Project design document form

(Version 11.0)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Micro Scale Biogas CDM Project of CROSS
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	5.1
Completion date of the PDD	08/05/2021
Project participants	Community Reconstruction of Social Service (CROSS)
Host Party	India
Applied methodologies and standardized baselines	AMS.I.E. Switch from non-renewable biomass for thermal applications by the user, Version 11.0
Sectoral scopes	1. SECTORAL SCOPE - 01 Energy industries (Renewable/Non-Renewable Sources) 2. Conditional Sectoral Scope 13; Waste Handling and Disposal
Estimated amount of annual average GHG emission reductions	15,233 tCO_2

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

The project "Micro Scale CDM project of CROSS" is a registered CDM project activity. The details of the registered project are as follows:

UNFCCC Project Number:	8784
Registration date:	18th December 2012
Crediting Type:	Renewable
First Crediting Period:	01 Jan 14 - 31 Dec 20

Through the submission of this PDD, the project proponent intends to renew the crediting period in line with the Standard CDM project standard for project activities, Version 2, CDM-EB93-A04-STAN and the PDD has been accordingly updated.

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 is financed

[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)

completely from carbon revenues. After the project was registered as a CDM activity, carbon forward funding enabled the construction of domestic bio-digesters.The project was implemented in phases. An end user agreement was 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.

Hence the project replaces baseline emissions from use of traditional inefficient cook stoves that used non-renewable woody biomass by households for their thermal energy. The annual emission reductions from 5,000 project households are 15,233 tCO_2 and are 106,631 tCO_2 for the second crediting period of 7 years.

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

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

>>
Country: India.
District: Chittoor District
Mandals: All the Mandals of Chittoor district
State: Andhra Pradesh State.

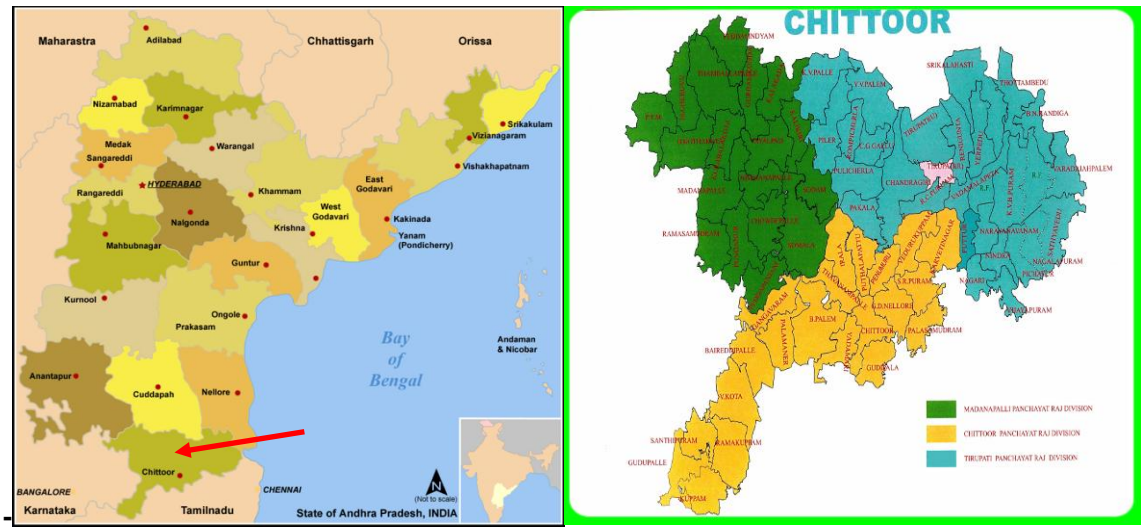


Fig 1: Map of Andhra Pradesh State showing Chittoor District and District Map showing all the Mandals where the project will be implemented

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].

A.3. Technologies/measures

>> 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 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.

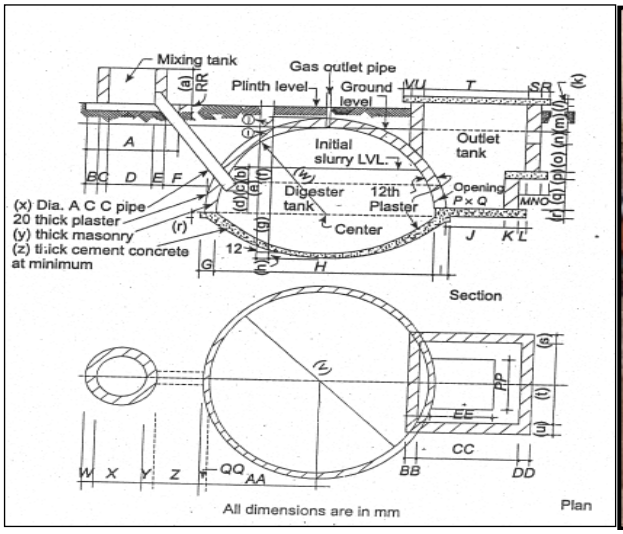
The technical specifications of the Deenabandhu model bio-digester are as follows[8]

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

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

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

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 is 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[9]. 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 supplies biogas to a 2-ring stove inside the house.



Plan of Deenabandhu Model Biogas Plant

Construction of Biogas Plant

Constructed Deenabandhu Biogas Unit

Biogas Stove used for Cooking

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

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)

[9] 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

India (host)	Private Entity - **Community Reconstruction of Social Service (CROSS)**	No

A.5. Public funding of project activity

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

A.6. History of project activity

>> This is to confirm that:

(a) The CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA);
(b) The CDM project activity is not a project activity that has been deregistered.

This is to further declare that the project activity was **not**:

(c) a CPA that has been excluded from a registered CDM PoA;
(d) a registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired exists in the same geographical location as the proposed CDM project activity.

The PP has provided a written statement to confirm the above.

A.7. Debundling

>> At the time of registration, 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, at the time of registration, 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.

At the time of registration, 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 methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

>> SECTORAL SCOPE - 01 Energy industries (Renewable/Non-renewable sources)
TYPE I - Renewable Energy Projects
CATEGORY- AMS. I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 11.0

B.2. Applicability of methodologies and standardized baselines

>>

Applicability Criteria	Applicability fulfilled by the Project Activity
2. This methodology comprises of activities to displace the use of non-renewable biomass by introducing renewable energy technologies to households, communities, and/or institutions such as schools, prisons or hospitals (hereinafter referred as end-users).	The project activity is biogas cook stoves for households and provides thermal energy from cattle dung that is renewable. It replaced the baseline technology mud/clay, three-stone traditional cook stove that used non-renewable biomass at the household level.
3. Project participants are able to show that non-renewable biomass has been used in the project region since 31 December 1989, using survey methods or referring to published literature, official reports or statistics.	Based on National Sample survey Report, Government of India, for 1983, in Andhra Pradesh, 92.01% of the households were using firewood or non-renewable biomass for cooking [10] . 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.
4. In the case that technologies using renewable biomass are used under the project activity, this methodology is applicable where all emissions related to processing of biomass are fully accounted for and biomass is sourced from biomass residues and/or a dedicated plantation of the CDM project activity, meeting the conditions specified in the methodology.	Not Applicable, The project activity does not use renewable biomass. The renewable source is cattle dung.
5. For electric cookstoves with integrated renewable energy device or with grid connected renewable energy system employing net metering, project participants shall demonstrate that, on an annual basis, at least 80% of the electricity generated is consumed by the electric cook stoves (i.e. 20% or less of electricity is consumed by other loads connected).	Not Applicable. The project activity is biogas cook stove and is not electric cook stoves.
6. For electric cook stoves, in all cases under	Not Applicable.

[10] NSSO, 1988. Report of source of drinking water and energy used for cooking and lighting. August 1988. Thirty Eighth Round. Number 336. Department of Statistics, Government of India, New Delhi, Table 3, Page 15. http://mospi.nic.in/sites/default/files/publication_reports/nss_report_336.pdf

paragraph 2(d) above where back-up diesel generators are used, this methodology is only applicable when no more than 1% of total electricity supply occurs from back up diesel generators on an annual basis.	The project activity is biogas cook stove and is not electric cook stoves.
7. Under this methodology, emission reductions cannot be claimed only due to fuel-switch aspect and proposed project activities shall introduce new renewable energy based technologies, i.e. technology switch is also involved.	There is a technology switch from traditional stove to biogas stove.
8. Project participants shall describe in the PDD/PoA-DD the proposed method for distribution of project devices and how the double counting of emission reductions has been addressed, for example, using methods such as unique identifications of product and end-user locations (e.g. programme logo), to prevent double counting of emission reductions from the project devices (e.g. between end users, distributors and producers of stoves, producers of renewable energy, producers of processed renewable biomass).	Each of the biogas unit is constructed by the PP close to the household. Each biogas unit has a unique ID, which is visible on the biogas unit. The Emission Reduction Calculations Sheet has the details of the end user's name and the location i.e. District, Mandal, village in which it is constructed along with the Unique ID. Also, the PP, CROSS, and end user has signed an end-user agreement that states that the end user transfers the emission reductions generated from the project activity to the PP, CROSS and is not transferable to any other entity preventing double counting.
9. For project activities introducing bio-ethanol cookstoves, project participants shall demonstrate that the bioethanol cookstoves are designed, constructed and operated to the requirements (e.g. with regard to safety) of a relevant national or local standard or comparable literature. Latest guidelines issued by a relevant national authority or an international organisation may also be used.	Not Applicable. The project activity is biogas cook stove and is not bio-ethanol cook stoves.

B.3. Project boundary, sources and greenhouse gases (GHGs)

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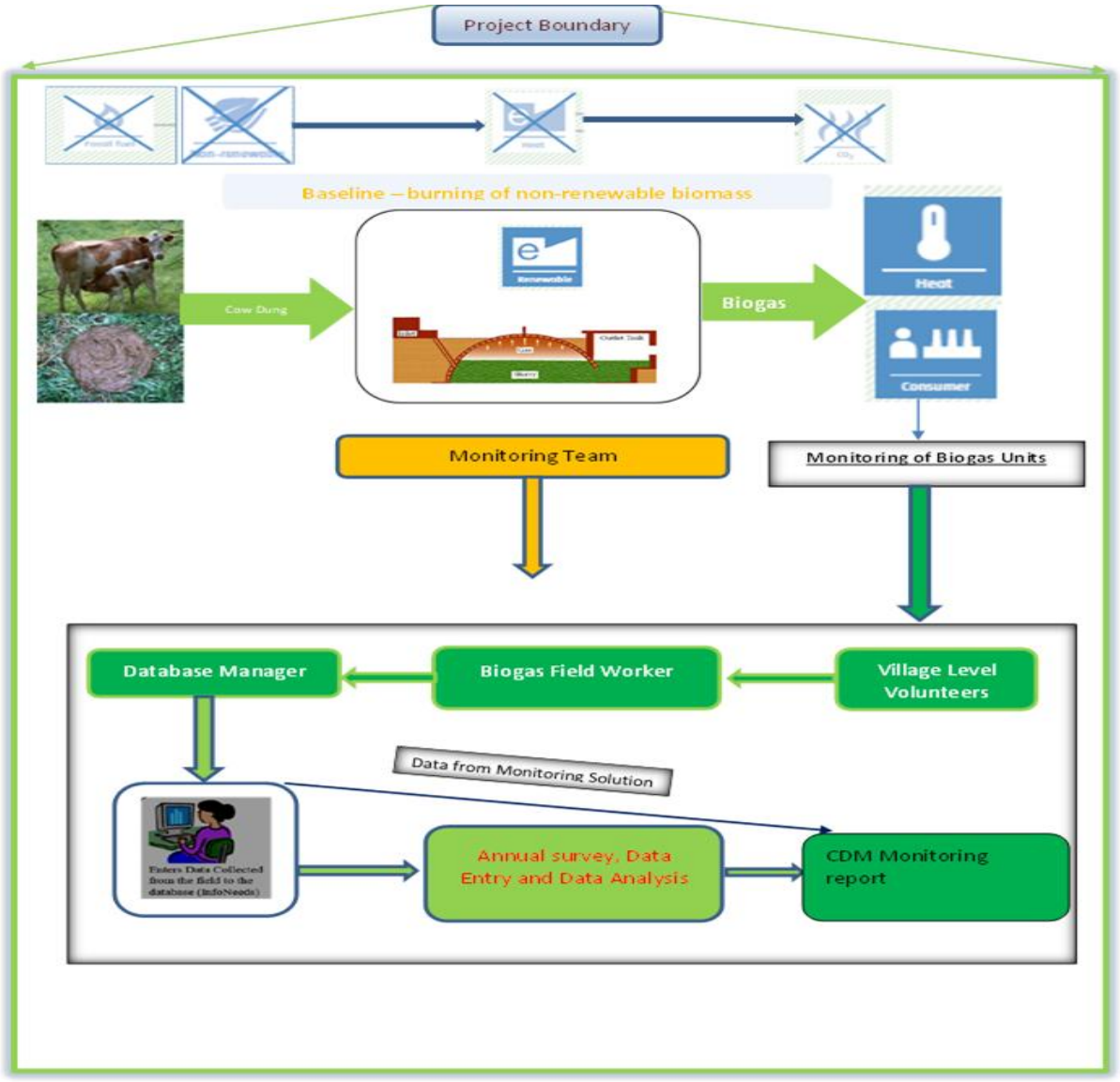
In accordance with Paragraph 16 of the chosen methodology, *The project boundary is the physical, geographic site of the use of biomass or the renewable energy.*

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:

	Source	GHG	Included?	Justification/Explanation
Baseline	Emissions from burning non-renewable wood	CO_2	Included	Major source of emission
		CH_4	Included	Included in the methodology as emission factor of fossil fuel mix
		N_2O	Included	Included in the methodology as emission factor of fossil fuel mix
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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According to the Standard CDM project standard for project activities, Version 2, (CDM-EB93-A04-STAN), the project participants has to demonstrate the validity of the original baseline or update it in accordance to the following (Paragraphs 283−286).

Para 283. To demonstrate the validity of the original baseline or its update, the project participants are not required to reassess the baseline scenario. Instead, the project participants shall assess the GHG emission reductions or net anthropogenic GHG removals that would have resulted from that scenario.

The baseline scenario is not assessed. The GHG emission reductions are reassessed that would have resulted from the scenario.

Para 284. The project participants shall assess and incorporate the impact of national and/or sectoral policies and circumstances, existing at the time of requesting renewal of crediting period, on the current baseline GHG emissions, without reassessing the baseline scenario.

This is also the Step 1.1 of the methodological Tool to assess the validity of the original/current baseline and update of the baseline at the renewal of the crediting period:

There are no relevant national and/or sectoral policies and circumstances ever since the project was registered that have an impact on the baseline. The Ministry has been supporting programmes for the deployment of renewable energy systems and devices such as biogas plants, in rural areas of the country[11]. But the implementation of biogas is still very low. The baseline scenario remains unchanged and is the same as that determined during the start of the project activity.

According to step 1.2 of the tool, *Assess the impact of circumstances*

The baseline scenario identified at the validation of the project activity was thermal energy from fuel wood, of which a large part of it was non-renewable for domestic cooking and water heating. Thus, this project activity was a voluntary investment which replaced equivalent amount of thermal energy from renewable source, the biogas. The project proponent was not bound to incur this investment as it was not mandatory by national and sectoral policies. Thus, the continued operation of the project activity would continue to replace thermal energy from fuel wood, hence the same baseline as identified in the previous crediting period is still valid for the project. Therefore, the assessment of the changes in market characteristics is not required for the renewal of the project's crediting period under CDM.

Step 1.3. Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

The target population are the rural households of Chittoor District. The rural households are primarily dependent on fuel wood for cooking and heating water. According to NSS Report, in India, 44.5% of households still use firewood for cooking, and in Andhra Pradesh, State, 18.4% of rural households still predominantly only use fuelwood for cooking[12]. Based on a national family health survey for Chittoor District, 2015-16, which is the project region, households using clean fuel for cooking accounts for only 47%, thus making 53% of households in rural areas still using solid fuels for cooking[13]. Based on a study conducted in Chittoor, though LPG is promoted by the Government under the Deepam Scheme, easy access to firewood without additional costs significantly contributes to continued use of firewood for cook ing. Fuel usage correlates with income levels and lower income households tend to use more fuelwood as cost is still a barrier for

[11] https://www.bioenergyconsult.com/biogas-india/

[12] http://mospi.nic.in/sites/default/files/publication_reports/Report_584_final_0.pdf, Page 47 and page 165.

[13] National Family Health Survey – 4, 2015-16. District fact sheet, Chittoor, Andhra Pradesh. International Institute of Population Sciences, Mumbai. http://rchiips.org/nfhs/FCTS/AP/AP_FactSheet_554_Chittoor.pdf.

use of LPG in rural areas[14]. Based on a survey conducted during November 2021 in Chittoor in the project region, 35% of the surveyed household were using LPG, but all the households were still using fuelwood as the dominant fuel for cooking and heating water for bath on inefficient mud/clay wood stoves that do not have chimney and grate and hence has an efficiency of 10% according to the methodology. Majority of the firewood users believed that cooking with this fuel improved their financial wellbeing because selling firewood generated income, whilst collecting the fuel gave them an opportunity to socialise and is a tradition they would like to continue[15]. They viewed LPG as a financial burden that gave food an undesirable taste and feared a fatal canister explosion.[16] This shows that though LPG has been provided with subsidy to the rural communities, the refill is very expensive and rural households are still using traditional stove for cooking. Result of a study in Chittoor, Andhra Pradesh shows that disparities in LPG adoption owing to affordability, accessibility, and awareness. Easy availability of biomass, affordability and concerns of safety issues deter households from adopting LPG and continue using fuelwood[17]. 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 has been replaced with biogas, a renewable source of thermal energy through this CDM project activity.

Hence, the new circumstances do not have an impact on the baseline emission. The conditions used to determine the baseline emissions in the previous crediting period are still valid even now. 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) at household level. Thus, the GHG emissions under the baseline condition comprise CO_2 emissions from the use of non-renewable biomass for thermal energy.

285. The requirements contained in paragraph 284 above are not applicable to a registered CDM project activity applying the valid version of an applicable approved standardized baseline that standardizes baseline scenario in accordance with paragraph 281 above.

Not Applicable

286. If data and parameters used for determining the original baseline, that were determined ex ante and not monitored during the crediting period, are no longer valid, the project participants shall update such data and parameters in accordance with the "Methodological tool: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".

Based on Step 1.4 of the Tool, Assessment of the validity of the data and parameters

The data and parameters that were determined at the start of the crediting period and not monitored during the crediting period were updated during this crediting period.

Step 2: Update the current baseline and the data and parameters

[14] Smitha Rao, Sanjeev Dahal, Sophia Hadingham and Praveen Kumar. Dissemination Challenges of Liquefied Petroleum Gas in Rural India: Perspectives from the Field. Sustainability 2020, 12, 2327. https://www.mdpi.com/2071-1050/12/6/2327/pdf

[15] https://www.sciencedaily.com/releases/2020/11/201109120642.htm

[16] https://www.sciencedaily.com/releases/2020/11/201109120642.htm

[17] Praveen Kumar, Robert Ethan Dover, Antonia Díaz-Valdés Iriarte, Smitha Rao, Romina Garakani, Sophia Hadingham, Amar Dhand, Rachel G. Tabak, Ross C. Brownson and Gautam N. Yadama. Affordability, Accessibility, and Awareness in the Adoption of Liquefied Petroleum Gas: A Case-Control Study in Rural India. Sustainability 2020, 12, 4790; https://www.mdpi.com/2071-1050/12/11/4790/pdf

As per step 1.4, the data and parameters that were determined at the start of the crediting period and not monitored during the crediting period is updated.

Step 2.1 Update the current baseline

Based on this step, the baseline emissions for the 2nd crediting period is updated without reassessing the baseline scenario based on the latest approved methodology applicable to the project activity.

The data and parameters that were determined ex-ante and updated are as follows:

The data and parameters that were determined ex-ante and updated are as follows:

$BC_{BL,HH,y}$	=	Quantity of woody biomass that is substituted or displaced in year y (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 (fraction or %)
$NCV_{biomass}$	=	Net calorific value of the non-renewable woody biomass that is substituted
$EF_{projected\_fossil\,fuel}$	=	Emission factor of fossil fuels projected to substitute non-renewable woody biomass by similar consumers tCO_{2e}/TJ).

$NCV_{biomass}$ - 0.0156 TJ/tonne as given by AMS I.E. methodology, Version 11.

$EF_{projected\_fossilfuel}$ – The default regional value given for South Asia in Table 2 of AMS I.E. methodology is considered for the project activity, which is in India. Accordingly, the value is 64.4 tCO_{2e}/TJ.

Determining B_y

A household level questionnaire survey and kitchen test was conducted in November 2020 for the renewal of the crediting period in the project region. Based on the survey conducted during validation, and the mean and standard deviation of fuelwood use for the project region, the sample size was calculated using the equation as shown below. At a mean of 3.58 kg/capita/day and standard deviation of 0.73, the sample size at 90/10 confidence/precision level and @80% response rate for infinite sample population it is 14 households.

$$n = \frac{1.645^2 V}{0.1^2}; where\ V = \left(\frac{SD}{mean}\right)^2$$

	Value
Mean (kg/capita/yr)	3.58
Standard Deviation	0.73
V	0.04158
N	11
@80% response rate	14

The fuelwood use in the baseline was determined by conducting a Kitchen Test in Novermber 2020 to estimate the fuelwood use. Kitchen test was done in 155 non-project households for 3 days to assess the fuel wood use at household level. A total of 155 households were interviewed and kitchen test conducted for the following households:

Taluk	Village	Total
G.D.Nellore	Etteri HW	12
	Etteri Village	5
	Mukklathur HW	24
	N.Venkatapuram	1
Karvetnagaram	Gangamambapuram	24
Narayanavanam	Kailasakona	6
	Srinivasa ST colony	27
Nindra	Vedanthapuram	32
S.R.Puram	Mangunta AAW	15
	Mangunta HW	5
	Mangunta ST Colony	4
Grand Total		**155**

Weighted amount of fuelwood was given to the households from which they used it for cooking and other activities. These are non-project households who are using traditional cook stove and other fuels. The start and end weight was taken for each day to assess the fuelwood used per day. A mean of the value is considered as the baseline fuelwood use in the project area. The per capita fuelwood use per day was determined. In addition the household size was also determined from the survey. The results of the study are as follows:

	HH Size	Average fuelwood use (kg/capita/day)
Mean	5.65	2.695
Standard Deviation	1.72	1.155
Count	155	155
Standard error of mean	0.138	0.093
Confidence level (90%)	0.23	0.15
Reliability	4.02%	5.66%

Based on the study conducted, the fuelwood use is 2.695 kg/capita/day and the household size is 5.65 persons and is within 90/10 confidence/precision level. The family size of households in which the project is implemented (3095 HHs), is 3.77, while based on the district statistics for Chittoor, 2016, the family size is rural area is 4[18]. To adopt a conservative approach, 3.77 is considered for the estimation of B_y and emission reduction calculations. Accordingly the fuelwood use is 2.695 kg/capita/day x 3.77 household size x 365 days = 3.71 t/household/year. This is a conservative value compared to 3.97 considered during the first crediting period.

The value considered is 3.71 t/household/yr. This is fixed ex-ante, as the project is for rural households.

Determining Non-renewable biomass (f_{NRB})

The value of f_{NRB} is calculated using the *ex-ante* option as follows:

Ex ante: the f_{NRB} value is determined once at the validation stage, thus no monitoring and recalculation of the f_{NRB} value during the crediting period is required;

[18] Handbook of Statistics, Chittoor District, 2016. Page XI.

http://14.139.60.153/bitstream/123456789/13007/1/Handbook%20of%20Statistics%202016%20Chittoor%20District%20Andhra%20Pradesh.pdf

The f_{NRB} is calculated based on CDM TOOL30, Methodological Tool for calculation of the fraction of non-renewable biomass. Version 3. The fraction of woody biomass that can be established as non-renewable is

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

Where
f_{NRB} = Fraction of non-renewable biomass in the country/region or project area
NRB = Quantity of non-renewable biomass (t/yr) in the country/region or project area
RB = Quantity of renewable biomass in the country/region or project area

The data/parameter to assess f_{NRB} and the calculations to determine f_{NRB} is as given in Appendix 3:

The f_{NRB} considered for Andhra Pradesh is 0.86.

Hence the fraction of non-renewable woody biomass used in the absence of the project activity considered for the project is 0.86.

The updated data and parameters to determine Emission Reduction Calculations during this first renewal is as follows:

Paramter	Value	Source
$BC_{BL,HH,y}$ (t)	3.71	Based on sample survey in the project area
$f_{NRB,y}$	0.86	Calculated based on Tool 30, Version 3.
$NCV_{biomass}$ (TJ/tonne)	0.0156	I.E. Methodology, Version 11
$EF_{projected\_fossil\ fuel}$(t CO_{2e}/TJ)	64.4	I.E. Methodology, Version 11

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[22]. Based on the FSI, 1989 (Fig 4)[23], 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.

[22] 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)

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

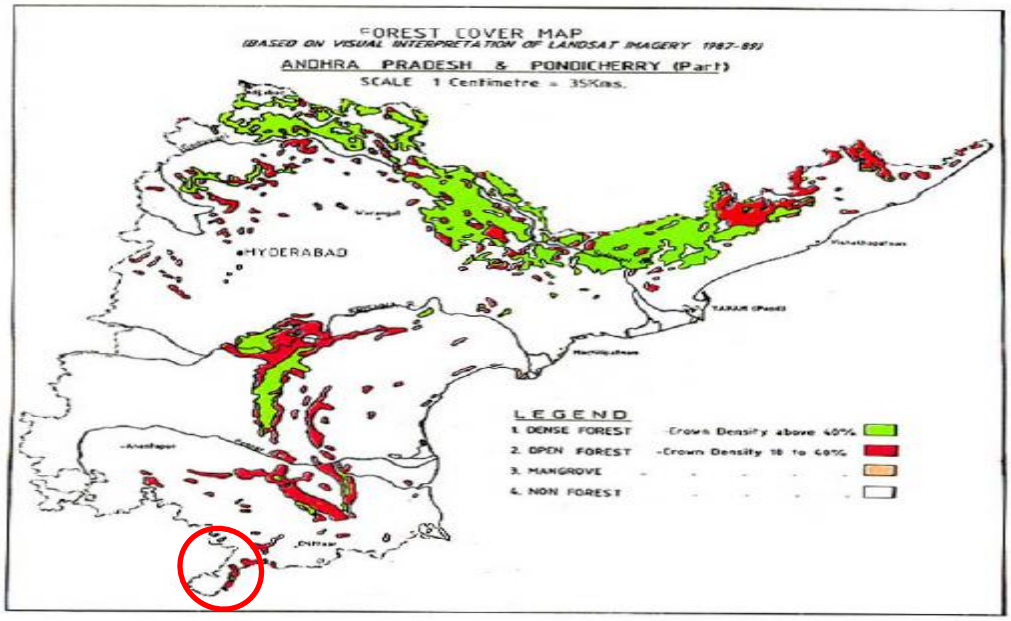

Figure 4: Forest Map of Andhra Pradesh for 1989 showing the project area.

Thus non-renewable biomass is being used since 1989.

According to para 31-35, the loss in efficiency of the project device type due to ageing shall be accounted for during the monitoring period. Biogas stoves do not change in thermal efficiency due to ageing as the efficiency the biogas burner is designed to provide good mixing of air and fuel, increase the volumetric heat release rate, combustion efficiency and heat transfer efficiency[24]. Also, burner efficiency is a strong function of biogas flow pressure, pan-size and its position over the burner head. The efficiency is adjusted by the knob of the stove by regulating the air supply. Hence the loss of efficiency of the project device is not accounted.

B.5. Demonstration of additionality

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According to the Standard CDM project standard for project activities, Version 2, (CDM-EB93-A04-STAN) Para 280, for renewal of crediting period of a registered CDM project activity, the project participants are not required to reassess the additionality of the project activity nor update the section of the PDD relating to additionality. Hence the additionality demonstration provided during the registration of the project is retained as is below.

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:

[24] Biogas Technology. By B.T. Nijaguna. New Age International Private Limited Publishers. 2002.

(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}[25]. 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.

- → 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.

[25] 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.

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. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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Baseline emissions

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.

Baseline emissions are calculated as:

$$BE_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected\_fossil\_fuel}$$ Equation (1)

Where:

BE_y = Baseline emissions in the year *y* (tCO_2e)

B_y = Quantity of woody biomass that is substituted or displaced in year *y* (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 (fraction or %)

$NCV_{biomass}$ = Net calorific value of the non-renewable woody biomass that is substituted (TJ/tonne)

$EF_{projected\_fossil\ fuel}$ = Emission factor of fossil fuels projected to substitute non-renewable woody biomass by similar consumers (tCO_2e/TJ).

According to Para 29, B_y is determined by following option (a) as follows:

Calculated as the product of the number of households using cookstoves distributed under the project activity multiplied by the estimate of average annual consumption of woody biomass per household that is displaced by the project activity:

$$B_y = N_{HH,y} \times (BC_{BL,HH,} - BC_{PJ,HH,y})$$ Equation (3)

Where:

$N_{HH,y}$ = Number of households with functional cookstoves distributed under the project activity in year *y* (number)

$BC_{BL,HH,}$ = Average annual consumption of woody biomass per household before the start of the project activity or at the renewal of each crediting period, whichever is later (tonnes/household/year)

$BC_{PJ,HH,y}$ = Average annual consumption of woody biomass per household in the pre-project devices during the project activity (tonnes/household/year). This parameter shall be considered if it is found that pre-project devices were not completely displaced but continue to be used to some extent

Project emissions

According to Para 36 of the methodology, if the project cook stoves use biomass, the sources of project emissions as detailed in Para 36 (a), i, ii, iii and iv and 36 (b) has to be considered as applicable, bearing in mind that some sources may be only relevant for specific fuels (e.g. production of bioethanol):

- Project Emissions is not applicable as the cook stoves do not use biomass.

According to Para 37 of the methodology, in case of electric cook stoves, if back up diesel generators are used in compliance with paragraph **Error! Reference source not found.***, project emissions due to use of diesel shall be accounted for, using the latest version of "TOOL03: Tool to calculate project or leakage CO2 emissions from fossil fuel combustion".*

- Project Emissions is not applicable as the project cook stoves are not electric stoves.

Leakage emissions

If the cookstoves distributed under the project activity involve the use of biomass, leakage emissions (LE_y) shall be calculated using the latest version of "TOOL16: Project and leakage emissions from biomass", including leakage emissions due to production of processed renewable biomass and bioethanol (e.g. CO_2 emissions due to consumption of fossi fuels and electricity).

- Leakage Emissions is not applicable as the project cook stoves do not use biomass.

Leakage emissions 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: the use/diversion of non-renewable woody biomass saved under the project activity by non-project end-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 end-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.

- B_y will be multiplied by a net to gross adjustment factor of 0.95 to account for leakages. Hence survey will not be conducted to assess leakage related to non-renewable woody biomass saved by the project activity.

Project activities switching from baseline device using woody biomass to efficient project device using charcoal or switching from woody biomass to processed renewable biomass (briquette, pellets, and woodchips), shall take into account the leakage effects related to the charcoal or processed biomass production.

- Leakage Emissions is not applicable as the project cook stoves are not switching to charcoal or processed renewable biomass.

1.1. Emission reductions

Emission reductions are to be estimated based on the equation below.

$$ER_y = BE_y - PE_y - LE_y$$ Equation (11)

Where:

ER_y = Emission reductions in year y, tonnes CO_2eq

B.6.2. Data and parameters fixed ex ante

Data/Parameter	**Rating Biogas**
Data 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	$BC_{BL,HH,y}$
Data unit	Tonnes /household/year
Description	Average annual consumption of woody biomass per household before the start of the project activity
Source of data	Survey and Kitchen test conducted in the project area
Value(s) applied	3.71 tonnes/year/family
Choice of data or measurement methods and procedures	Based on survey conducted during the renewal of crediting period to estimate the average annual consumption of woody biomass. The average annual consumption of biomass is 2.695 kg/capita/day. The adult equivalent per family in the project area is considered as 3.77 based on the household size of all the 3095 households in which the project is implemented. By = 2.695 kg/capita/day x 365 days x 3.77/family = **3.71 t/family/yr**.
Purpose of data	Estimation of Baseline Emissions
Additional comment	This parameter is fixed for the entire crediting period

Data/Parameter	$f_{NRB, y}$
Data 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	Calculated based on following sources of data: 1. State of Forest Report, Forest Survey of India, 2019. 2. Kaul, M., Mohren, G.M.J., and Dadhwal, V.K.,Phytomass carbon pool of trees and forests in India, Climatic Change, DOI 10.1007/s10584-010-9986-3, 2011 3. Wood is Good, Is India doing enough to meet its present and future needs? A status report by Centre for Science and Environment, CSE, 2017. 4. FAO database of round wood consumption.
Value(s) applied	0.86
Choice of data or measurement methods and procedures	As per "TOOL30: Calculation of the fraction of non-renewable biomass, Version 3"
Purpose of data	Estimation of Baseline Emissions
Additional comment	This parameter is fixed for the entire crediting period

Data/Parameter	$NCV_{biomass}$
Data unit	TJ/tonne
Description	Net Calorific Value of non-renewable woody Biomass
Source of data	AMS_I.E., Version 11 methodology
Value(s) applied	0.0156
Choice of data or measurement methods and procedures	The baseline fuel replaced is only woody biomass. IPCC default for wood fuel, 0.0156 TJ/tonne, based on the gross weight of the wood that is 'air-dried' may be used if fuel used in project device is also woody biomass given in methodology
Purpose of data	Estimation of Baseline Emissions
Additional comment	This parameter is fixed for the entire crediting period

Data/Parameter	$EF_{projected\_fossilfuel}$
Data unit	tCO_2/TJ
Description	Emission Factor for the substitution of non-renewable woody biomass by similar consumers.
Source of data	AMS-I.E., Version 11 methodology
Value(s) applied	64.4
Choice of data or measurement methods and procedures	AMS I.E. Methodology, Version 11.
Purpose of data	Estimation of Baseline Emissions
Additional comment	This parameter is fixed for the entire crediting period

Data/Parameter	Determination of Leakage
Data unit	t/HH/yr
Description	woody biomass
Source of data	AMS I.E. Methodology
Value(s) applied	0.19 for household fuelwood use of 3.71 t/HH/Yr. Based on the fuelwood use determined ex-post ($BC_{BL,HH,y,}$-$BC_{PY,HH,y}$) leakage will be determined by net to gross adjustment factor of 0.95 to account for leakage.
Choice of data or measurement methods and procedures	By is multiplied by a net to gross adjustment factor of 0.95 to account for leakages
Purpose of data	Leakage
Additional comment	Surveys will not be required to determine leakage.

B.6.3. Ex ante calculation of emission reductions

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$$BE_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected\_fossil\_fuel}$$

Without Leakage			
Data	**Value**	**Description**	**Source**
BE_y	**16,035.24**	Baseline emissions during the year *y* in t CO_2e	Calculated
B_y	18,559.52	Quantity of woody biomass that is substituted or displaced in tonnes	Based on survey value of per capita value and conservative HH size (3.71 t/HH/yr)
$f_{NRB,y}$	0.86	Fraction of woody biomass used in the absence of the project activity in year y that can be established as non-renewable biomass (fNRB)	Calculated
$NCV_{biomass}$	0.0156	Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.0156 TJ/tonne)	Methodology
$EF_{projected\_fossil\ fuel}$	64.4	Emission factor for the substitution of non-renewable woody biomass by similar consumers.	Methodology (value for South Asia)

$$B_y = N_{HH} \times (BC_{BL,HH,y} - BC_{PJ,HH,y})$$

By	18,559.52	Quantity of woody biomass that is substituted or displaced in tonnes	Calculated
N_{HH}	5000	Number of households in the project activity, number	PDD
$BC_{BL,HH,y}$	3.71	Average annual consumption of woody biomass per household before the start of the project activity, tonnes/household/year	Based on survey value of per capita value and conservative HH size (3.71 t/HH/yr)
$BC_{PJ,HH,y}$	0	If it is found that pre-project devices were not completely displaced but continue to be used to some extent, average annual consumption of	Assumed as zero for ex-ante calculations; For ex-post calculations, will be based on surveys

		woody biomass per household in the pre-project devices during the project activity, tonnes/household/year	conducted in the project area

After considering Leakage			
Activity Data	Value	Description	Source
BEy	15,233.48	Baseline emissions during the year *y* in t CO_2e	Calculated
B_y	17,631.54	Quantity of woody biomass that is substituted or displaced in tonnes	Based on survey and third party study
$f_{NRB,y}$	0.86	Fraction of woody biomass used in the absence of the project activity in year y that can be established as non-renewable biomass (fNRB)	Calculated
$NCV_{biomass}$	0.0156	Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.0156 TJ/tonne)	Methodology
$EF_{projected\_fossil\ fuel}$	64.4	Emission factor for the substitution of non-renewable woody biomass by similar consumers.	Methodology (value for South Asia)

By	17631.54	Quantity of woody biomass that is substituted or displaced in tonnes	Calculated
N_{HH}	5000	Number of households in the project activity, number	PDD
$BC_{BL,HH,y}$	3.71	Average annual consumption of woody biomass per household before the start of the project activity, tonnes/household/year	Based on survey and third party study
$BC_{PJ,HH,y}$	0	If it is found that pre-project devices were not completely displaced but continue to be used to some extent, average annual consumption of woody biomass per household in the pre-project devices during the project activity, tonnes/household/year	Assumed as zero for ex-ante calculations; For ex-post calculations, will be based on surveys conducted in the project area

PEy	0	Project Emissions	

LEy	801.75	Leakage as tCO_2 due to reduction of By by 5%	Calculated as (BE_y-$BE_{y,with\ leakage}$)

BEy	**16,035**	Baseline emissions during the year *y* in t CO_2e
PEy	**-**	Project emissions during the year *y* in t CO_2e
LEy	**802**	Emissions due to leakage during the year *y* in t CO_2e
ERy	**15,233**	Emission Reduction during the year *y* in t CO_2e for 5,000 households

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)
2021 (From 1st Jan 2021)	16,035	0	802	15,233
2022	16,035	0	802	15,233
2023	16,035	0	802	15,233
2024	16,035	0	802	15,233
2025	16,035	0	802	15,233
2026	16,035	0	802	15,233
2027	16,035	0	802	15,233
Total	**112,245**	**0**	**5,614**	**106,631**
Total number of crediting years				7
Annual average over the crediting period	**16,035**	**0**	**802**	**15,233**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	Date of commissioning of biogas units
Data unit	Date
Description	Actual date of commissioning of the project device.
Source of data	Monitoring Solution
Value(s) applied	As and when commissioned
Measurement methods and procedures	The construction processes were monitored on a day to day basis and database maintained from its initiation to completion dates for each of the biogas unit. Thus the start date of each of the unit installed recorded on the online monitoring solution.
Monitoring frequency	As and when commissioned and fixed and recorded in the monitoring solution
QA/QC procedures	This can be triangulated with the End User Agreement.
Purpose of data	To estimate baseline emissions.
Additional comment	The date of commissioning is reported during verification in the ER calculations sheet.

Data/Parameter	N_{HH}
Data unit	Number
Description	Number of households in the project activity in year y
Source of data	Monitored on a daily basis and entered into the monitoring database.
Value(s) applied	5,000
Measurement methods and procedures	The construction processes are monitored on a day to day basis and database maintained from its initiation to completion dates for each of the biogas unit. Thus the start date of each of the unit installed is fixed for each of the unit. In case of replacement of any unit due to demolition will be recorded and the loss days accounted for. This could be for the same user or new users, in which case the baseline is the users were using fuel wood. A new end user agreement will signed with them and recorded.
Monitoring frequency	As and when the unit is commissioned and updated into the monitoring solution

QA/QC procedures	All activity processes, including financial transactions for construction of biogas units, are digitally monitored using the online monitoring solution. This provides verification for the construction of biogas units. All data will be archived and stored throughout the crediting period and an additional 2 years.
Purpose of data	Baseline Emissions
Additional comment	ERs are calculated for only the installed and operational biogas units.

Data/Parameter	**Number of biogas plants operating**
Data unit	Number
Description	Number of plants operating in year
Source of data	Log books maintained and entered in the digitized monitoring database for biogas units operating
Value(s) applied	5,000
Measurement methods and procedures	In every village, the women Volunteer monitors the biogas units that are non-operational. The days other than that non-operational will determine the biogas units which are operational. For the monitoring period, the 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	The data of non-operational units are done on a regular basis as and when a unit is dysfunctional. As and when biogas units are not operational, it is recorded. The remaining days are considered operational.
QA/QC procedures	Log books and digitized database will be checked regularly by project staff and CDM coordinator.
Purpose of data	Baseline Emissions
Additional comment	All data will be archived and stored throughout the crediting period and an additional 2 years. This is to ensure that the units are repaired and provide sustainable thermal energy to the end user.

Data/Parameter	$BC_{PJ,HH,y}$
Data unit	tonnes/household/year
Description	Average annual consumption of woody biomass per household in the pre-project devices during the project activity, if it is found that pre-project devices were not completely displaced but continue to be used to some extent
Source of data	1. 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. 2. Surveys for parallel use of traditional stoves.
Value(s) applied	0 for ex-ante calculations
Measurement methods and procedures	1. As and when biogas units are not functional, the beneficiaries report to the village level women volunteer, who in turn reports to the Case Worker of the project for the repair of the unit. A log book is maintained for the reason of non-function and days under repair. The data is entered into the monitoring solution for each of the unit. The appropriate fuelwood use for non-operational days of biogas units will be accounted. 2. For parallel use of pre-project devices, monitoring shall consist of estimation of a representative sample thereof, at least once every two years (biennial). A statistically determined sample size will be sampled to determine the quantity of fuelwood used on pre project devices. A household level questionnaire survey will be conducted.
Monitoring frequency	1. It will be monitored on a day to day basis by the Village level volunteers, which is then entered into the monitoring solution for all the biogas units. 2. At least once every two years (biennial)

QA/QC procedures	The two pronged approach to determine the data/parameter will result in emission reduction calculations that are based on real time data and have less uncertainty.
Purpose of data	Baseline Emissions
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**
Data unit	-
Description	Confirmation that non-renewable biomass has been substituted
Source of data	Sample survey
Value(s) applied	100% of non-renewable biomass is replaced
Measurement methods and procedures	A household level sample survey will be conducted to confirm that non-renewable biomass has been substituted.
Monitoring frequency	At least once every two years (biennial) simple random Sample Survey
QA/QC procedures	This survey will be done for a statistically determined number of households at 95/10 precision confidence level.
Purpose of data	Confirmation of replacement of non-renewable biomass
Additional comment	

B.7.2. Sampling plan

>>

The parameters that need to be monitored through sample surveys are:

(i) Confirmation that non-renewable biomass has been substituted
(ii) Average annual consumption of woody biomass per household in the pre-project devices during the project activity, used in parallel.

In consideration of occupancy and demographics of the location there is no difference among the households. The socio-economic and cooking patterns of households are similar. All the households are from rural region of Chittoor District. Simple random sample will be conducted to determine the parameter of interest. As a biennial inspection is chosen a 95 per cent confidence interval and a 10 per cent margin of error requirement will be achieved for the sampling parameter. In cases where survey results indicate that 95/10 precision is not achieved, the lower bound of a 95 per cent confidence interval of the parameter value will be chosen as an alternative to repeating the survey efforts to achieve the 95/10 precision.

The sampling plan to monitor the parameters is described here based on “Guidelines for sampling and surveys for CDM project activities and programme of activities, Version 4”, which details information relating to: (a) sampling design; (b) data that will be collected; and (c) implementation plan.

(a) Sampling Design

(i) Objectives:

The objective of the sampling effort is to

(i) Confirmation that non-renewable biomass has been substituted
(ii) Average annual consumption of woody biomass per household in the pre-project devices during the project activity, used in parallel.

The sampling frequency will be once in every two years (biennial).

As a biennial inspection is chosen a 95 per cent confidence interval and a 10 per cent margin of error requirement will be achieved for the sampling parameter.

The population is homogeneous in terms of cooking patterns and socio-economic strata. The biogas units implemented in the region is also of single type – 2 cum deenabhandu model. Hence simple random sample will be conducted for the project activity.

(ii) Target Population: The target population is the rural households for which biogas was constructed and operational in the Mandals of Chittoor District, Andhra Pradesh, India.

(iii) Sampling Method: The sampling method chosen for the project area will be simple random sampling. Households with operational units will be the population from which the sampling will be randomly selected.

(iv) Sample Size:

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. A pilot study will be conducted based on which, the sample size will be assessed. Subsequently, the value of the previous survey will be considered.

The largest of sample size for the 2 parameters of interest will be considered to gather information.

i) The sample size will be determined for "Confirmation that non-renewable biomass has been substituted" as follows:

$$n \geq \frac{1.96^2 N \times p(p-1)}{(N-1) \times 0.1^2 \times p^2 + 1.96^2\, p(p-1)}$$

Where

n	=	sample size
N	=	Total number of households
p	=	expected proportions
1.96	=	Represents the 95% confidence required
0.1	=	Represents the 10% relative precision

Checking Reliability

The reliability will be estimated as

The standard error of proportion is calculated as
$\sqrt{(1-f)\frac{pq}{n}}$,

Where p is the sample proportion and q = (1-p)

Precision associated with proportion is z-value x standard error of the proportion.

z-value is 1.96

The ratio of precision to the proportion gives the relative precision, which needs to be within 10%

ii) For the parameter Average annual consumption of woody biomass per household in the pre-project devices during the project activity, used in parallel, the sample size will be determined as follows:

$$n = \frac{1.96^2 NV}{(N-1) \times 0.1^2 + 1.96^2 V}$$

Where:

$$V = \left(\frac{SD}{mean}\right)^2$$

n	Sample size
N	Total number of households
Mean	*Expected mean*
SD	*Expected standard deviation*
1.96	Represents the 95% confidence required
0.1	Represents the 10% relative precision

Checking Reliability

The standard error of mean is calculated as
$\sqrt{(1-f)\frac{s^2}{n}}$,

where

f is the sampling fraction – the proportion of the population that is sampled,
s^2 is the sample variance (s is the sample standard deviation).

Precision associated with mean is t-value x standard error of the mean.

t value will be derived in Microsoft Excel using the TINV function. =TINV(0.10, (sample minus 1))

The ratio of precision to the mean gives the relative precision, which needs to be within 10%.

(***v) Sampling Frame:*** The sampling frame to be used is the complete listing of all the rural households for which biogas has been built and operational under the project activity in the Mandals of 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 variable to be recorded/measured on field is Confirmation that non-renewable biomass has been substituted and the average annual consumption of woody biomass per household in the pre-project devices during the project activity, used in parallel.

A household level questionnaire will be designed to collect information for the parameter of interest. The questionnaire that is administered is given in Appendix 5. It will be field tested when administered for the first time and modified accordingly based on its ease of getting information on the field and its analysis. The frequency of measurement will be once two years. The parameter of interest is not subject to seasonal fluctuations. Hence it will be conducted at 2 years interval.

(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. Oversampling will be done to replace non-respondents, if any. The data collected will be entered, checked and verified further for any typographic mistakes.

(iii) Analysis: The data entry will be done in Microsoft excel sheet. The data will be cross checked with the filled in questionnaire as QA/QC procedure. The data will be analyzed for the parameter.

(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 15 years. 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 was implemented only after registeration as a GS CDM project activity andupfront carbon money was available for implementation of the project under an ERPA drawn up for the purpose. Revenues are 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 was placed after procuring the advance CER revenues as the project was funded only from CER revenues.

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

2. Project Management and Monitoring

This Biogas CDM project is implemented and monitored by CROSS. CROSS facilitates 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 is set up within CROSS for management and monitoring of the Biogas CDM Project. This Project Management & Monitoring Unit consists of the following staff:

- **One Biogas CDM Project Manager:** A biogas CDM project manager is in overall in-charge of the project activity. The CDM project manager is responsible for overall project implementation in the first 4 years and meeting the requirements of monitoring protocol thereafter. He is directly appointed by CROSS Board of Trustees and reports to the Director, CROSS. The main function are 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 appointed directly reports to the Director, CROSS. He is 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 for the project activityis responsible for ensuring a strict and diligent spending of CER Revenues and the recording thereof in a computerised accounting package. He reports to the Director, CROSS andadministers 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

- **Biogas Field Workers:** Biogas field workers oversee the construction of biogas units. Each field worker is in-charge of construction of approximately 250 units during the construction phase. They report to the Project Manager and their tasks are 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 were trained at ongoing Biogas CDM Projects. They were assigned to each Biogas Field Worker. They were paid a piece rate for each unit they built and their personal and contact details are stored in the digitized monitoring solution to fix responsibility.

Similarly, the personal and contact details of each Material Supplier is recorded, along with their bank account numbers. Payments are 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:

-

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

She is responsible for post construction monitoring of usage and identifies 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.

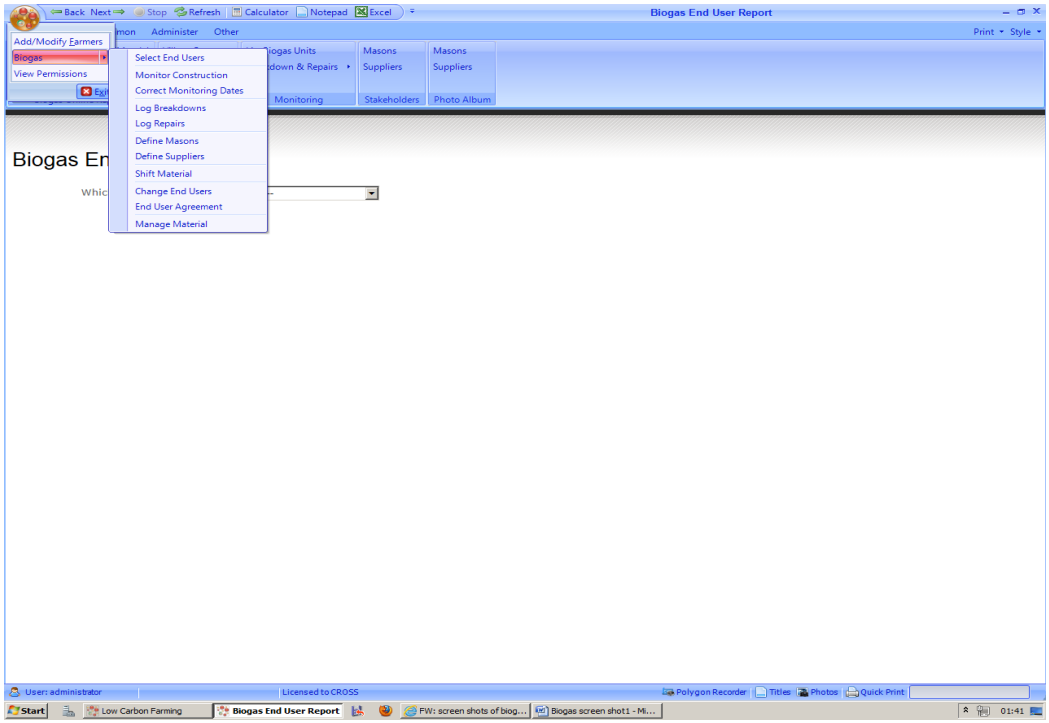
Volunteers are paid by their respective End User Groups from the maintenance fund given to them.

2.3 Digitized Monitoring system

A customised Biogas CDM Monitoring database Solution developed and tested by Tristle Technologies Pvt. Ltd. for CROSS, is 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, are digitally entered and monitored at the CROSS head office. Open and transparent online reports are used by all the Project Staff and secondary stakeholders to know the Progress and Results. Reports are 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 are 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 is 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

Monitoring during Construction Phase

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

Each Biogas Unit is marked with a unique Identification Number. Along with the Village Code and Family Code, these 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 is signed with the Participating Family. Full account of emission reduction is considered from Day 1 of commissioning.

Monitoring after Commissioning of biogas units

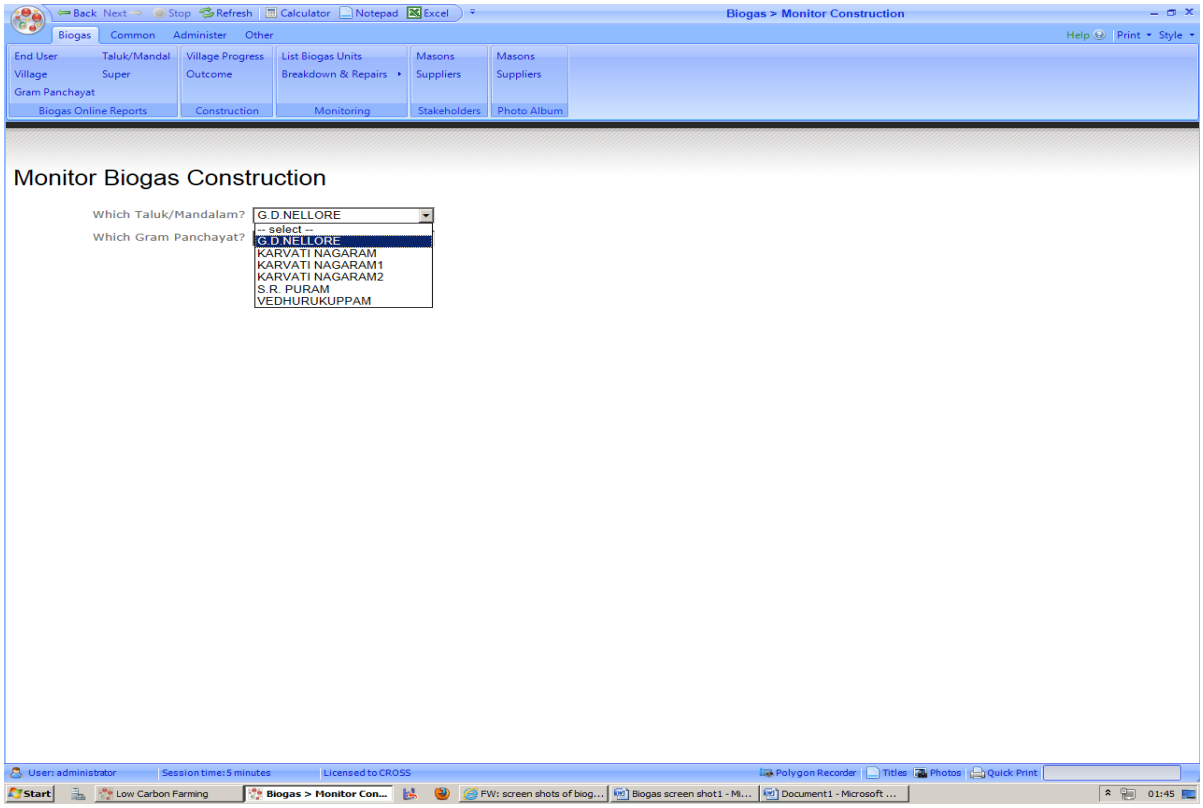
A Daily monitoring book is maintained in each of the villages where the volunteers record number of non usage days. This data is fed into the individual Biogas User's monitoring database solution, once a month, for days not used and reasons.

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

This monitoring solution positively impacts 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 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. are used to measure their performance.
- The totally open and transparent reports track progress from marking to commissioning. These, along with budget realisations, keep a wider audience constantly informed on progress and financial health. They 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 is 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.

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 is 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 was signed by each participating farmer with CROSS.

5. Maintenance, Servicing & dealing with Emergencies

From the forward sale of CERs mentioned earlier, money is kept aside for maintenance and servicing.

Volunteers will have about 25-30 units and record Daily Monitoring data. They are therefore be the point persons who immediately identify problems. Minor repairs will be done either by the End User family or the Volunteer herself, since she is trained and given a kit with tools and spare parts.

If the repair involves the expenditure of monies for the purchase of material, it is discussed in the End User Group and resources obtained. If the problem is beyond their scope, the Biogas Field Worker is informed and the problem attended to at the earliest.

Other emergencies like the sudden loss of cattle and fodder, etc. is 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 is built under this CDM Project.

Trainings were conducted before project implementation at various stages. The types of trainings imparted were:

- 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.

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.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

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

C.2. Expected operational lifetime of project activity

>>
25y-0m[26]

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
Renewable Crediting Period

C.3.2. Start date of crediting period

>>
First Crediting Period: 01/01/2014
Second Crediting Period: 01/01/2021

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

C.3.3. Duration of crediting period

>>
7y-0m
First Crediting Period: 7 years, 0 months – 01/01/2014 to 31/12/2020
Second Crediting Period: 7 years, 0 months – 01/01/2021 to 31/12/2027

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>> Not Applicable

D.2. Environmental impact assessment

>> 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[27].

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>
The excerpts of local stakeholder consultation are from those conducted before the start of the project.

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.

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

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.

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. Consideration of comments received

>> 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

>>

This PDD is for renewal of crediting period. The letters of approval and authorization from DNA of India to CROSS for the project activity was issued before the start of the project. Both the letters were provided to the DOE.

Appendix 1. Contact information of project participants

Organization name	**Community Reconstruction of Social Service - CROSS**
Country	INDIA
Address	Velkur Village & Post, Gangadhara Nellore Mandal, Chittoor, Andhra Pradesh, 517 125
Telephone	08572 – 273292; 098854 12972
Fax	
E-mail	cross_org2005@yahoo.com
Website	
Contact person	Mr. Bhupathi Puvvani

Appendix 2. Affirmation regarding public funding

No ODA fund will be diverted for this project.

Appendix 3. Applicability of methodologies and standardized baselines

The applicability of methodologies and baseline survey during the renewal process in described in section B.2 and B.4. of the PDD.

Calculations of f_{NRB}

The f_{NRB} is calculated based on CDM TOOL30, Methodological Tool for calculation of the fraction of non-renewable biomass. Version 3. The fraction of woody biomass that can be established as non-renewable is

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

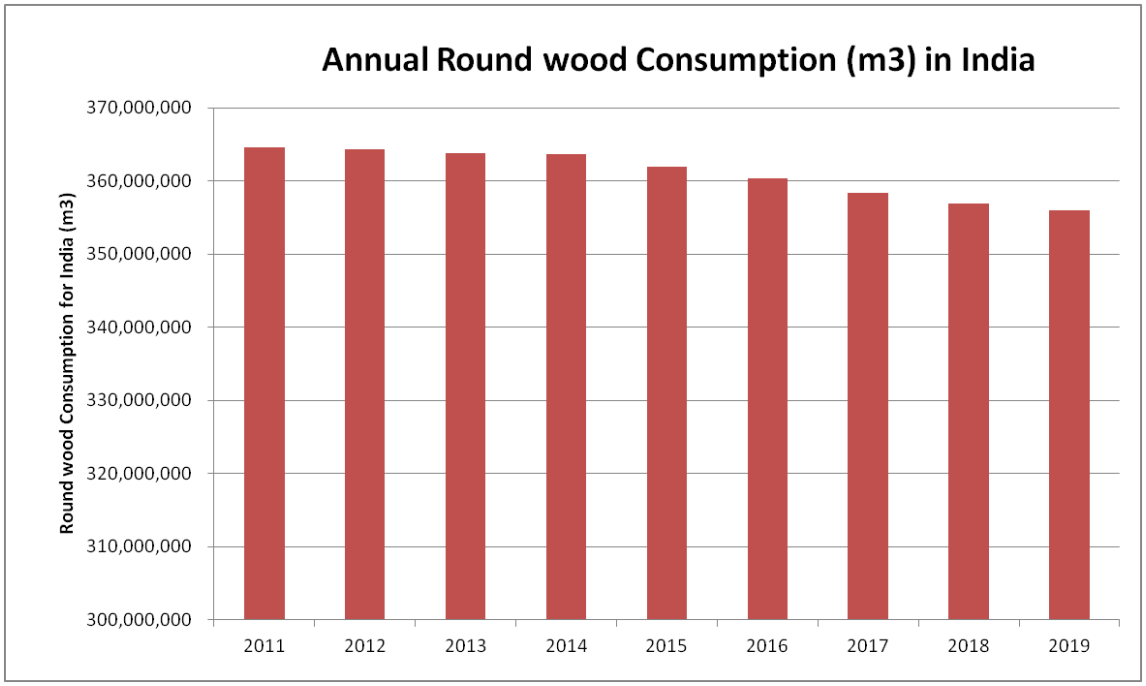
Where
f_{NRB} = Fraction of non-renewable biomass in the country/region or project area
NRB = Quantity of non-renewable biomass (t/yr) in the country/region or project area
RB = Quantity of renewable biomass in the country/region or project area
Based on Tool 30, in the case of ex ante calculation of f_{NRB}, the parameter f_{NRB} shall be estimated using the most recent historical year for which data is available. Where available, the same vintage of data should be used for all parameters applied in this tool to calculate f_{NRB}. Where data for one single vintage is not available for all parameters, different vintages may be used for parameters, as long as it can be justified (e.g. the use of different vintages leads to a conservative estimate of f_{NRB}).

The aggregated value of wood consumption given by the FSI, 2011 based on field studies is 46.30 Mt.

Determination of consumption of wood in erstwhile Andhra Pradesh - H			
Activity Data	**Value (2011)**	**Value extrapolated for 2019 based on**	**Source**

		National trend	
Fuelwood (Mt)	24.30	23.7	Source: Wood is Good, Iis India doing enough to meet its present and future needs? A status report by CSE, 2017
Timber (Mt)	22.59	22.1	
Total (Mt)	**46.89**	**45.79**	

This is the latest data available for Andhra Pradesh (which included Andhra Pradesh and Telangana states). A look at the National consumption of Roundwood based on FAO statistics shows that there is a marginal decrease in consumption during 2011 – 2019.



Source: FAO, 2015 and FAO, 2019. Annual Consumption of roundwood (cum) in India
FAO, 2015. Forest Products. Page 83. http://www.fao.org/3/i7304m/i7304m.pdf
FAO, 2019. Page 3. Forest Products. Page http://www.fao.org/3/cb3795m/cb3795m.pdf

There was a reduction of 2.36% in roundwood consumption between 2011 to 2019 based on FAO statistics. As the data available for the Andhra Pradesh state in available for 2011, a consumption trend as seen at the national level is applied to the state level data. Hence a decrease of 2.36% is applied to the 2011 data of Andhra Pradesh to determine H for the f_{NRB} analysis.

The FSI, 2019 has conducted a similar study of use of fuelwood, fodder, small timber and bamboo for all the states in forest fringe villages (FFVs). The data gives only values for the forest fringe villages and is not at the district or state level to apply the values. Hence the trends of national level data of consumption based on FAO statistics is applied which includes the rural and urban consumption.

In 2014, the Andhra Pradesh was separated from the north western part as the newly formed state of Telangana. Hence the data and analysis is done inclusive of Telangana as the data of 2011 is inclusive of Andhra Pradesh and Telangana.

Determination of consumption of wood in Andhra Pradesh - H				
Activity Data	**Value (2011)**	**Source**	**Value extrapolated for 2019 based on National trend (FAO**	**Source**

			database)	
Fuelwood (Mt)	24.30	Source: Wood is Good, Iis India doing enough to meet its present and future needs? A status report by CSE, 2017 from cross reference FSI, 2011	23.7	Extrapolated for state level from National trend for the period 2010 to 2019.
Timber (Mt)	22.59		22.1	
Total (Mt)	**46.89**		**45.79**	

Determination of RB		
Activity Data	**Value**	**Source**
Area of Forest (ha) (F_{forest})	6,158,959	Chapter 11.1, Andhra Pradesh Page 5, & Chapter 11.26, Telangana, Page 2. FSI, 2019
Protected forests (ha) (P_{forest})	1,100,800	Chapter 11.1, Andhra Pradesh, Page 3, and Chapter 11.26, Telangana, Page 2. FSI, 2019
Mean Annual Increment (t/ha/yr) (MAI_{forest})	0.763	Kaul et al, 2008., Page 9
Total Biomass Increment (t/yr) from Forests	3,859,375	Calculated
Total Biomass Increment (Million t/yr)	3.86	Calculated
Sustainable Production from TOF (Trees outside Forests) of Andhra Pradesh		
Growing Stock in TOF Million cum	109.13	Chapter 11.1, Andha Pradesh, Page 10, and Chapter 11.26, Telangana, Page 8, State of Forest Report 2019
Mean Annual Increment (Von Mantel's Method) (t=2GS/R); where GS is the growing stock and R is the rotation period	2.73	Million cum
Mean Annual Increment in TOF	2.16	Million t
Source: Chapter 11.1, Andhra Pradesh, State of Forest Report 2019. Conversion of cum to t-wood density of 0.79 (Kaul et al, 2008); Mean Annual Increment is calculated based on the equation t=2GS/R, where GS is growing stock and R is rotation. 80 years is considered as the rotation period, as in Andhra Pradesh, the TOF is dominated by long-term trees.		
RB	**6.01**	Million t

Based on FSI, 2019 the area of forests inclusive of Andhra Pradesh and Telangana is 6.15 Mha, of which 1.1 Mha is protected forests in Andhra Pradesh and Telangana. Based on the research paper by Kaul et al, applying a MAI of 0.763 t/ha/yr, the total renewable biomass from forests is 3.86 t/yr. Trees outside forest (TOF) play an important role in providing biomass, especially for fuelwood and small timber. Based on FSI, 2019, the total growing stock in TOF is 109.13 for Andhra Pradesh and Telangana. Von Mantel's Method was applied for estimating MAI from TOF's growing stock, which is t = 2GS/R; where GS is the growin stock and R is the rotation period. The rotation period is calculated based on the dominant trees in TOF as given by FSI, 2019.

Andhra Pradesh (Top 5 species Chapter 11.1, Page 11)					
TOF (Rural)	**Relative Abundance**	**Rotation Period**	**TOF (Urban)**	**Relative Abunda**	**Rotation Period**

	(%)	(Years)		nce (%)	(Years)
Neem[28]	9.84	150	Cocus nucifera[30]	16.46	60
Borossus flabellifornis[29]	11.72	100	Neem[28]	11.66	150
Cocus nucifera[30]	7.95	60	Mango[31]	7.69	100
Mangifera indica[31]	29.44	100	Tectona grandis[32]	3.02	120
Anacardium occidentale[33]	5.2	25	Pongamia glabra[34]	6.88	100
Telangana					
Mangifera indica[31]	41.63	100	Neem[28]	18.94	150
Neem[28]	11.78	150	Mango[31]	8.84	100
Borossus flabellifornis[29]	5.21	100	Leucaena leucocephala[35]	7.04	10
Acacia arabica[35]	4.38	50	Tectona grandis[32]	6.72	120
Borossus flabellifornis[29]	3.56	100	Pongamia glabra[34]	6.49	100

The rotation period is determined for the most abundant tree in TOF for Andhra Pradesh and Telangana as given by FSI, 2019. The analysis is done for TOF for Andhra Pradesh and Telangana of abundant trees in rural and urban areas. The average rotation period was 103 years. Based on Ajit et a[35]., the average rotation period is 90 years for slow growing trees, 50 for medium growing tress and 10 for fast growing forests. Based on average life of the life span of TOF trees 103 years is the rotation period. For calculations of MAI, a value of 80 years is applied. This is very conservative compared to the actual calculations. Accordingly the MAI for TOF is determined as 2.16 Mt. Hence the total Renewable Biomass from forests and TOF is 3.86 + 2.16 = 6.01 Mt.

Determination of f_{NRB} for erstwhile Andhra Pradesh (AP + Telangana)	
Consumption (million tonnes) - H	45.79
Renewable Biomass (million tonnes) - RB	6.01
Non-Renewable Biomass, (million tonnes) - NRB	39.77
f NRB = (NRB/NRB+DRB)	**0.86**

Accondingly the fNRB is as shown above. Consumption of wood is 45.79, while the fuelwood from renewable energy sources is 6.01 Mt. Accordingly the non-renewable biomass is 39.77 Mt. Based on the calculations of TOOL30, the fNRB is 0.86.

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.6.3.

[28] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3695574/#:~:text=Neem%20trees%20are%20fast%20growers,span%20of%20150%20%2D%20200%20years.

[29] file:///C:/Users/Sudha%20P/Downloads/30229-Article%20Text-56701-1-10-20200804.pdf

[30] https://dtmag.com/thelibrary/tree-life-coconut-palm/#:~:text=With%20a%20life%20span%20of,100%20feet%20(30%20m)

[31] http://tropical.theferns.info/viewtropical.php?id=Mangifera+indica

[32] https://aranya.gov.in/aranyacms/downloads/Acts/FORESTRY%20IN%20KARNATAKA%20-%20DIPAK%20SARMAH.pdf

[33] https://plantvillage.psu.edu/topics/cashew-nuts/infos

[34] https://investancia.com/what-is-pongamia/

[35] Ajit et al., 2016. Estimating carbon sequestration potential of existing agroforestry systems in India. Article in Agroforest Syst. DOI 10.1007/s10457-016-9986-z.

Appendix 5. Further background information on monitoring plan

It is provided in Section 7.2 and 7.3.

The questionnaire that will be administered as per the methodology is as follows:

Survey format B: Project survey

1.1. General information[36]

Title of project activity	
Name of Surveyor	
Date of survey	mm/dd/yyyy
Period of measurements (for consumption rate)	mm/dd/yyyy to mm/dd/yyyy

1.2. Household profile

Name (Household representative)	
Household size (total number of people)	
- Adult	
- Children	
Address	
Phone number (if available)	

1.3. Household fuel consumption pattern post the project implementation

Cooking device	
Model name/number	
Unique ID	
Date of installation	mm/dd/yyyy
Do you use the project cookstove? (Physically check the stove).[37]	Yes/No
Do you use your traditional (baseline) cookstove also?	Yes/No
- If yes, how many meals did you prepare using traditional (baseline) cookstove last week or last month?[38]	Meals/week or month
Do you use any other stove? (ICS etc.)[39]	Yes/No
If yes, list the types and number of other non-project stoves	
How many times a week do you use the non-project stoves?	
How much do you spend on fuel for cooking/type of cooking device in a week/month?	

[36] Selection of households will be based on a sampling plan of operational biogas units.

[37] The question is to determine if the cookstove is currently in use, i.e. to address the parameter of "usage factor." Physical checks to verify the usage may be done by checking the conditions of stoves, e.g. warm to touch.

[38] The question is to determine if the baseline stove is being used to account for project emissions.

[39] The question is to cross-check if the project cookstove is used for all cooking requirements. It may also detect the situation where a household is taking part in more than one project activity, avoiding double-counting.

1.3.1. Fuel use for cooking

	Yes/No	Quantity of usage	Unit	Money spent on fuel/month/year
Charcoal			kg/month or year	
Crop Residue			Head load/week	
Wood			Head load/week	
LPG			Months/1 cylinder use	
Kerosene			Liters/month or year	
Coal			kg/month or year	
Electricity			kWh/month or year	
Other fuels (explain)				

1.4. Replacement of non-renewable biomass

If Wood is still used, how is it collected?		Percentage[40]
Collection of twigs and branches fallen down		
Lopping of twigs and branches		
Cut and carry wood		

Appendix 6. Summary report of comments received from local stakeholders

This is included in Section E.3.

Appendix 7. Summary of post-registration changes

The section is left blank intentionally.

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.

[40] The total should be 100% if value entered.

Version	*Date*	*Description*
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 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	Revision 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; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • 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-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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