure; and
(c) Registered within the previous 2 years; and
(d) Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

CROSS does not have any CDM projects registered in the same project category and technology. This is the first CDM project activity of the NGO, CROSS.

According to Para 7 of "Guidelines on assessment of debundling for SSC project activities", Version 3, Annex 13, EB 54, 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.

- Each of the independent biogas unit is having an installed capacity of 1.69 kW_{th} (Section B.2). This is not greater than 1% of small scale thresholds defined by the applied methodology I.E. under Type I – renewable energy project activity, i.e. not greater than 0.45 MW_{th} or 450 kW_{th}.

Thus the micro scale project is not a debundled component of a small scale project activity.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

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SECTORAL SCOPE - 01 Energy industries (Renewable/Non-renewable sources)
TYPE I - Renewable Energy Projects
CATETORY- I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04, EB 60.

B.2. Project activity eligibility

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This project is applicable as per the definition in the Annex B of the simplified methodologies for selected small-scale CDM project activity categories, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04 due to the following:

1. The project activity comprises of biogas units that will displace the use of non-renewable biomass by introducing new renewable end-user technology, the biogas units.
2. As shown in section B.4, the communities are using non-renewable biomass since 31st December 1989. This is based on using published literature, official reports and statistics.
3. The capacity of the project activity is 8.46 MW_{th} and will remain under this limit during every year of the crediting period as shown below.

Micro Scale Biogas Project of CROSS (Version 2)			
$E = \eta . H_b . V_b$			
Activity Data	**Value**	**Unit**	**Reference**
Where:			
E = Energy available from a biogas digester			
n= combustion efficiency of burners	**60%**		Reference: Biogas Technology, B.T. Nijajuna, New Age International Publishers, New Delhi, 2002 (Page no 38)
H_b = heat of combustion per unit volume of biogas	**21.6**	**MJ/m^3**	
V_b = Volume of the biogas	**2**	**m^3/day**	Deenabandhu Model, of 2 cum, construction
E =	**25.92**	**MJ/day**	Calculated
E =	**7.20**	**kWh/day**	Calculated @ 1 megajoule = 0.277 777 777 78 kilowatt hour
E =	**1.69**	**kW thermal Capacity**	Calculated installed capacity of biogas (quantity of gas consumed for a 4" burner is 0.47 m3/hr, thus taken as 4.2 hrs/day, Nigaguna, 2002, Pg no 157)
Number of Biogas Units	**5000**		
E =	**8.46**	**MW, thermal**	Calculated for 5,000 biogas units
Reference: Biogas Technology, B.T. Nijaguna, New Age International Publishers, New Delhi, 2002			

B.3. Project boundary

In accordance with Paragraph 3 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04, EB 60:

The project boundary is the physical, geographic site of the use of biomass or the renewable energy.

The projects boundary will therefore encompass the sum of the 5,000 physical geographical sites of all individual biogas plants (digester system, pipe leading to the stove and the stove itself) realized by the project activity.

Based on the methodology, the GHGs included are as follows:

	Sources	**GHG**	**Included/Excluded**	**Justification/Explanation**
Baseline	Emissions from burning non-renewable wood	CO_2	Included	Major source of emission
		CH_4	Excluded	Not a major source
		N_2O	Excluded	Not a major source
Project Activity	Emissions from use of non-renewable wood by non-project household/users that previously used renewable energy	CO_2	Included	Leakage from use of non-renewable woody biomass by non- project households/users that previously used renewable energy is a source according to AMS I.E.
		CH_4	Excluded	Not a source
		N_2O	Excluded	Not a source

B.4. Establishment and description of baseline scenario

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In the absence of the project activity, the baseline scenario in the project boundary is the use of non-renewable biomass for cooking and heating water on traditional cook stoves with low efficiencies. There are no mandatory national and sectoral policies or regulations for use of biogas (renewable energy) and to capture methane from cattle dung at household level. Thus, the GHG emissions under the baseline condition comprise of CO_2 emissions from the use of non-renewable biomass for thermal energy.

In accordance with Paragraph 4 and 5 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04:

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.

And

Emission reductions would be calculated as:

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

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 the substitution of non-renewable woody biomass by similar consumers. Use a value of 81.6 tCO_2/TJ

Step 1: B_y is determined:

According to Paragraph 6 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04, EB 60, using Option (a):

B_y is determined by taking the following option:

(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.*

Adopting Option (a) of the methodology:

A survey was conducted to estimate the average annual consumption of woody biomass. The details of the study are described in Annex 3. The average consumption of biomass based on survey is 3.58±0.73 kg/capita/day. The lower bound of 95/5 confidence/precision level per capita consumption is 3.48 kg/capita/yr. The adult equivalent per family in the project area is 3.13 (see Annex 3 for details). Thus the annual consumption of biomass per family or per appliance is 3.48 kg/capita/day x 365 days x 3.13 adult equivalent/family = **3975 kg/appliance/yr or 3.97 t/appliance/yr**.

Adopting option (a), the B_y value is shown below

Amount of Biomass using survey method - option (a)	
Parameter	**Value**
Number of Biogas Units	5,000
Average annual biomass consumption per biogas Unit (tonnes/family/year)	3.97
B_y = Quantity of Biomass that is substituted or displaced for 5,000 biogas units (in tonnes/yr)	19,850

The quantity of biomass that will be substituted or displaced is 3.97 t/yr/family or 19,850 t/year for 5,000 families.

Step 2: Determining $f_{NRB,y}$:

In accordance with Paragraph 7 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04:

Project participants shall determine the share of renewable and non-renewable woody biomass in B_y (the quantity of woody biomass used in the absence of project activity) the total biomass consumption using nationally approved methods (e.g. surveys or government data if available) and then determine $f_{NRB,y}$.

According to Paragraph 8 of the methodology, the fraction of woody biomass saved by the project activity is year y that can be established as non-renewable is

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

Where

NRB = Non-renewable woody biomass
DRB = Demonstrably renewable woody biomass

A national study was conducted by the Forest Survey of India, Ministry of Environment and Forests, Government of India to assess the woody biomass demand and availability at the state and national level[12]. Based on the study, the consumption of fuel wood for each of the state was determined based on surveys conducted at household level for each of the state. The annual production of wood from forests was determined from records of each of the forest division in the state. Using this data, the state and national level data was generated. Further, the production of wood and fuel wood from the trees outside forests was determined from short rotation, medium rotation and long rotation species. Also the trees harvested for industrial wood provide substantial quantity of fuel wood as by-product. This has also been accounted for the production fuel wood from trees outside forests. According to the study, the total fuel wood consumption for Andhra Pradesh state is 24.293 Mt. Fuel wood productions from forests and from trees outside Forests account for 0.002 Mt and 1.024 Mt respectively. Therefore the DRB component of total fuel wood production is 1.026 Mt. Accordingly the NRB component of fuel wood consumption is 23.267 Mt. This accounts for an f_{NRB} of 0.95. The following table summarizes the calculations for f_{NRB} based on FSI, 2011.

f_{NRB} Calculations for Andhra Pradesh State based on Forest Survey of India, 2011		
Parameter	**Value**	**Source of Data**
Fuel wood Consumption (tonnes)	2,42,93,000	State of Forest Report, Forest Survey of India, Ministry of Environment and Forests, Government of India, 2011
Fuel wood production from Forest (tonnes)	2,000	
Fuel wood production from trees outside Forests (tonnes)	10,24,000	
Non-Renewable Biomass (NRB) (tonnes)	2,32,67,000	(Consumption) minus (Production from forests and outside forests)(24293000-(2000+1024000)
Demonstably Renewable Biomass (DRB) (tonnes)	10,26,000	Production from forests and from trees outside forests (2000+1024000)
$f_{NRB,y} = \frac{NRB}{NRB + DRB}$	**0.95**	Based on formula given in I.E. Version 4 methodology

The fraction of non-renewable woody biomass used in the absence of the project activity **is 0.95.**

According to the methodology, *the Non-renewable woody biomass (NRB) is the quantity of woody biomass used in the absence of the project activity (B_y) minus DRB component, as long as at least two of the following supporting indicators are shown to exist:*

- *A trend showing an increase in time spent or distance for gathering fuel-wood by users (or fuel-wood suppliers) or alternatively, a trend showing an increase in the distance the fuel-wood is transported to the project area;*

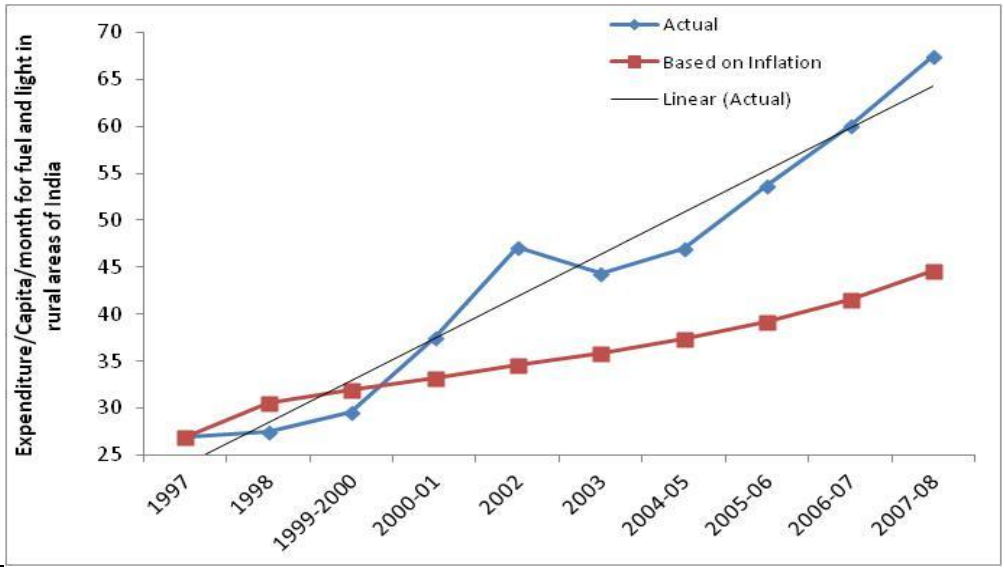
[12] FSI, 2011. Chapter 7: Socio-economic contribution of forests: Production and consumption of forest resources in India. State of Forest Report. Forest Survey of India, Ministry of Environment and Forests, Government of India. Page numbers 72, 74 and 77.

- *Survey results, national or local statistics, studies, maps or other sources of information such as remote-sensing data, that show that carbon stocks are depleting in the project area;*
- *Increasing trends in fuel-wood prices indicating a scarcity of fuel-wood;*
- *Trends in the types of cooking fuel collected by users that indicate a scarcity of woody biomass.*

To demonstrate the non-renewability of woody biomass, the supporting indicators that exist are as follows:

i. *Increase in time spent for gathering fuel-wood by users:* The baseline household survey conducted in 2011 for the project area showed that 100% of the respondents spend more time to collect fuel-wood now compared to that 20 years back. This is due to depletion of biomass stocks in wastelands and forests. They need to trek longer distances to collect fuel-wood compared to that 20 years back resulting in increased time spent. This corroborates with a study done in Chittoor district. A Participatory Rural Appraisal (PRA) was conducted wherein the communities identified declining fuelwood availability as a dynamic and a very important problem. They defined the problem in terms of their perception of the availability of fuelwood in the forest and elaborated on the problem using indicators such as longer time taken and distance travelled to collect fuel wood[13].

ii. *Increasing trends in fuel wood price indicating scarcity;* Yearly consumer expenditure survey among Indian households is carried out by the National Sample Survey Organisation (NSSO) for rural areas at the state level. Information on energy sources used both for cooking and lighting is collected as part of the survey. It can be seen that there is an increase in price beyond the yearly inflation rate, indicating scarcity (Fig 3). Further, the baseline survey conducted in the project area for Chittoor shows that the average fuel wood price has increased from Rs. 1,210 to Rs 10,065 per ton of woody biomass in the past 20 years (see Annex 3 for the details of survey). The baseline survey also revealed that they travel long distances compared to year 1989 and the present price of the fuelwood increased 10 times of the price of 1989 (Annex 3 of the PDD).



[13] Yadama, *et al*., Community Driven Modeling of Social-Ecological Systems: Lessons from Andhra Pradesh, India. George Warren Brown School of Social Work, Washington University of St. Louis and Foundation for Ecological Security, India,Page no 9.

Fig 3: Relative escalation of prices (average yearly inflation rate in India vis-á-vis the actual prices) towards fuel and light spent by rural population in Andhra Pradesh[14]

As mandated in the methodology, two conditions; increase in time spent for gathering fuel wood by users and increasing trends in fuel wood price indicating scarcity clearly proves non-renewable woody biomass use in the project area.

Use of non-renewable biomass since 31st December 1989.

Andhra Pradesh, the state in which the project will be implemented, is a forest scarce state with less than a critical minimum of 0.1 hectares per person during 1989. Though forest cover has stopped declining further, its quality however is still declining in terms of lowered growing stock and annual incremental rates depicting a lowered volume of the forest's stock and of the productivity of India's forest covered areas. Between 1989-1997, there has been a decrease of 10% change in the crown cover in Andhra Pradesh. Thus not only at the national level, even at the state level of Andhra Pradesh there has been non-renewable biomass used since 31st December 1989[15]. Based on the FSI, 1989 (Fig 4)[16], at the level of consumption of forest produce and the productivity of forests, the country needed a minimum of 0.47 ha of forests per capita to meet their needs which includes fuel wood. Andhra Pradesh had forest cover of 0.05 – 0.1 ha per capita, below the critical minimum required for sustainable production and extraction of forest produce including fuel wood.

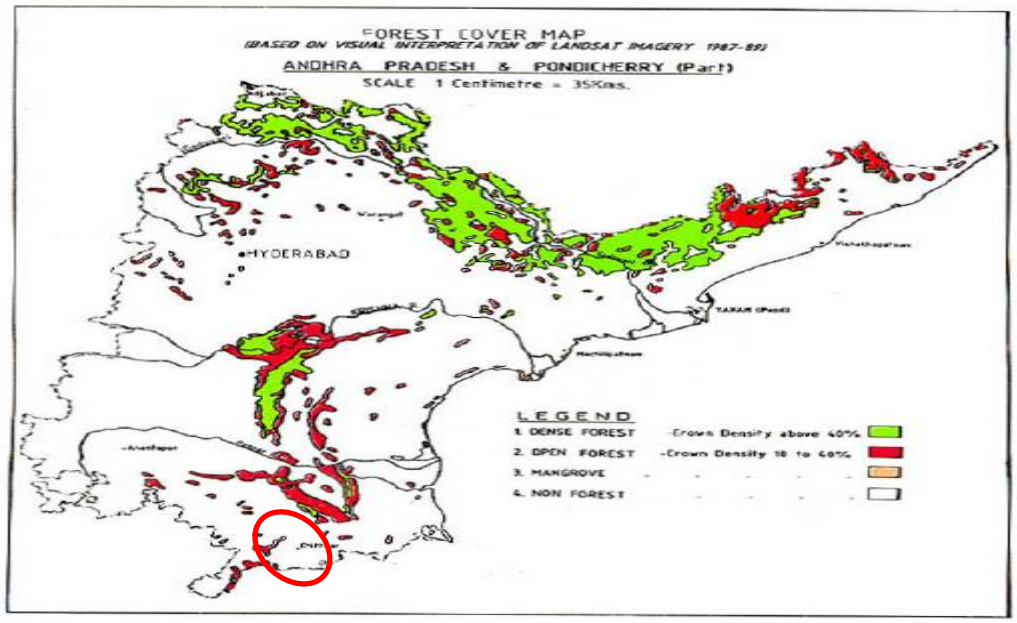


Figure 4: Forest Map of Andhra Pradesh for 1989 showing the project area.

[14] http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=442&type=NSSO (1997) (Page no 19)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=448&type=NSSO (1998) (Page no 22)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=454&type=NSSO (1999-2000) (Page no 52)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=476&type=NSSO (2000-01) (Page no 22)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=484&type=NSSO (2002) (Page no 23)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=490&type=NSSO (2003) (Page no 24)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=509_P1&type=NSSO (2004-05) (Page no A-201)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=523&type=NSSO (2005-06) (Page no A-8)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=527&type=nsso (2006-07) (Page no A-8)
http://mospi.nic.in/Mospi_New/upload/530_final.pdf (2007-08) (Page no A-8)

[15] Population pressure and deforestation in India. S.C. Gulati and Suresh Sharma. Population Research Centre, Institute of Economic Growth, University Enclave, Delhi.(Page no 10 and 11)

[16] State of Forest Report, 1989. Forest Survey of India, Ministry of Environment and Forests, Government of India.(Page no 15)

Thus non-renewable biomass is being used since 1989.

Step 3: Choosing $EF_{projected\_fossilfuel}$

According to Paragraph 5 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04, this should be *emission factor for the substitution of non-renewable woody biomass by similar consumers. Use a value of 81.6 tCO_2/TJ.*

As can be seen from the energy ladder for rural India (Fig 5), the mix of present and future fuels used would consist of a solid fossil fuel at the lowest in the ladder of fuel use choices, followed by liquid and gaseous fuel type in progression.

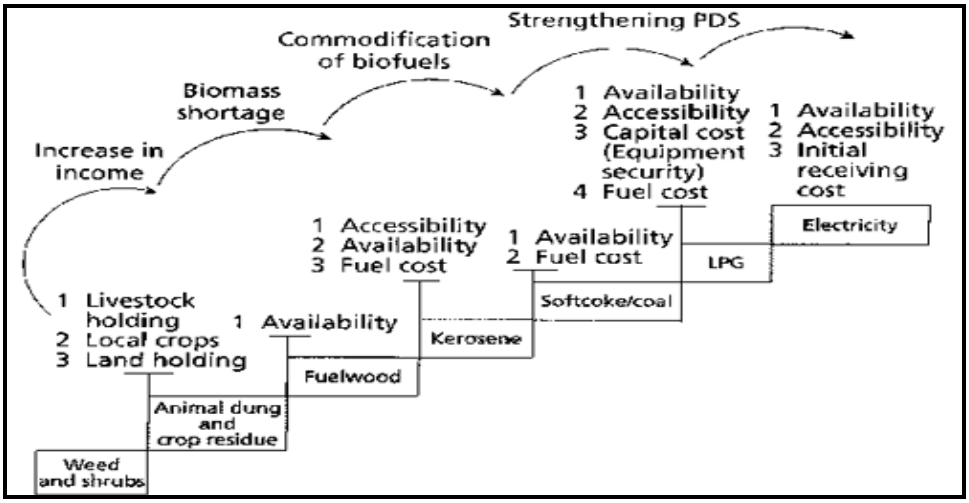


Fig 5: Environmental implications of the energy ladder in rural India. Boiling Point. Issue 42. Household energy and the environment[17]

Thus $EF_{projected\_fossilfuel}$ is 81.6 tCO_2/TJ.

Thus the variables, parameters, data source to determine baseline emissions from the use of non-renewable biomass for thermal energy are as follows:

Parameters	Value	Source of Data
By – Quantity of biomass that is substituted (t/family/yr)	3.97	Based on Baseline Survey 3.48 kg/capita/day x 365 days x 3.13 adult equivalent/family = 3975 kg/appliance/yr or 3.97 t/appliance/yr.
By - Quantity of Biomass that is substituted for 5,000 biogas units @ 3.97 t/family/yr (t/yr)	19,850	Calculated
$f_{NRB,\,y}$ - Fraction of NRB	0.95	State of Forest Report. 2011. Forest Survey of India, Ministry of Environment and Forests, Government of India.
$NCV_{biomass}$ - NCV Biomass (TJ/t)	0.015	Methodology I.E. Version 4
$EF_{projected\_fossilfuel}$ - Emission factor (tCO_2/TJ)	81.6	Methodology I.E. Version 4

B.5. Demonstration of additionality

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[17] http://www.hedon.info/BP42_EnvironmentalImplicationsOfTheEnergyLadderInRuralIndia

The project activity by CROSS is, substituting the use of non-renewable fuel wood by using biogas which is renewable to meet the thermal requirements for cooking and heating water with the primary aim of reducing carbon dioxide emissions.

The additionality is demonstrated based on the Micro-scale CDM project activities approach using the **"Guidelines for demonstrating additionality of micro scale project activities"** Version 04, EB 68, Annex 26.

The project activity falls under the category– Type I

As per Para 2 Applicability Condition:

Project activities up to five megawatts that employ renewable energy technology are additional if any one of the conditions below is satisfied:

(a) The geographic location of the project activity is in one of the least developed countries or the small island developing States (LDCs/SIDS) or in a special underdeveloped zone (SUZ) of the host country;

(b) The project activity is an off-grid activity supplying energy to households/communities (less than 12 hours grid availability per 24 hrs is also considered off-grid for this assessment);

(c) The project activity is designed for distributed energy generation (not connected to a national or regional grid) with both conditions (i) and (ii) satisfied;

(i) Each of the independent subsystems/measures in the project activity is smaller than or equal to 1500 kW electrical installed capacity;

(ii) End users of the subsystems or measures are households/communities/small and medium enterprises (SMEs).

(d) The project activity employs specific renewable energy technologies/measures recommended by the host country designated national authority (DNA) and approved by the Board to be additional in the host country. The following conditions shall apply for DNA recommendations:

(i) Specific renewable energy technologies/measures refers to grid connected renewable energy technologies of installed capacity equal to or smaller than 5 MW;

(ii) The ratio of installed capacity of the specific grid connected renewable energy technology in the total installed grid connected power generation capacity in the host country shall be equal to or less than 3 per cent;

Project Case:

→ The project activity is implementation of 5,000 biogas units of 2 m^3 capacity. The project activity falls under Type I project activity, methodology I.E., which is renewable energy technology. Each biogas unit generates thermal energy of 1.69 kW_{th}. Thus 5,000 biogas units that will be constructed under the project activity will have an installed capacity of 8460 kW_{th} or 8.46 MW_{th}. This is less than 15 MW_{th}[18]. According to the guidelines for micro scale projects, definitions provided for output capacity and guidelines provided for conversion from electrical to thermal units in the most recent version of General Guidelines to SSC CDM methodologies shall be used. According to this guidelines, multiply by 3 to derive thermal units from electrical units irrespective of the type of project or methodology applied.

→ Thus the project activity having thermal capacity 8.46 MW is less than fifteen megawatts (thermal) that employ renewable energy technology.

[18] 5 $MW_{(e)}$ x 3 = 15 MW_{th}. As per General Guidelines to SSC CDM methodologies. Multiply by 3 to derive thermal units from electrical units irrespective of the type of project or methodology applied.

→ The project activity is domestic household level biogas units designed for purposes of cooking and heating water. Thus it is distributed energy generation which produces thermal energy at the individual household level.

The project activity fulfils the condition (c) of Para 2 Applicability condition as follows:

→ The project activity is domestic household level biogas units designed for purposes of cooking and heating water. Thus it is distributed energy generation which produces thermal energy at the individual household level.
→ Each of the independent biogas unit in the project activity has a thermal energy installed capacity of 1.69 kW_{th} (kindly see section B.2. for rating each of the unit) and thus smaller than 4500 kW_{th} (1500 kW (installed electrical capacity) x 3 = 4500 kW_{th}).

→ The end users of each of the biogas units are individual households.

Thus Para 2, condition (c) of the "Guidelines for demonstrating additionality of micro-scale project activities", Version 04, Annex 26, EB 68 is satisfied by the project activity.

As per Para 8, Applicability Condition:

The eligibility of project activities as micro-scale CDM project activities will be determined in accordance with the principles laid out in paragraph 3 and paragraph 4 of the General Guidelines to SSC CDM methodologies. (Version 16 or its update), i.e.:

(a) Project activities remain under the thresholds defined above during each year of the crediting period and in cases where ex ante projected emissions reductions show an increase during the crediting period; project activities that go beyond the micro-scale limits in any year of the crediting period are not eligible;

(b) Renewable energy projects that produce electrical, thermal and mechanical energy, and cogeneration projects are covered. Definitions provided for output capacity and guidelines provided for conversion from electrical to thermal units in the most recent version of General Guidelines to SSC CDM methodologies shall be used. Where applicable, additional guidelines provided in relevant methodologies shall be followed, e.g. eligibility of cogeneration projects as currently defined in AMS-I C;

(c) A project activity with more than one component, where each component meets the micro-scale threshold, is eligible. The sum of the size of components of a project activity belonging to the same type (capacity for Type I, energy savings for Type II and emission reductions for Type III) shall not exceed the limits for micro-scale project activities (e.g. the limit for the methane recovery component is 20 ktCO2e/yr and the limit for the electricity production component is 5 MW output capacity).

Project Case:

The project activity will remain under the thresholds of 15 MW_{th} installed capacity during each year of the crediting period as the installed capacity of the project activity is 8.46 $MW_{th.}$

The project activity produces thermal energy and hence covered under micro-scale project activity.

According to the micro-scale guidelines, where applicable, additional guidelines provided in relevant methodologies shall be followed. As shown in section B.2, guidelines provided by the methodology I.E is followed and thus eligible.

According to Para 9, micro-scale CDM project activities shall apply the Guidelines on the demonstration and assessment of prior consideration of the CDM. (EB 57, paragraph 12).

The project activity is conceived as a CDM project, wherein the construction of biogas digesters will be only after successful CDM registration and obtaining forward carbon fund for construction of biogas units. CDM revenues are indispensible for the project activity.

For the proposed project activity, the evidence to support awareness of CDM prior to the project activity start date, and that the benefits of the CDM were a decisive factor in the decision to proceed with the project is the board resolution dated 30th June 2011 in which CROSS has decided to implement the project activity considering CDM revenue.

The project schedule is as follows:

Sl No.	Chronicle of Events	Dates
1.	First CDM Training programme to SCINDeA NGO groups (SACRED, BEST, WORD and CROSS) by Fair Climate Network (FCN)	10th November- 2010
2.	Second CDM Training programme to the staff of participating NGOs by FCN	23rd May 2011
3.	Board Resolution of CROSS to take up CDM project activity	30th June2011
4.	Consultancy contract between SCINDeA/CROSS and FCN Technical Team	1st July 2011
5.	Demographic survey and Baseline survey of the project area	01st Jul-2011 to 30th December 2011
6.	Stakeholders' Meetings	9th January 2012
7.	Contract with DOE for Validation of the project activity	29th February 2012
8.	Submission of "Prior Consideration of CDM Form" to UNFCCC and DNA	06th March 2012
9.	Likely start date of biogas construction after CDM registration, sign ERPA and procure carbon revenue	1st April 2013

Thus the start date of the project activity is much after the PDD is submitted, project registered as a Gold Standard CDM project activity and forward carbon funding will be obtained.

According to Para 10, micro-scale CDM project activities shall demonstrate that they are not a debundled component of a small-scale (SSC) CDM project activity by applying the criteria in the Guidelines on assessment of debundling for SSC project activities., for example by suitably considering micro-scale thresholds in the place of SSC thresholds (EB 62, para 48).

Applying micro-scale thresholds in place of SSC thresholds, a proposed micro-scale project activity shall be deemed to be a debundled component of a small scale project activity if there is a registered micro-scale CDM project activity or an application to register another micro-scale CDM project activity:

(a) With the same project participants;
(b) In the same project category and technology/measure; and
(c) Registered within the previous 2 years; and
(d) Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

CROSS does not have any CDM projects registered in the same project category and technology. This is the first CDM project activity of the NGO, CROSS.

Thus the project is not a debundled component of a small scale project activity.

From the above analysis it can be concluded that the additionality of the project activity is justifiable since the project activity meets all the applicability conditions as discussed above.

Thus based on "Guidelines for demonstrating additionality of micro scale project activities" Version 04, EB 68, Annex 26, the project activity proves to be additional.

The table below is only applicable if the proposed project activity is a type of project activity which is deemed automatically additional, as defined by the applied approved methodology, tool, standardized baseline or specific renewable technologies/measures conferring automatic additional microscale CDM project activities proposed by a DNA and approved by the Board.

Specify the methodology, tool, standardized baseline or specific renewable technologies/measures conferring automatic additional microscale CDM project activities proposed by DNAs and approved by the Board, that establish automatic additionality for the proposed project activity (including the version number and the specific paragraph, if applicable).	Tool 21, Demonstration of additionality of small-scale project activities, Version 11, Para 11 (c).
Describe how the proposed project activity meets the criteria for automatic additionality in the relevant methodology, tool, standardized baselines or specific renewable technologies/measures conferring automatic additional microscale CDM project activities proposed by a DNA and approved by the Board.	According to latest Tool 21, demonstration of additionality of small-scale project activities, Version 10, according to Para 11 (c), the project activity solely is composed of isolated units where the users of the biogas units are households. The size of each of the unit is no larger than 1% (450 $kW_{thermal}$) of the small-scale CDM threshold. Each units is 1.78 $kW_{thermal}$

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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Sectoral Scope 01, TYPE I - RENEWABLE ENERGY PROJECTS, I.E. Thermal energy for the user, Version 04, EB 60.

Baseline emissions for the non-renewable biomass component are calculated based on the use of the biomass that is replaced, the fraction of the biomass that is non-renewable biomass, and the emission factor of projected fossil fuel according to AMS I.E "Switch from non-renewable biomass for thermal application by the user".

Equation used to calculate Emission reductions under this methodology is as follows:

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

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 the substitution of non-renewable woody biomass by similar consumers. Use a value of 81.6 tCO_2/TJ

Leakage relating to non-renewable biomass B_y will be multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys will not required as per the methodology AMS-I.E, Para 10.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**Rating Biogas**
Unit	kW_{th}/digester
Description	Thermal capacity of a digester
Source of data	Calculated as shown in Section B.2
Value(s) applied	1.69
Choice of data or Measurement methods and procedures	Calculated as shown in Section B.2
Purpose of data	To establish that it is within the small-scale limit
Additional comment	Qualifies as a micro-scale project activity. This parameter is fixed for the entire crediting period

Data / Parameter	**B_y**
Unit	Tonnes /year
Description	Quantity of woody biomass that is substituted or displaced in tonnes
Source of data	Survey
Value(s) applied	3.97 tonnes/year/family and 19,850 t/year for 5,000 families
Choice of data or Measurement methods and procedures	Based on survey conducted to estimate the average annual consumption of woody biomass. The details of the study are described in Annex 3. The average annual consumption of biomass is 3.58±0.73 kg/capita/day. The lower bound of 95/5 confidence/precision level of per capita consumption is 3.48 kg/capita/yr. The adult equivalent per family in the project area is 3.13. By = 3.48 kg/capita/day x 365 days x 3.13 adult equivalent/family = **3.97 t/family/yr**. B_y for 5,000 biogas units is 3.97 x 5000 = 19,850 t/year.
Purpose of data	Estimation of Baseline Emissions
Additional comment	This parameter is fixed for the entire crediting period

Data / Parameter	**$f_{NRB, y}$**
Unit	-
Description	Fraction of woody biomass used in the absence of the project activity in year y that can be established as non-renewable biomass
Source of data	Assessment of Non Renewable Biomass based on data provided by Forest Survey of India, 2011, Ministry of Environment and Forests, Govt of India.
Value(s) applied	0.95
Choice of data or Measurement methods and procedures	Based on data from State of Forest Report, 2011. Forest Survey of India, Ministry of Environment and Forests, Government of India. The data gives the consumption of fuel wood and production of fuel wood from forests and from trees outside forests. This data is assessed at the state level. Thus the f_{NRB} for Andhra Pradesh is applied for the project activity.
Purpose of data	Estimation of Baseline Emissions
Additional comment	This parameter is fixed for the entire crediting period

Data / Parameter	**$NCV_{biomass}$**
Unit	TJ/tonne
Description	Net Calorific Value of Biomass
Source of data	AMS_I.E., Version 4 methodology

Value(s) applied	0.015
Choice of data or Measurement methods and procedures	-
Purpose of data	Estimation of Baseline Emissions
Additional comment	This parameter is fixed for the entire crediting period

Data / Parameter	**$EF_{projected\_fossilfuel}$**
Unit	tCO_2/TJ
Description	Emission Factor for fossil fuel. Emission factor for substitution of non-renewable woody biomass by similar consumers.
Source of data	AMS-I.E., Version 4 methodology
Value(s) applied	81.6
Choice of data or Measurement methods and procedures	Based on the methodology, this value represents the emission factor of the substitution fuels likely to be used by similar users on a weighted average basis. It is assumed that the mix of present and future fuels would consist of a solid, liquid and gaseous fossil fuel.
Purpose of data	Estimation of Baseline Emissions
Additional comment	This parameter is fixed for the entire crediting period

Data / Parameter	**Diversion of non-renewable biomass saved under the project activity by non-project households**
Unit	tonnes / year
Description	Diversion of non-renewable biomass saved under the project activity by non-project households
Source of data	Based on the methodology B_y will be multiplied by a net to gross adjustment factor of 0.95 to account for leakages.
Value(s) applied	Biomass (t) - 3.97 x 0.95 = 3.77 t/yr. The biomass diversion is 3.97 – 3.77 = 0.20 t/family/yr or 1000 t/yr for 5,000 families. Emissions (tCO_2) - 4.61 - 4.38 = 0.23 tCO_2/family/yr; 0.23 x 5000 = 1150 tCO_2/year
Choice of data or Measurement methods and procedures	According to I.E, Version 4, B_y can be multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required. 3.97 x 0.95 = 3.77 t/Household/yr. Thus the diversion is 3.97 – 3.77 = 0.20 t/family/yr or 1000 t/yr for 5000 families. In terms of leakage of emissions, 4.61 - 4.38 = 0.23 tCO_2/family/yr and 0.23 x 5000 = 1150 tCO_2/year.
Purpose of data	Estimation of Leakage
Additional comment	This parameter is fixed for the entire crediting period. Surveys will not be conducted to determine leakage

B.6.3. Ex ante calculation of emission reductions

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The ex-ante calculations of emission reductions are from emission reductions calculations from I.E. Switch from non-renewable biomass from thermal applications by the user.

Emission Reductions (tCO_2) = Baseline Emissions – Project Activity Emission – Leakage

According to the methodology, there are no project emissions. According to the methodology, Para 4, the specific equations for calculations of Baseline emissions and Project emissions is not provided, but only for Emissions Reductions as follows:

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

Baseline Emissions

The parameters and values for baseline emissions are explained in Section B.4

Emissions from the use of fossil fuels for meeting similar thermal energy needs		
Activity Data	**Value**	**ID Ref**
Quantity of Biomass that is substituted (t/yr) per family	3.97	B_y
Fraction of NRB	0.95	$f_{NRB, y}$
NCV Biomass (TJ/t)	0.015	$NCV_{biomass}$
Emission factor (tCO_2/TJ)	81.6	$EF_{projected\_fossilfuel}$
Emission Reductions (tCO_2/yr/family)	**4.61**	$\boldsymbol{ER_y}$
Emission Reductions for 5,000 families (tCO_2/yr)	**23,050**	$\boldsymbol{ER_y}$

Leakage

According to Para 10 and 11 of the methodology:

Leakage related to the non-renewable woody biomass saved by the project activity shall be assessed based on ex post surveys of users and the areas from which this woody biomass is sourced (using 90/30 precision for a selection of samples). The following potential source of leakage shall be considered:

(a) *The 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, that is attributable to the project activity, then* B_y *is adjusted to account for the quantified leakage. Alternatively,* B_y *is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required.*

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

There will not be any transfer of equipment being currently utilized transferred from outside the project boundary to the project boundary. All the biogas units will be constructed at site. Thus leakage from equipment transfer need not be monitored.

B_y will be multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys will not be required.

Thus B_y is considered as 3.97 x 0.95 = 3.77 taking into account leakage factor. Thus survey will not be conducted to account for leakage.

According to the methodology, Version 4, after considering leakage, the emission reduction calculations are as follows:

Activity Data	**Value**

B_y (t/year/family)	3.97
B_y adjusted for leakage (B_y x 0.95) (t/year/family)	**3.77**
f_{NRBy}	0.95
$NCV_{biomass}$ (TJ/tonne)	0.015
$EF_{projected\ fossilfuel}$ (tCO_2/TJ)	81.6
ER generated/year/household	**4.38**
ER generated/year for 5,000 households	**21,900**

Thus Emission Reductions calculations from I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User is 4.38 tCO_2/year/family or 21,900 tCO_2/year for 5,000 households.

The biogas plants will be monitored continuously for non-usage. The emission reduction will be calculated only for usage days of all the constructed and operational units. The emission reduction ex-post will be as follows:

$$ERy = \sum_{n=1}^{5000} \left(\frac{B_{y(\text{adjusted for leakage})}}{365} * N_{days}\right) * f_{NRB,y} * NCV_{biomass} * EF_{projected\_fossilfuel}$$

Where:
N_{days} = operational days of installed biogas units for the monitoring period
n = biogas units installed

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2014	3,227	0	161	3,066
2015	9,681	0	483	9,198
2016	16,135	0	805	15,330
2017	23,050	0	1,150	21,900
2018	23,050	0	1,150	21,900
2019	23,050	0	1,150	21,900
2020	23,050	0	1,150	21,900
Total	98,193	0	6,049	1,15,194
Total number of crediting years				7
Annual average over the crediting period	17,320	0	864	16,456

After registration of the project and securing CER forward finance funding, the project will be implemented in phases. The project implementation will be over 4 year's period. First year 700 biogas units, second year 1,400 units, third year 1,400 units and fourth year 1,500 units will be built. Thus, all the 5,000 biogas units would be constructed by 31st December 2016, wherein the start date of construction is 1st April 2013.

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	**Biogas Units constructed**
Unit	Number
Description	Number of biogas units constructed

Source of data	Monitoring of construction of biogas units and its start date of operation will be from the monitoring database solution of CROSS
Value(s) applied	700 units during Year 1, 1400 units in Year 2 and 1400 units in Year 3 and 1500 in 4th year totalling to 5,000
Measurement methods and procedures	- The biogas units built for the households will be entered into the on-line monitoring database. - The beneficiary will sign an End User agreement with CROSS with all details of the family to identify the user irrefutably. - The timeline of construction of the units will be monitored and database maintained
Monitoring frequency	Continuous
QA/QC procedures	100% of the units will be monitored from the procurement of material till construction and commissioning of the biogas units. Each biogas unit will be marked with the unique ID number and "CROSS" for identification. This can be triangulated with the end user agreement signed with the end user.
Purpose of data	Estimation of Emission Reduction
Additional comment	The progress of construction can be triangulated with financial statement from the monitoring database. The data will be archived and stored throughout the crediting period and an additional 2 years.

Data / Parameter	**Number of biogas plants operating**
Unit	Number
Description	Number of plants operating in year (t)
Source of data	Log books maintained and entered in the digitized monitoring database for biogas units operating
Value(s) applied	700 from Year 1; 2100 from Year 2, and 3500from Year 3 and 5000 from 4th year.
Measurement methods and procedures	In every village, the village level volunteer will monitor the biogas units that are not operational. The days other than that non-operational will determine the biogas units which are operational for each of the day.
Monitoring frequency	Continuous basis
QA/QC procedures	Log books and digitized database will be checked regularly by project staff and CDM coordinator.
Purpose of data	Estimation of Emission Reduction
Additional comment	Though the methodology requires monitoring this parameter biennially, it will be done on a day to day basis. This is to ensure regular energy supply to the rural households through continuous monitoring and immediate repairs to decrease downtime.

Data / Parameter	**Non-usage of biogas plants**
Unit	Days
Description	Usage of non-renewable biomass in case of non-performance of biogas units
Source of data	The days not used from the daily monitoring report for each of the unit done at the village level and data maintained on the digitized monitoring database.
Value(s) applied	Dependent on the number of days the biogas units are under repair
Measurement methods and procedures	As and when the biogas units are not functional, the beneficiaries will report to the village level volunteer, who in turn will report to the Biogas Field Worker of the project for the repair of the unit. A log book will be maintained for the reason of non-function and days under repair. The data will be entered into the monitoring solution for each of the unit. For the monitoring period, the N_{days} (operational days of installed biogas units) will be calculated by subtracting the non usage days. The emission reduction will be estimated only for operational days.

Monitoring frequency	Continuous basis
QA/QC procedures	CERs will be reduced for the non-functional days of the units.
Purpose of data	Estimation of Emission Reduction
Additional comment	The objective to monitor the non-functional days is to ensure prompt operation and maintenance of the units so that the rural communities can continuous use biogas and are rid of drudgery they are facing using traditional biomass cook stove.

Data / Parameter	**Confirmation that non-renewable biomass has been substituted**
Unit	
Description	Confirmation that non-renewable biomass has been substituted
Source of data	Sample survey
Value(s) applied	95% of 3.97 t/family/year i.e. 3.77 t/family/year is substituted
Measurement methods and procedures	A household level sample survey will be conducted to confirm that non-renewable biomass has been substituted. Survey sheets will be given to sample households to record the details.
Monitoring frequency	This survey will be done annually for a statistically determined number of households at 90/10 precision confidence level (Please refer to Sampling plan for survey details).
QA/QC procedures	-
Purpose of data	Only for cross check. Will not be used for emission reduction calculations
Additional comment	

Data / Parameter	**Average annual hours of operation of a system**
Unit	Hrs
Description	average annual hours of operation of a biogas unit
Source of data	Based on annual sample survey that will be conducted on statistically determined number of households.
Value(s) applied	Based on the survey conducted annually
Measurement methods and procedures	A household level sample survey will be conducted to estimate the average hours of operation of a biogas system for a day. Survey sheets will be given to sample households to record the start and finish time of use of biogas units in a day for a period of 7 days.
Monitoring frequency	This survey will be done annually for a statistically determined number of households at 90/10 precision confidence level (Please refer to Annex 4 for survey details).
QA/QC procedures	-
Purpose of data	This is not included for ER Calculations
Additional comment	-

B.7.2. Sampling plan

>>

The monitoring details for the project activity are given in the monitoring section. The sampling plan to monitor the parameters is described here based on Annex 5, EB 69, “Guidelines for sampling and surveys for CDM project activities and programme of activities”, which details information relating to: (a) sampling design; (b) data that will be collected; and (c) implementation plan.

The various parameters that need to be monitored as described in section B.7 are:

(i) Biogas units constructed
(ii) Number of biogas plants operating
(iii) Non-usage days of biogas plants
(iv) Average annual hours of operation of a system
(v) Confirmation that non-renewable biomass has been substituted

The parameters (i), (ii) and (iii) will be monitored for all the biogas plants constructed and in operation and the parameter (iv) and (v) will be monitored based on sample survey.

(a) Sampling Design

(i) Objectives and Reliability Requirements: The objective of the sampling effort is to determine the mean yearly value of the following parameters with 90/10 confidence/precision during the crediting period:

(i) Average annual hours of operation of a system
(ii) Confirmation that non-renewable biomass has been substituted

The survey will be conducted yearly once for a period of 7 days and extrapolated for the year. The estimated value of parameter will be determined through a random sample survey.

(ii) Target Population: The target population is the rural households for which biogas will be constructed and operational in Chittoor district of Andhra Pradesh State, India. These rural households are from all the mandals of Chittoor. The target population are from the biomass scarce district of Chittoor and are predominantly using fuel wood in the baseline scenario. The target population is homogeneous in nature with a low per capita income of less than 1 dollar/day.

(iii) Sampling Method: The sampling method chosen for the project area is simple random sampling as the target population is homogeneous in nature. A simple random sample is a subset of a population chosen randomly, such that each biogas of the population has the same probability of being selected. The sample-based estimate of mean is an unbiased estimate of the population parameter. It will also be easy to implement as the sampling frame (household details for which biogas has been implemented) will be collected and stored in the monitoring database.

(iv) Sample Size: The sample size will be determined use the equation

$$n \geq \frac{1.645^2 NV}{(N-1)\times 0.1^2 + 1.645^2 V}$$

Where:

$$V = \frac{p(1-p)}{p^2}$$

n	Sample size
N	Total number of households (5,000)
p	Our expected proportion (0.75)
1.645	Represents the 90% confidence required
0.1	Represents the 10% relative precision

Substituting the values for the project activity,

$$V = \frac{0.75\times(1-0.75)}{0.75^2} = 0.33$$

$$n \geq \frac{1.645^2 \times 5000 \times 0.33}{(5000-1)\times 0.1^2 + 1.645^2 \times 0.33} = 88.6 \approx 89$$

Therefore the required sample size is at least 89 households. This is assuming that 75% of the biogas units would be operating. This assumption is conservative as the monitoring system will be robust to ensure that all the systems are immediately repaired and operational. Assuming a response rate of only 80%, the number of households will be scaled up to 89/0.8 = 112 households.

During initial years after implementation, the number of households for sample survey will be calculated based on the number of biogas units that would be constructed. The value of N will be the number of biogas units or the number of households provided with biogas units for the monitoring period. If the sample size calculation returns a value of less than 30 samples, a minimum sample size of 30 will be chosen.

The sample will be drawn at random from the sampling frame. This will be done using random number tables or using the random number generator of appropriate software.

(***v) Sampling Frame:*** The sampling frame to be used is the complete listing of all the rural households for which biogas has been built under the project activity in Chittoor district, Andhra Pradesh State. Each of the household will have a unique identify number with all the required details of the family.

(b) Data:

(i) Field Measurements: The variables to be recorded/measured on field are as follows:

(i) Average annual hours of operation of a system
(ii) Confirmation that non-renewable biomass has been substituted

A household level questionnaire will be designed to collect information for the parameters of interest. The frequency of measurement will be once a year during the monitoring period and will be done for 7 days for the sample household, which will be scaled up for the whole year. The parameters that will be monitored are not subject to seasonal fluctuations and hence could be conducted during any time of the year and scaled up for the entire year.

The most reliable and cost effective method for data collection will be through respondent filled in questionnaire with assistance of village level volunteers. Each household will be given the questionnaire to fill in data for the parameters. The village level volunteers will assist the households in collection of field data and filling in the data in case the household members are illiterate.

The average annual hours of operation of a system will be monitored by recording the time of start and switch off biogas units each time it is used by the household for a period of 7 days.

(ii) Quality Assurance/Quality Control: The QA/QC procedure will be to achieve good quality data through field measurements. The household level questionnaire will be designed and field tested before administering the actual questionnaire survey. The questionnaire will be translated into local language for easy understanding of households and village level volunteers. The village level volunteers will be trained to administer the questionnaire at the household level. The households will be trained to collect and fill in the questionnaire. The village level volunteers will be trained to conduct and supervise data collection at the household level. This will reduce non-response from the households. Oversampling will be done to replace non-respondents, if any.

The data collected will be entered by the field staff, which will be checked and verified further for any typographic mistakes. A valuator will further cross-check each entry with the physical form for any typographic mistakes or to clarify any sort of confusion in the data. The field staff, the data entry staff and the valuators will be literate to collect good quality data. Outliers if any will be defined and excluded and/or replaced.

(iii) Analysis: The data entry will be done in Microsoft excel sheet. The data will be cross checked with the filled in questionnaire by Valuators as QA/QC procedure. The data will be analyzed for the mean annual value of all the parameters.

(c) Implementation:

(i) Implementation Plan: The implementation of sampling effort will be done by the NGO in consultation with CDM Team of Fair Climate Network (FCN). The FCN has the skill and resources to implement the sampling procedure. The team is experienced with rural energy CDM projects implemented for the rural poor for more than 5 years. The FCN team will train the village level volunteers to conduct the survey along with the randomly selected households. The village level volunteers will also be literate and would already be involved in monitoring of biogas units at the village level for their operation and maintenance. The collected data will be analysed by the FCN for inclusion in the monitoring report.

B.7.3. Other elements of monitoring plan

>>

1. Implementation Plan

The project activity will be implemented only after its gets registered as a CDM project activity. CERs generated will be sold, in advance, to a Carbon Investor under an ERPA drawn up for the purpose. Revenues will be used in a completely open and transparent manner to construct the 5,000 biogas units. Orders to various local entrepreneurs for construction of biogas units i.e. bricks, cement, sand, stoves, pipes, nozzle will be placed after procuring the advance CER revenues as the project will be funded only from CER revenues.

As elaborated below, before commencement of the Biogas CDM Project, village-wise Participation Agreements will be signed between CROSS and potential End Users, describing the roles and responsibilities.

A CDM Team will be appointed to facilitate construction and maintenance of the biogas units as described below.

First year, 700 biogas units will be built. Second year 1400, third year 1400 & fourth year 1500 biogas units would be built.

A Standard Operation Procedure Manual will be prepared for implementation and monitoring of the project activity, which will be followed by the CDM Team.

2. Project Management and Monitoring

This Biogas CDM project will be implemented and monitored by CROSS, where in over 4 years CROSS will construct 5,000 domestic biogas units of $2m^3$ capacity, for as many farmer families in all the Mandals of Chittoor district, Andhra Pradesh, India.

CROSS will facilitate the End User families to set up village level institutions to take care of minor repair, maintenance and the social controls/peer support needed to cope with various exigencies that will crop up. These will be participatory mutual support systems in each and every village. The sudden loss of animals, destruction of fodder, family illness and other exigencies that lead to a non-functioning of biogas units will be considerably reduced due to the operation of these grassroots structures and systems.

2.1. Biogas Project Management Unit within CROSS

A dedicated team will be set up within CROSS for management and monitoring of the Biogas CDM Project. This Project Management & Monitoring Unit will consist of the following staff:

- **One Biogas CDM Project Manager and two Assistant Biogas Managers:** A biogas CDM project manager will be appointed for overall in-charge of the project activity. The CDM project manager will be responsible for overall project implementation in the first 4 years and meeting the requirements of monitoring protocol thereafter. Additionally 2 staff program assistant Biogas Managers will be appointed to help the CDM project manager. He will be directly

appointed by CROSS Board of Trustees and will report to the Director, CROSS. His main function will be as follows:

- To deal with CDM issues (DOE, DNA, CDM Consultants),
- Coordinate Biogas CDM Staff and village functionaries,
- Ensure quality from material supply, through construction, to commissioning of units
- Set up a repair and maintenance system to attend to issues that cannot be locally addressed through the Village level systems

- **IT Professional:** An IT professional will be appointed who will directly report to the Director, CROSS. He will be responsible for the following:
  - Maintain the digitized monitoring solution and monitoring sheets for CDM Verification
  - Ensure that authentic data is entered into the solution and make spot checks to verify
  - Deal with the IT Company, TRISTLE that prepared the solution.
  - Peruse the analytical reports in the digitized monitoring solution and recognise patterns to predict problem areas and under-performance

- **Accountant:** An accountant will be appointed for the project activity, who will be responsible for ensuring a strict and diligent spending of CER Revenues and the recording thereof in a computerised accounting package. He will report to the Director, CROSS. He will administer the following tasks:
  - Arrange for the bulk purchase of cement and hardware and transfer them to the Mandal storehouses
  - Arrange timely payments for material suppliers and masons
  - Inspect quality of material (bricks and sand) before making payments
  - Negotiate for the timely supply of high quality cement and hardware
  - Prepare statutory reports for end of year audit
- **Mandal Storekeepers:** For each Mandal one store keeper is appointed and those will be responsible for the safekeeping of hardware, cement and other material required for construction of biogas units. He will report to the accountant. His responsibility will be to:
  - Maintain a strict inventory of cement and various hardware (asbestos pipes, nozzles, gate valves, gas pipes and stoves)
  - Issue supplies to Biogas Field Workers on the signed orders of the Project Manager.

- **Biogas Field Workers:** Ten biogas field workers will be appointed for overseeing the construction of biogas units. Each field worker will be in-charge of construction of approximately 250 units during the 4 year construction phase. They will report to the Project Manager and their tasks will be to:
  - Inspect the number of cattle, distance from kitchen in each household, mark and arrange for excavation of pits
  - Identify local suppliers of material (bricks and sand) for each village, get the price and quality approved by the Project Manager, and arrange for transportation to the villages
  - Transport cement and hardware from the Mandal storehouses
  - Assign Masons to particular villages and oversee the quality of their work and ensure that End User family labour is actively used
  - Record the progress of processes in specially designed formats and enter the data into the digitized monitoring solution on a fixed day every week

- **Local Masons**: They will be trained at ongoing Biogas CDM Projects. They will be assigned to each Biogas Field Worker. They will be paid a piece rate for each unit they build and their personal and contact details will be stored in the digitized monitoring solution to fix responsibility.

Similarly, the personal and contact details of each Material Supplier will also be recorded, along with their bank account numbers. Payments will be made only by crossed cheque.

Post construction of the biogas units for the initial four years, the biogas field workers will continue to be responsible to:

- Form and support village level institutions; assist in selection of Volunteers, train and support them
- Record the monthly totals from the Daily Monitoring Books maintained by Volunteers and, once a month, enter the data into the digitized monitoring solution
- Contract Masons and attend to major repairs that cannot be handled by the village level institution.

2.2. Management system at village level:

- **End User Groups:** About 20-25 End User families will be organized into a group called End User Group. These will function on the lines of Self Help Groups (SHGs) specifically for local management of construction and post construction, ensuring proper functioning of all biogas units in their respective villages. These End User Groups are a support system to each End User. E.g. If a cow or buffalo suddenly dies and the family faces a dung shortage, the Group will make arrangement with neighbours to ensure that the unit functions uninterrupted.

- **Volunteers:** Every participating village will have a Volunteer, preferably women staff with either minimum SSLC or PUC qualification, to monitor usage of about 20 - 25 biogas units. She will be a young woman, selected by the End User Group of her Village.

  She will be responsible for post construction monitoring of usage and be the first to identify dysfunctional units. The Volunteer will either prompt the End User Group to set right a problem or bring it to the notice of the Biogas Field Worker.

  Volunteers will be paid by their respective End User Groups from the maintenance fund given to them.

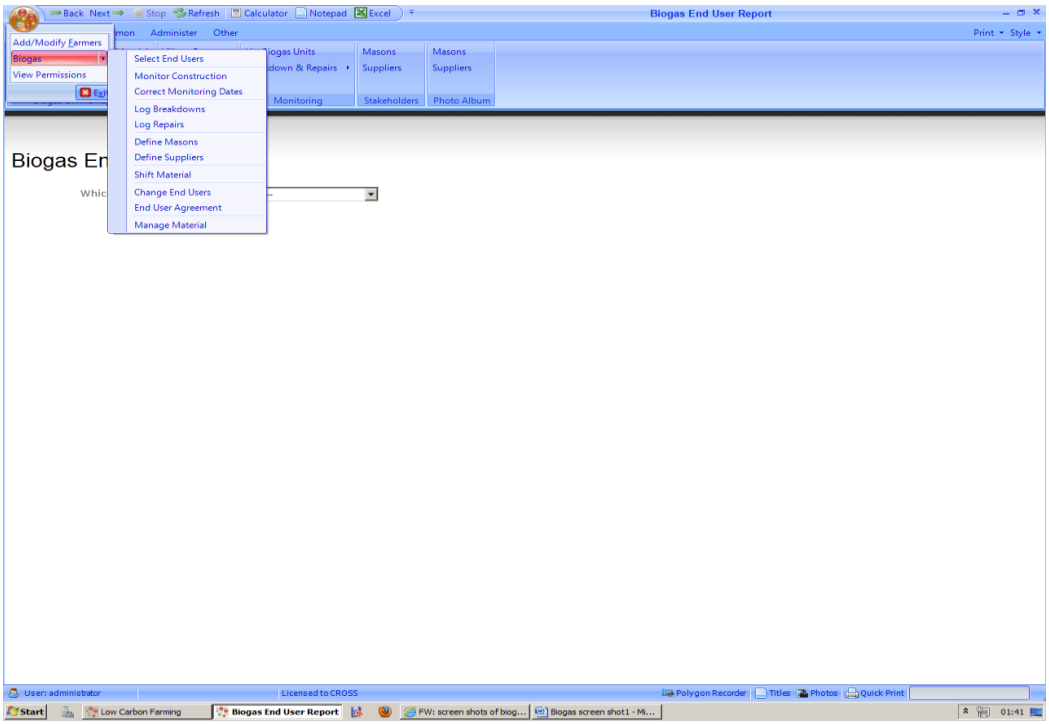
2.3 Digitized Monitoring system

A customised Biogas CDM Monitoring database Solution developed and tested by Tristle Technologies Pvt. Ltd. for CROSS, will be used to maintain demographic data, construction processes, and the regular monitoring of the project activity. Tristle Technologies Pvt. Ltd. has developed a database which is permission driven, intuitive and easy to use by Project Staff and Volunteers. All activity processes, including financial transactions, will be digitally entered and monitored at the CROSS head office. Open and transparent online reports can be used by all the Project Staff and secondary stakeholders to know the Progress and Results. Reports can be generated at all levels – Project, Mandal, Gram Panchayat, Village and Participating Family. The database will be updated on an everyday basis, as and when Project Staff return from their respective villages.

Progress Reports: Real-time Progress Reports can be available to everyone in an open and transparent manner for the following:

- Implementation Progress (overall project to village reports) on
  - Construction progress, time line & efficiency
  - Gender disaggregated analysis & dwelling details of participating families
  - Daily usage resume, Audit & Maintenance & CER generation to date
  - Total expenditure & average cost per unit
- Participating Families
  - Demographic details
  - Mason, Commissioned Date & Usage Days
  - Construction Details with Date, Process, & Who Monitored
- Construction Overview
  - Village-wise Progress
  - Output, Outcome & Results

- Monitoring of operating units
- Masons & Suppliers
  - Masons
  - Suppliers
  - Photo Albums of Masons and Suppliers
- Reports that meet CER Verification requirements
  - Monitoring operating units
  - Full List of all the Commissioned Units
  - Non-usage days



Snapshot of the TRISTLE Monitoring Database Solution

Processes: The solution will be used to:

- Record the Mandals, Gram Panchayats and Villages where the CDM project is implemented
- Enter demographic details on participating Families
- Select Villages & Families
- Assign Staff and Volunteer responsibilities during the actual construction and monitoring phases, respectively

1. Monitoring during Construction Phase

Construction of 5,000 Biogas Units will be carried out in a phased manner over 4 years. The various processes involved in the implementation of the technology are as follows:

- Selection of Participating Families
- Defining Masons & Material Suppliers
- Monitoring Construction Progress
  - Marking
  - Excavation
  - Supplying crushed Stone Jelly, Sand, Bricks and Cement
  - Supplying Hardware
  - Concreting, Brick Work & Plastering
  - Filling dung
  - Supplying & Fixing Pipes and Stove
  - Fixing the Safety Grill

- Commissioning the Biogas Units
- Generating End User Agreements
- Monitoring operating units
- Logging Breakdowns & Repairs – Non usage days

Project Staff will ensure quality of installed Biogas Units. They will check the quality and ensure that the required quantities of material are used during construction. All payments will be made by cheque and Suppliers irrefutably identified with personal data and digital photographs fed into the computerized databank.

Each Biogas Unit will be marked with a unique Identification Number and date of construction. Along with the Village Code and Family Code, these will irrefutably identify each of the 5,000 Biogas Units on the digitized monitoring database.

After commissioning and satisfactory functioning of the Biogas Unit for a minimum of 2 weeks, an End User Agreement will be signed with the Participating Family. Full account of emission reduction will be considered from Day 1 of commissioning.

2. Monitoring after Commissioning of biogas units

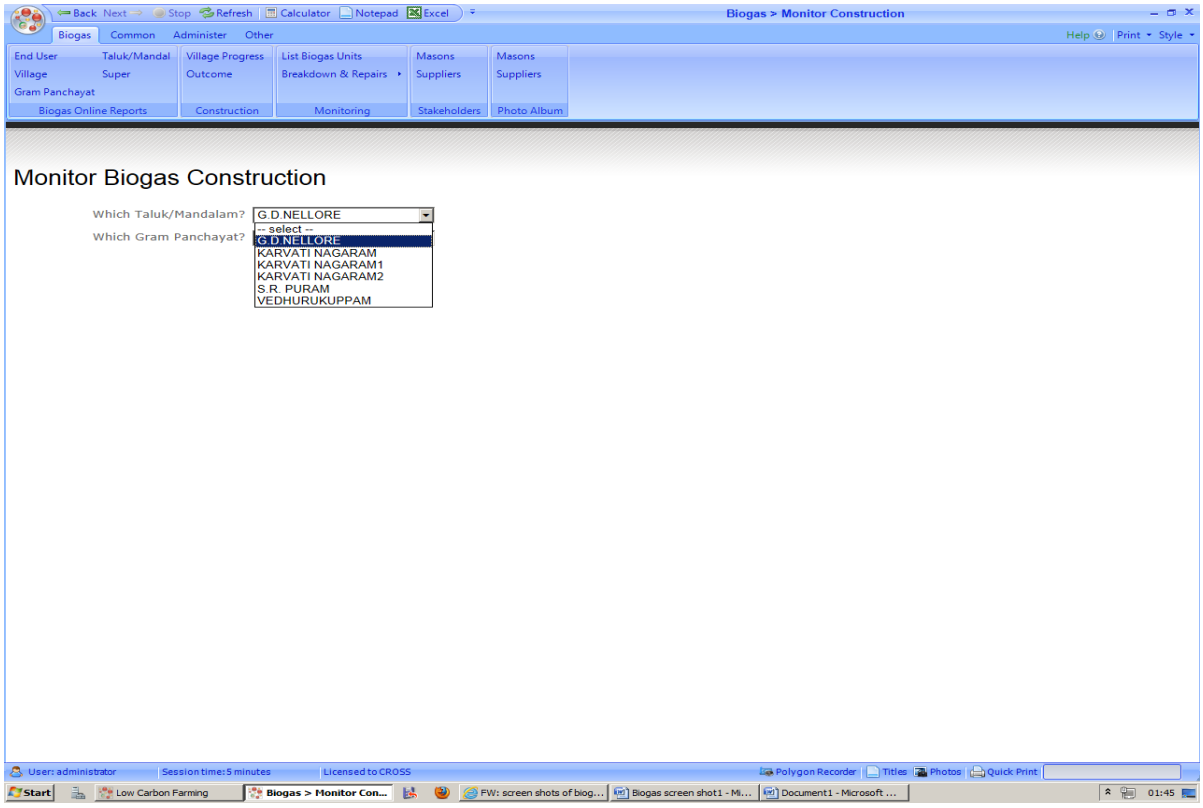
A Daily monitoring book will be maintained in each of the villages where the volunteers will record number of non usage days. This data will be fed into the individual Biogas User's monitoring database solution, once a month, for days not used and reasons.

If any Biogas Unit is faulty or not functional, the problem report will be automatically passed on to the Area Team for action. There will be a continuous database maintained of all the Biogas Units not operational on a day-to-day basis. The computerized solution will provide all the details at the Participating Family level for the number of non-operational days, and the reasons of non-operation. This monitoring will give the operational Biogas Units and serve to triangulate the data.

This monitoring solution will positively impact Staff and Volunteers to enhance Performance and produce good Results.

- The features, organisation and ordering accurately mirror the implementation plan and serve as unambiguous job descriptions for secondary stakeholders. Project processes are sequentially ordered into jobs and tasks. Project staff will know exactly where they stand in terms of progress and results. They will be comfortable in the knowledge that objective standards like number of commissioned Units, recording of breakdowns, conducting timely repairs, etc. will be used to measure their performance.
- The totally open and transparent reports track progress from marking to commissioning. These, along with budget realisations, will keep a wider audience constantly informed on progress and financial health. They will also give up-to-date information on the volume of CERs generated and thereby serve as an indicator on financial viability and feasibility.
- Verification data needed by the DoE will be generated as Excel files from the monitoring solution.

All data will be archived and stored throughout the crediting period and an additional 2 years.



Snapshot of the TRISTLE Monitoring Database Solution

3. Participation Agreements

Farmer families have been educated on project dynamics, CDM mechanism and the carbon market. This has ensured an informed participation right from the planning state of the CDM Project. They will further be educated on their responsibilities during the construction and post-construction phases.

Before commencement of the Biogas CDM Project, village-wise Participation Agreements will be signed between CROSS and potential End Users. This will clearly state the roles and responsibilities of each party, fully disclose the finances and commit CROSS to the carbon revenue sharing arrangement.

4. End User Agreements

About 15 days after commissioning each Biogas Unit (i.e. after the satisfactory functioning of the unit), a legally binding End User Agreement will be signed between the Project Proponent (CROSS) and every single End User. These will formally spell out the roles, entitlements and responsibilities of both parties.

Once the farmers are ready for participating in the project, an End User Agreement on stamp paper will be signed by each participating farmer with CROSS.

5. Maintenance, Servicing & dealing with Emergencies

Each End User Group will be given a sum of money, from the forward sale of CERs mentioned earlier, for maintenance and servicing. This fund will be managed by the Group itself in a self governing and transparent manner.

Volunteers will have about 25-30 units record Daily Monitoring data. They will therefore be the point persons who will immediately identify problems. Minor repairs will be conducted either by the

End User family or the Volunteer herself, since she will be trained and given a kit with tools and spare parts.

If the repair involves the expenditure of monies for the purchase of material, the matter will be discussed in the End User Group and resources obtained. If the problem is beyond their scope, the Biogas Field Worker will be informed and the problem attended to within 3-4 working days.

Other emergencies like the sudden loss of cattle and fodder, etc. will be dealt with by the End User Groups as described earlier.

A serious and well thought bottom-up plan is chalked out to ensure maximum functionality of the 5,000 biogas units that will be built under this CDM Project.

Trainings will be conducted before project implementation at various stages. The types of trainings to be imparted are:

- Orientation to end users on the effects of climate change, CDM processes and biogas.
- Training beneficiary farmers on quality aspects to be ensured while constructing the units.
- Training beneficiary farmers, particularly women on use and maintenance of bio-gas units.
- Training the masons on construction parameters and quality of construction, including assessment of the quality of materials like bricks, cement etc.
- Training the Volunteers and End User Groups (EUGs) on maintaining Monitoring Records of usage of bio-gas stoves by the families.
- Training the beneficiary families and Volunteers on the "Repair and Maintenance" of Bio-gas units.
- Any other training as need arises.

6. Monitoring Parameter for Emission Reduction

In accordance with Paragraphs 12 to 16 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04:

Monitoring shall consist of checking of all appliances or a representative sample thereof, at least once every two years (biennial) to ensure that they are still operating or are replaced by an equivalent in service appliance.

- The single relevant project aspect deemed necessary to monitor and report reliable emission reductions is the continued use of the biogas plant. As mentioned above, the number of systems built and operating annually will be recorded through evidence of continuous monitoring at the village level by the village level volunteer as mentioned above.
- This is not just for monitoring of emission reduction, but to ensure that none of the biogas units have fallen to despair and are providing energy for continuous use by the communities.

In order to assess the leakages specified under paragraph 10, monitoring shall include data on the amount of woody biomass saved under the project activity that is used by non-project households/users (who previously used renewable energy sources). Other data on non-renewable woody biomass use required for leakage assessment shall also be collected.

- As stated in Para 10(a) of the methodology, By will be multiplied by a net to gross adjustment factor of 0.95 to account for leakages.
- Thus survey will not be conducted to assess leakage.

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.

- Provided all plants are in continuous use throughout the project period, and emergency preparedness arrangements are recorded as having been used, it is expected that the ex-ante emission reductions will be achieved and there is complete displacement of non-renewable

woody biomass by biogas.
- The project activity does not include production of renewable biomass as the substrate is dung. Thus leakage in the production of renewable biomass need not be monitored.

Para 15 of methodology on monitoring is not applicable as option (b) in Para 6 is not chosen.

Para 16 of methodology on monitoring is not applicable, as it is not water treatment technologies that is implemented.

Frequency of Monitoring

- 100% of plants will be monitored for non-usage of biogas units on daily basis and accordingly calculate emission reduction in the monitoring report for only usage days for verification.

All monitored data required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occur later both on paper and electronically.

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>
Date of Completion: 12/07/2017

Responsible entity: Dr.Sudha Padmanabha, **Fair Climate Network**[19]
19/1, Alexandria Street, Richmond Town
Bangalore – 560025, Karnataka, India.

The Technical Team of Fair Climate Network assists grass root NGOs to do pro-poor CDM projects. FCN is not a project participant.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
01/04/2013 (Expected Date of start of construction)

C.1.2. Expected operational lifetime of project activity

>>
25y-0m[20]

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>
Renewable Crediting Period

C.2.2. Start date of crediting period

>>
01/01/2014 or date of registration with UNFCCC, whichever is later.

[19] http://www.fairclimate.com/tech/team/

[20] Dheenabandhu Model 2000 Biogas Units, developed by AFPRO, Action For Food Production, New Delhi.

C.2.3. Length of crediting period

>>
7y-0m

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

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The project activity does not fall under the purview of the Environmental Impact Assessment (EIA) notification of the Ministry of Environment and Forest, Government of India, 2006. Hence, it is not required by the host party[21].

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>
The local stakeholders' meeting was conducted based on Gold Standard guidelines. The stakeholder's meeting was conducted at Hindu Muslim Kalyana Mandapam, Karvetinagaram, Chittoor District, Andhra Pradesh on 9th January 2012 between 11:30 AM to 1:30 PM.

Notification was sent through letters, emails and personally to various categories of stakeholders i.e. local communities, local policy makers and official representatives, local NGOs, Gold Standard national and international NGOs and the DNA to attend the stakeholders meeting. A non-technical summary was also enclosed along with an agenda for the meeting. The meeting was conducted in the local language - Telugu. An open invitation to the meeting was published in the local newspaper "Andhra Prabha" dated 08/01/2012. Posters and banners were also displayed announcing the conduct of the meeting.

The agenda of the meeting included discussion on the purpose of the consultation, description of the project activity, providing clarifications on the project activity, discussion of the sustainable development checklists for the project and methods by which to monitor them.

The meeting was attended by 185 people. The various stakeholders for the meeting were as follows:

Local Communities: The local communities invited were primary stakeholder representatives from villages, the farmers and women in the project area. The primary stakeholder's included both men and women representatives from the project area. The meeting was also attended by media.

Local Policy Makers, Representative of Local authority and Official Representatives: The invitees' among local policy makers included members from Zilla and Mandal Panchayat members and officials representatives from the Andhra Pradesh Government like Mandal Development Officer (MPDO), Animal Husbandry, Police Department and a teacher from the local school.

Local NGOs: Representatives from local NGOs of Chittoor, VEEDU, RWDS and SUCHI attended the meeting. National NGOs from the Fair Climate Network (FCN) were also invited of which representatives from SCINDeA attended the meeting. The FCN is a network of grass root NGOs working on CDM issues, many of whom have taken up CDM projects for rural communities.

GS NGOs: There are 8 GS NGOs in India. All of them were sent invitations for the meeting. Also international Gold Standard NGO supporters were invited to comment on the project activity. FCN, a GS NGO supporter attended the meeting.

[21] http://moef.nic.in/legis/eia/so1533.pdf

Official Representative of DNA: The official representative of the DNA for India, Ministry of Environment and Forests (MoEF) were intimated of the meeting and invited.

Evaluations forms were filled in by the meeting participants to express their thoughts on the conduct of the meeting and their opinion on the project. The responses were compiled.

E.2. Summary of comments received

>>

During the meeting, the stakeholder's questions were answered. Their doubts on biogas technology, mode of implementation, operation and maintenance were clarified by CROSS staff. The local communities expressed happiness that the project is being done in their region, helping women to get rid of their drudgery. Speaking in the meeting, Mr. Srinivasa Prasad Mandal Parishad Development Officer (MPDO) appreciated the project activity and asked the people to utilize this opportunity to conserve forests.

Mr.Prabhakar Reddy, local political party president expressed that the biogas project is very good for rural poor and the communities should utilize this opportunity to improve their energy needs and thereby reduce deforestation.

An analysis of the filled in evaluation forms are as follows:

Questions	Responses	No. of Stakeholders
What is your opinion on this meeting?	Construction of biogas will solve all the problems of women for cooking. Especially during rainy season it is very difficult for them to store and cook with the wet fire wood. With the project activity, it will become easy for both women & men to cook on biogas stove.	62
	This program is good, because it discusses about protection of our environment by saving existing forests. I learned that the dung used for producing gas is not going to be a waste product, but the slurry can again be used to the fields and vermi-composting.	52
	It is a good program because its main aim is to reduce pollution. Deforestation leads to low rainfall and in turn leads to less crop yields and economic loss. This was explained very well by the dignitaries.	19

	Today's meeting is an ideal one. Protection of tree wealth is everybody's responsibility. It is a good opportunity to save trees by establishing biogas unit for each family and also reduce atmospheric pollution.	38
	Good for Chittoor district and is useful to the rural families in many ways. Improves education of children and women health.	46
What did you like in the project?	Installation of 5,000 biogas plants is connected to increased access for sustainable agriculture. Helpful for poverty reduction.	31
	There is no need for me to make any investment in the establishment of the unit. It will be smokeless, trees can be protected and health of women and children will improve. The project could lead to timely rains due to avoided deforestation, leading to high agricultural yields.	40
	We appreciate Mr. P. Bhupathi (Director) for taking up such a good program. It is good fortune to Chittoor, Rural Women & Climate.	16
	Use of biogas would reduce lung diseases, eye infections and sight problems. The project will improve health, environment and living standards of rural communities.	20
	Village level meetings with women will encourage more women to participate in meeting.	10
What do you dislike in the project?	Only people with two cattle can construct a biogas plant. Poor people who do not have cattle also wish to have a biogas unit. Is there any way? It will be good if the organization can provide loan for purchasing 1 or 2 cattle.	07
	Some of the units constructed by Government agencies are not working now.	04
	This project will not help families without cattle	01
	No Comments	74

There were no negative comments on the project activity.

E.3. Report on consideration of comments received

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During the stakeholders' meeting, the queries of the stakeholders were clarified with regard to project implementation, construction of biogas units, and service and maintenance.

The queries and clarifications of the meeting were as follows:

Stakeholder comment	Explanation
How much space is needed to build the biogas plant?	Space of approximately 12 X 15 feet close to the kitchen is required to build biogas plant.
How many cows or cattle per family is required for maintenance of biogas?	Nearly 2 to 3 cows are required.
Has the project fixed the family size for selection of beneficiaries?	We are building a plant of size $2m^3$. So it can serve a family size of 5 to 6 people.
Who will purchase the material to construct the biogas plant under the project activity?	CROSS, the NGO, will supply the material and capital to construct the plant. The households will have to provide labour for construction of the plant

When will the project activity commence?	As soon as project gets registered in UNFCCC as a CDM project and after the forward funding is received.
What would be the distance between the biogas plant and kitchen? Is there any maximum limit?	It is advised to construct the biogas plant close to the kitchen.
Will you provide biogas plants for those without cattle?	No, having cattle is a must to be included as a beneficiary of the project activity.
Is the biogas plant constructed at free of cost or do we have to make any contribution?	Yes, beneficiary has to make a contribution in kind as labour or a small contribution so that the beneficiary would have a sense of ownership and responsibility. The contribution will be used for the maintenance of the plant.
In how many Mandals and families will the project be implemented? And what about other families who are left out in the project?	As explained by Mr. Bhupathi, NGO Director, the project activity encompasses 5000 families in 4 Mandals of Chittoor district namely Karvetinagaram, SR Puram, GD Nellore and Vedurukuppam. Based on the experience of this first CDM project, we would explore other technologies like improved cookstoves, etc. for other families.
How will the units be maintained?	The NGO will train village level volunteers to undertake maintenance and minor repair of the units. For major problems, the NGO will replace parts or get it repaired for structural problems.

There were no negative comments requiring mitigation measures for the project activity.

SECTION F. Approval and authorization

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	**Community Reconstruction of Social Service - CROSS**
Street/P.O. Box	Velkur Village & Post, Gangadhara Nellore Mandal
Building	-
City	Chittoor
State/Region	Andhra Pradesh / South India
Postcode	517 125
Country	India
Telephone	08572 – 273292
Fax	-
E-mail	cross_org2005@yahoo.com
Website	-
Contact person	-
Title	Director
Salutation	Mr.
Last name	Bhupathi
Middle name	-
First name	Puvvani
Department	-
Mobile	098854 12972
Direct fax	-
Direct tel.	-
Personal e-mail	-

Appendix 2. Affirmation regarding public funding

No ODA fund will be diverted for this project.

Appendix 3. Applicability of methodology and standardized baseline

BASELINE INFORMATION

1. Introduction

Project Description: The purpose of the project activity is to set up 5,000 biogas plants (digesters) of 2m^3 capacity each for single households in Chittoor district of Andhra Pradesh and in this way replace Non-Renewable Biomass with biogas for cooking and heating water. The district has greatly diminished biomass resources and wood demand far exceeds the available renewable woody biomass. Each household will install a 2 m^3 biogas plant and feed cattle dung, organic waste and biomass waste into the anaerobic digester.

The project is being implemented by **CROSS,** which is a grass root level NGO in Chittoor. Implementation of this project will reduce GHG emissions by replacing inefficient traditional cook stoves that uses non-renewable biomass with biogas plants. CROSS intends to construct household level biogas units for 5,000 families in the Mandals of Chittoor District, Andhra Pradesh State, India.

The project will be implemented upon registration of the project as a CDM project activity, as the project will be financed completely from carbon revenues.

A baseline survey was conducted to gather baseline information within the project boundary of the project activity. The surveys conducted were also to determine unbiased and reliable values for parameters to estimate emission reductions as specified in the applicable methodologies I.E, Version 04.

2. Sampling Design

2.1. Objectives and Reliability Requirements

Two surveys were conducted in the project area.

- A survey of a larger database in the target project area was conducted to collect information of the communities and establish the prevailing practices of the local communities with regard to energy use for everyday cooking and water heating purposes.
- A detailed statistically determined baseline sample survey was also carried out to;
    - Understand the pattern of energy use for cooking and heating water for bath.
    - Study the quantity of woody biomass use for cooking and hot water bath

The surveys were conducted between July-December 2011. The sampling was done to obtain a 90/10 confidence/precision level.

2.2. Target Population

Chittoor is one of the four districts of Rayalaseema region of the South Andhra Pradesh. Agriculture is relatively underdeveloped. The intensity of the poverty is high compared to the other parts of the state. The livelihood opportunities for poor are limited and declining in recent years. Distress activities are eating into the resource per capital base (depleting of natural resource base), migration etc.,[22]. The vegetation of the region is predominantly scrub forest and forest area is a meagre 16.97% of the total geographic area.

The target population is the rural households of Chittoor District. The rural households are primarily dependent on fuel wood for cooking and heating water. This is concurrent with the latest survey conducted at the national and state level, wherein nearly 77.6% of rural household use fuel wood for household energy need at national level, 80.6% at the state level of Andhra Pradesh (NSSO, 2010)[23]. The region is scarce of biomass and non-renewable biomass is part of the biomass used for cooking and heating water. In 5,000 households, the fuel wood use will be replaced with biogas, a renewable source of thermal energy.

2.3. Sampling Method

A simple random sampling was done in 2011 to assess the baseline scenario of the project area. Simple random sampling was the sampling method as there was no significant difference in the population, altitude and temperature. The region has an altitude of 333.75 meters above mean sea level [24] and annual average minimum and maximum temperatures of 23-25^{0}C and 33-46^{0}C respectively [25] . The target population is dominated by economically backward scheduled communities.

2.4. Desired precision/expect variance and Sample Size and Sampling Frame

A demographic sampling was conducted by CROSS for 5550 families in 320 villages belonging to100 Gram Panchayats[26] encompassing 4 Mandals of Chittoor District to assess the features of target population. A household level questionnaire was designed, field tested and utilized to collect the relevant information at the household level. Each and every family of the 5550 families were visited to collect relevant information of the families. The data was collected during July-November 2011. The data was entered into an online monitoring solution designed by TRISTLE Technologies Pvt. Ltd. A summary of the Mandals, Gram Panchayats, Villages and the number of families surveyed is as follows.

Taluk	Gram Panchayat	Number Of Households
G.D.Nellore	Agaramangalam	138
	Ambodarapalli	15
	Athamakuru	22
	Balaganganapalle	83
	Bangareddy Palle	25
	Bukkapatnam	3
	Chinna Vepanjeri	33
	Ejjupalle	94

[22] ftp://ftp.solutionexchange.net.in/public/wes/cr/res-15061003.pdf (Page no 1)

[23] NSSO 2010. National Sample Survey Organization, Household Consumer Expenditure in India, Ministry of Statistics and Programme Implementation, Government of India. (Page no A-39)

[24] http://en.wikipedia.org/wiki/Chittoor

[25] http://apshm.ap.nic.in/Agri_Climatic_Zones.html#7

[26] Gram Panchayat is a local self-governments at the village or small town level in India. A gram panchayat can be set up in villages with minimum population of 300. Sometimes two or more villages are clubbed together to form Gram Panchayat when the population of the individual villages is less than 300.

	G.D.Nellore	44
	Gangadharanellore	12
	Kadapagunta	85
	Kalijavedu	75
	Kondepalli	41
	Kotagaram	118
	Kotrakona	113
	Mahadevamangalam	13
	Mukkulthur	38
	Nandanur	13
	Nellapalli	74
	Pachigunta	11
	Papireddy Palle	78
	Peddakalva	12
	Peddha Venkatapuram	8
	Thugundrum	35
	Tiruveedi Kuppam	6
	Varathur	107
	Veerakanellore	35
	Vejjupalli	99
	Velkur	45
	Vepanjeri	50
	Vezzupalle	12
	Vinjam	70
Karvetinagaram	Allathur	28
	Ammapalli	24
	Annur	81
	D.M.Puram	117
	Erama Raja Palli	54
	Gajanki	71
	Gopi Chetti Palli	211
	K. Nagaram	84
	K. P. Agraharam	35
	K.M. Puram	136
	K.P.Agraharam	22
	Karvetti Nagar	12
	Kathirapalli	15
	Kollagunta	55
	Kotorvedu	54
	L.R. Pet	52
	Mukkiravanipalli	104
	R.K.V.B Peta	92
	Katthirapalli	21
S.R. Puram	Am Puram	29
	Chilamakulapalli	5
	Chinnathayur	1

	D.K Maripalli	38
	Diguva Mudi Kuppam	34
	Eguvakamma Kandriga	14
	G.M.R Puram	4
	Katikapalli	56
	Kotagaram	5
	Mangunta	22
	Medavada	4
	Muddikuppam	85
	Nelovay	8
	Padmapuram	32
	Pillarikuppam	4
	Pullur	2
	S.R.Puram	70
	Settivanatham	15
	Thayyur	102
	Udamalakurthi	21
	V.V. Puram	61
	Venkatapuram	80
	Venugopalpuram	7
	G.M. Puram	30
	Kothapallimitta	17
Vedhurukuppam	Aggichenupalli	163
	Allamadugu	62
	Bommiahpalli	101
	Bramahanapalle	12
	Deveragudipalle	81
	Diguvapallalu	26
	Enamalamanda	40
	Gantavaripalli	20
	Goduguchintha	95
	Inamkothhuru	46
	Jakkadona	79
	Komaragunta	64
	Kuruvikuppam	66
	Mambedu	21
	Marrepalli	50
	Mondivenganapalle	29
	Nallavenganapalli	325
	Pachikapallam	164
	Pathagunta	107
	Perumallapalle	33
	Thippanaidu Palli	63
	Tirumalaiah Palle	244
	Vedhurukuppam	21
	Yanamala Mandha	17

Grand Total		5550

The data from the Monitoring database Solution was exported to Excel and analysed. The survey provided information on demographic details at family level, farm land details, type of live stock and its population, and energy use pattern of families for cooking, water heating and lighting.

- The sample frame for the baseline fuel wood survey was developed from the 5550 families in the region. Firstly the target families or target beneficiaries of 5,000 families belong to 4 mandals of Chittoor district. In all 5550 households in 100 Gram Panchayats and 317 villages were sampled, data collected and analysed.
- From this list, sample survey was conducted to study the quantity of woody biomass used for cooking and heating water for bath at the family level. The sample unit, which is the minimum unit or the clearly defined unit for constructing the sample frame is the traditional wood stove used in each household for cooking and hot water bath.

Based on the survey of 5550 households, it can be seen that it is homogeneous. All the Mandals are homogeneous is terms of demography and cooking patterns. The households are from the rural region and are predominantly using fuelwood for cooking. Thus, Simple Random Sampling was undertaken to further assess quantity of fuel wood consumption as i) considerable knowledge of entire population is known before the sample was selected and ii) the population being studied is relatively homogeneous with respect to fuel wood usage being studied. To determine the mean value of fuel wood use per capita, a random sampling was conducted from the 5550 surveyed families. The sample size was determined to achieve 90/10 confidence/precision level. Based on a pilot study conducted in the region, the mean per capita fuel wood consumption is 3.65 kgs/capita/day and standard deviation derived from the study was 0.95 Kgs/capita/day.

Then, the following formula with finite population correction can be used:

$$n = \frac{1.645^2 N (\frac{SD}{mean})^2}{(N-1) \times 0.1^2 + 1.645^2 (\frac{SD}{mean})^2}$$

Where:

n	=	Sample size with finite population correction
N	=	Total number of households
mean	=	Mean (3.65 as mentioned above)
SD	=	Standard deviation (0.95 as mentioned above)
0.1	=	Represents the 10% precision, expressed in relative terms to the mean

$$n = \frac{1.645^2 \times 5000 \times (\frac{0.95}{3.65})^2}{(5000-1) \times 0.1^2 + 1.645^2 (\frac{0.95}{3.65})^2} = 18.24 \approx 19$$

Therefore the required sample size is at least 19 households. If we expect the response rate from the sampled households to be only 80%, then the scale up for the survey would be 19/0.8≈ 23 households.

Thus the sample size required to estimate the woody biomass usage within a target 90/10 confidence/precision level is 23. To be conservative and more precise, **228 households of the target population** have been chosen. This also compensates for any sampling error due to sampling approach.

The random sampling was performed in a sample of 228 families in 15 villages across 4 Mandals of Chittoor district to assess the quantity of woody biomass that is substituted or displaced in

tonnes/family. The sample was drawn at random wherein which each case having an equal probability of selection. For each chosen sample that participated, they were involved in conducting the required survey along with the field staff of CROSS. The details of sampling households were as follows:

Mandal	Village	Total
G.D. Nellore	Etteri	19
	Guttakindapalli	6
	Kotagaram	11
	Reddaypalli	9
	Vejjupalli	32
Karvetinagaram	Gopichettipalli	19
	Kollagunta A.A.W	20
	Kotarvedu H.W	13
S. R. Puram	A. M Puram	9
	Diguvamuddikuppam	21
	Mangunta	17
	Peddathayur	10
Vedurukuppam	Aggichenupalli	19
	Chinthalagunta	15
	Mittor	8
Grand Total		**228**

3. Field Measurements

The variables that were measured and determined for the baseline scenario and *ex-ante* baseline emission calculations are as follows:

- Determination of average family size – adult male, female and children
- Animal Type – Dairy Cow, Buffaloes and other cattle type
- Number of animal type in each of the family
- Type of energy use for cooking and heating water in each of the family – biomass, coal, kerosene, LPG, etc.
- Type of Cook stove used

These were determined based on household survey conducted for 5550 families

Further, in 228 households in-depth survey was conducted to determine the following:

- Per capita fuel wood use

This fuel wood study is based on the FAO report: “A guide for woodfuel surveys”, EC-FAO Partnership Programme (2000-2002). Sustainable Forest Management Programme, Forest Products Division, Forestry Department, FAO **27** and “Biomass Studies; Field Methods for Monitoring Biomass” (1997) by Shailaja Ravindranath and Sudha (1997). Oxford & IBH Publishing Co.Pvt. Ltd. New Delhi.

The measurements involved were as follows:

- Selection of families from the 4 Mandals in which the project will be implemented.
- The amount of woody biomass used for cooking and heating water for bath by a family. This was based on actual measurements taken for a week in each household.
- The type of cooking device used in the sample household was recorded.

[27] http://www.fao.org/DOCREP/005/Y3779E/Y3779E00.HTM

- The person who cooks for the household was requested to set aside an approximate quantity of cooking fuel required for a week prior to cooking in the morning.
- The house was visited in the morning before the start of cooking activity.
- The type and weight of the fuel set aside was recorded for each of the day.
- The fuel from weighed bundle was used for cooking every day.
- For each day, the remaining fuel was weighed and value recorded.
- The average fuel wood use/day was estimated.
- The timeline use of fuel wood over the 20 years period was also conducted based on PRA.
- The value obtained from the study was compared to other scientific studies conducted for similar ecological region.

The CROSS staff were trained in the classroom and on field by the FCN Technical Team to conduct the baseline survey. The questionnaire was designed and field tested. Based on the feedback of field test, the questionnaire was modified for maximizing response rate from the rural households. The sample size was larger than that statistically determined to account for outliers. The data from the survey was entered into excel sheet and analysed. The study was conducted by CROSS staff under the guidance of the Technical Team of FCN. CROSS staff entered the data in Microsoft Excel and the data was analysed by the FCN Tech Team. Thus there was no conflict of interest of those involved in data collection and analyses. The results from the analysis are used for determining the parameters for emission reduction calculations.

4. Survey Findings

4.1. Family details

The demographic survey of 5550 families revealed a total population of 21,488 members indicating an average family size of 3.87. The male to female ratio is 1000:831. The proportion of children less than 18 years is 28.68%. The average adult equivalent per household is 3.13. The adult equivalent is based on PCIA guidelines and Ramachandra Study[28], wherein standard adult equivalent for male, female and children respectively were of 1, 0.85 and 0.5[29]. A study done by NCAER[30] showed that an average household has adult male number of 1.73; adult female of 1.55; Children - 2.06 resulting in household size of 5.34 for Andhra Pradesh. This translates to an adult equivalence of 4.08 per household.

The survey reveals that most of the people are daily and agricultural labours. Nearly 85% of the population are agricultural labourers. This figure is further substantiated by the TERI report which says 60% people are daily and agricultural labourers.[31] The Chittoor district is in dry region of Rayalaseema and rainfall is less compared to the other districts. Other occupations include wage-earners, small businesses and salaried persons. The average income of the family is far below $1/capita/day. This is also evident from the Human Development Report for India[32], wherein the per capita income/year for Rural Andhra Pradesh is just Rs.5,250, which is far below $1/capita/day.

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[28] Ramachandra, T.V., 2007. Geospatial Mapping of Bioenergy Potential in Karnataka, India. Journal of Energy & Environment, Vol 6, May 2007 (Page no 35)

[29] http://www.pciaonline.org/files/KPT_Version_3.0_0.pdf Ramachandra paper gives an adult equivalent of 0.35 for children less than 6 years. The survey has been done for children (< 18 years) and adults (>18 years). The PCIA guidelines gives a conversion rate of 0.5 for children 0-14 years.. The same conversion factor has been used for children till 18 years in the PDD, which is a conservative estimate.

[30] NCAER, 2002, Evaluation survey of the National programme on Improved Chulha, National Council of Applied Economic Research, Ministry of Non-Conventional Energy Sources, Government of India.(pg no 115)

[31] http://forest.ap.nic.in/JFM%20CFM/CFM/Special%20Reports/NTFPs%20in%20AP%20%20by%20TERI/NTFP%20Final%20Report%20July-04.pdf (pg no 20)

[32] http://www.ncaer.org/downloads/Reports/HumanDevelopmentinIndia.pdf (pg no 38)

In fact, a rural family income is about 20,642, which is just about $1/household/day. Thus the project is targeted at the rural poor.

4.2. Biomass and Cooking Pattern

The rural households are primarily dependent on fuel wood for cooking and heating water. In the project area, the traditional cook stoves are predominantly built of mud/clay (74%), brick, cement and the three stone rudimentary types without any chimney. Kerosene is used by these families to kindle the fire and a few families also have kerosene stoves alongside to quickly prepare snacks and tea. Few families use LPG and none use electric stoves. This is concurrent with the latest survey conducted at the national and state level, where more than 77.6% of rural household use fuel wood for household energy need at national level, 80.6% at the state level of Andhra Pradesh (NSSO, 2010)[33].

All the surveyed households reported dependence on fuel wood or woody biomass for cooking. Few households (0.77%) used crop residue as fuel wood seasonally. Forests are the dominant source of fuel wood. About 33% and 36% of the households depend exclusively on the biomass from forests and wastelands respectively. The rest of the households collect fuel wood from forests, wastelands and tank bunds in the vicinity of the village. The rocky hills have scant vegetation, which are predominantly scrub forests. None of the household reported using dung cakes or coal as a source of fuel. All households reported to be using kerosene supplied through the public distribution system to kindle the fire. Most households used the fuel for lighting purposes. About 2 litres are provided through public distribution system every month. It is drudgery for the women to collect fuel wood, process and cook. Households on an average travel nearly 3.5 kms/trip for collecting fuel wood and nearly 4¾ hours for daily cooking. Two persons from each house spend 5 to 5½ hours collecting fuel wood per trip. On an average, each household spend 2-3 days/week to collect fuel wood. Nearly 13 headloads were collected per month per family for their requirement. Thus considerable time is spent on collection of fuel wood. Further, respondents were asked if it takes more time to collect fuel wood today than it had taken to collect the equivalent amount 20 years ago. All replied that it takes more time today due to a greater scarcity of fire wood. Respondents were also asked to recall the price of a headload of firewood in 1988 and the cost of the same today. The answers show that the cost of firewood today is much more than that in 1988. This price rise is far greater than what can be attributed to inflation alone and supports the idea that the price has risen due to the increasing scarcity of available firewood to local communities. The average fuel wood price has increased from Rs. 12.00 to Rs 100.00 for 10 kgs for woody biomass from the past 13 years. This is further substantiated by the NSSO survey conducted biannually at the national level. Yearly consumer expenditure survey among Indian households is carried out by the National Sample Survey Organisation (NSSO) for rural areas at the state level. There is an increase in price beyond the yearly inflation rate, indicating scarcity of biomass as explained in the section B.4.

The fuel wood survey was conducted for 7 days in 228 households in the project area during December, which shows that the average per capita fuel wood use is 3.58±0.73 kg/capita/day. The households responded that fuel wood was used for cooking and heating water during all the seasons of the year. The per capita consumption at lower bound of 95:5 confidence/precision level is 3.48 kg/capita/day. Thus a per capita consumption of 3.48 kg/capita/day is considered for emission reduction calculations in the project area.

The adult equivalent per family in the project area is 3.13. Thus the annual consumption of biomass per family or per appliance is 3.48 kg/capita/day x 365 days x 3.13 adult equivalent/family = **3975 kg/appliance/yr or 3.97 t/appliance/yr**.

4.3. Average number of animals

[33] NSSO 2010. National Sample Survey Organization, Household Consumer Expenditure in India, Ministry of Statistics and Programme Implementation, Government of India. (Page no A-39)

The survey from demographic survey from 5550 families reveal that the various animal type in the project area are i. Dairy Cow ii. Buffaloes and iii. Other cattle such as bulls, bullocks and native cows. Though each family also have large livestock's of sheep, goat and pigs, they have not being included. Thus the average animal type per family at 95/5 confidence precision level is as follows:

Parameter	Value	Source of Data
Dairy Cow	1.93	Demographic Survey
Buffaloes	0.07	
Cattle	0.37	

From the above table it is evident that for $2m^3$ capacity biogas plant the cattle population per family size of four to five is sufficient for cooking and heating needs of the family.[34] In the baseline, most of the manure in the project area is managed aerobically and hence not accounted for methane emission reduction.

Appendix 4. Further background information on ex ante calculation of emission reductions

The information for calculations of ex-ante calculations of emission reductions are provided in Section B.4.

Appendix 5. Further background information on monitoring plan

It is provided in Section 7.

Appendix 6. Summary of post registration changes

The post registration changes to the PDD is a permanent change to the Project Design and the change to the registered CDM Project activity is addition of more sites to the project activity.

The project activity will be in all the Mandals of Chittoor District, which was earlier only for 4 Mandals of Chittoor District.

This change is submitted as a combine request for approval with request for issuance of CERs. This is as per para (6) of the appendix 1 of CDM PS, version 09 , the changes do not adversely impact any of the following:

1. The applicability and application of the applied methodologies and, where applicable, the applied standardized baselines with which the project activity has been registered;
    - The project activity has been registered under AMS.I.E. Version 4. The changes will not impact the applicability criteria of the project activity and hence the applicability and application of the applied methodology.
    - The project activity will continue to comprise of biogas units that displaces the use of non-renewable biomass by introducing new renewable end-user technology, the biogas stoves.

[34] Biogas Technology, B.T. Nijaguna, New Age International Publishers, New Delhi, 2002 (Page no 157)

- The proposed project activity will continue to save non-renewable biomass which is currently being used in the baseline by the beneficiaries.
- As shown in section B.4, the communities are using non-renewable biomass since 31st December 1989.
- The capacity of the project activity will remain below 45 MW_{th} and under the limits of small-scale project activity during every year of the crediting period as the number of units are the same.

2. The additionality of the project activity;
    - There are no changes to the additionality of the project activity, as it has been deliberated upon at the State/District level. In addition, there is no investment analysis and the barriers as discussed in section B.5 is still valid under the circumstances.
3. The scale of the project activity.

The scale of the project activity remain unaltered, as the number of biogas units will remain the same at 5,000 units.

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Document information

Version	*Date*	*Description*
08.0	22 July 2016	EB 90, Annex 2 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revisions to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Editorial improvement.

Version	*Date*	*Description*
05.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the project design document form for small-scale CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for small-scale CDM project activities" (Version 01.1)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from *F-CDM-SSC-PDD* to *CDM-SSC-PDD-FORM*; • Editorial improvement.
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	13 March 2012	EB 66, Annex 9 Revision required to ensure consistency with the “Guidelines for completing the project design document form for small-scale CDM project activities”
03.0	15 December 2006	EB 28, Annex 34 • The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.
02.0	08 July 2005	EB 20, Annex 14 • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
01.0	21 January 2003	EB 07, Annex 05 Initial adoption.

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