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	Accion Fraterna Biogas CDM project for rural communities in Anantapur, Andhra Pradesh
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	12
Completion date of the PDD	05/10/2021
Project participants	ACCION FRATERNA ECOLOGY CENTRE
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	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	29,784 tCO_2

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The project "Accion Fraterna Biogas CDM project for rural communities in Anantapur, Andhra Pradesh" is a registered CDM project activity. The details of the registered project are as follows:

UNFCCC Project Number:	3779
Registration date:	20th Jan 2012
Crediting Type:	Renewable
First Crediting Period:	31st May 2014 to 30th May 2021

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.

Accion Fraterna Ecology Centre (AF Ecology Centre) is a Non-Governmental Organization (NGO) working in Anantapur district of Andhra Pradesh, India. The guiding principle of AF Ecology Centre is concern for the poor and reaching out to as many needy people as possible. The main mission of the NGO is to organize and strengthen distressed farmers and farm labour for their empowerment, self-reliance, food and nutritional security; promote Integrated Sustainable Farming Systems and sustainable healthy environment. The NGO also works with women and youth and promote diversified livelihoods including agri-processing, marketing and non-farm skill based employment. They also work for gender and social equality and human dignity. AF Ecology Centre are always working for people's wellbeing and strives to positively influence the society and adapt itself to be relevant to the changing contexts[1]. Thus under the aegis of Clean Development Mechanism (CDM), AF Ecology Centre took up this project to provide biogas to the rural communities of the drought prone and biomass scarce Anantapur district of Andhra Pradesh, India.

Anantapur district is a resource-poor arid region. It has very low and erratic average rainfall of 522 mm annually. It witnesses droughts in 3 out of every 5 years. The district depends predominantly on rain fed farming. Ninety percent of the land and 80% of the farmers depend entirely on rain fed farming. The district has predominantly small and marginal farmers with 90% of the farmers owning less than 10 acres of dry land. Anantapur does not have any worthwhile forest area or vegetation, and biomass is very poor. The nature of forests is such that this does not contribute towards improving the arid climate in the region. The forests in the District are thin and scanty and there are numerous isolated peaks and rocky clusters which are devoid of any vegetation[2]. Thus the region is a drought prone, biomass deficient region, which requires climate mitigation measures.

The purpose of this Biogas CDM Project activity is to set up 15,000 biogas plants (digesters) of 2 m^3 capacity each for single households in all Mandals[3] of Anantapur District. Each household will install a 2 m^3 biogas plant and feed cattle dung and other organic waste into the anaerobic digester for the production of biogas for cooking purpose and water heating for bath. The aim of the project is to replace the commonly used inefficient wood fired mud stoves technology, with clean, sustainable and efficient biogas and in this way replace Non-Renewable Biomass with biogas for cooking and water heating for bath. The project activity will decrease the dependence of 15,000 families on forests in the region.

By utilizing cattle dung in a controlled anaerobic digestion and combustion system, biogas will be available as thermal energy, which will be used for cooking and water heating for bath. The biogas is used on a two-ring gas stove supplied as part of the project activity. Households having cattle or

[1] http://www.af-ecologycentre.org/aboutus3.htm

[2] http://www.mssrf.org/fs/pub/Study-of-Anantapur-RR10-24.pdf

[3] Mandal is an administrative unit below the district consisting of a group of villages with administrative and local government functions.

willing to collect cattle dung participate in the project activity. The project was implemented upon registration of the project as a CDM project activity, as the project is financed completely from carbon revenues.

In so far, of the 15,000 biogas units, 3,178 units are constructed and the details of the constructed and commissioned units are as follows:

Mandals	2014	2015	2016	2017	2018	2019	2020	Total
Anantapur		36	129	51	19	9		244
Atmakur		112	24	9				145
Battalapalli		55	144	25	19	38	45	326
Bukkarayasamudram		106	171	37	25	20		359
Dharmavaram		154	106	52	37	34		383
Garladinne		11	73	17	28	1		130
Kanaganepalli		13	43	161	61	8		286
Kothacheruvu							51	51
Kuderu		46	36	8				90
Narpala		62	73	56	2	6	20	219
Pamidi					19	10		29
Pedda Vadaugur						22		22
Putaparthi			32		17	42	15	106
Rapthadu	1	75	41	128		25		270
Singanamala		60	161	31	58	29	1	340
Tadimarri		6	111	46	6	3	6	178
Grand Total	**1**	**736**	**1,144**	**621**	**291**	**247**	**138**	**3,178**

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 15,000 project households are 29,784 tCO_2 and are 2,08,488 tCO_2 for the second crediting period of 7 years.

The project contributes to social, environmental, economic and technological benefits which contribute to sustainable development of the local environment and the country as follows:

Social benefits:

- ✓ Reduces drudgery to women who spend long hours and travel long distances in search of fuel wood
- ✓ Increases women and children's overall health situation by reducing indoor air pollution, thus eliminating health hazards.
- ✓ Security of energy supply
- ✓ Better management of dung and organic wastes
- ✓ 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, preservation of pasture land, reduced indoor pollution, increased use of manure rather than chemical fertilizers.

Economic benefits:

- ✓ Higher productivity of workers 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
- ✓ Better biogas digester models.
- ✓ Training in chemistry of biogas for masons and users leading to improved scientific temper in community and more jobs.

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

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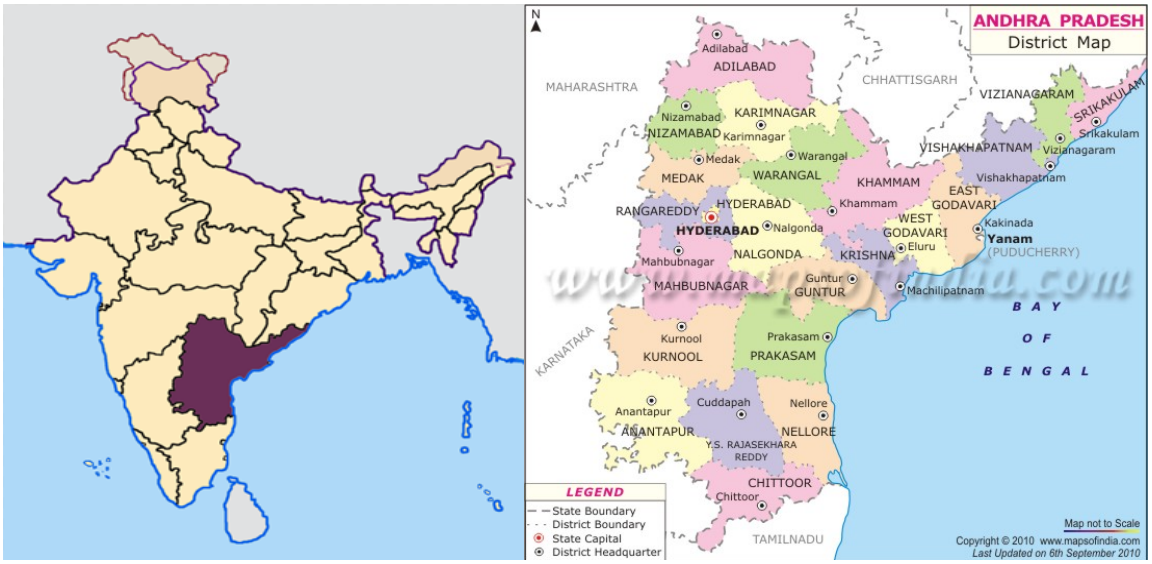
Host Country: INDIA.
State: Andhra Pradesh.
District: Anantapur District
Villages: All Villages of the District



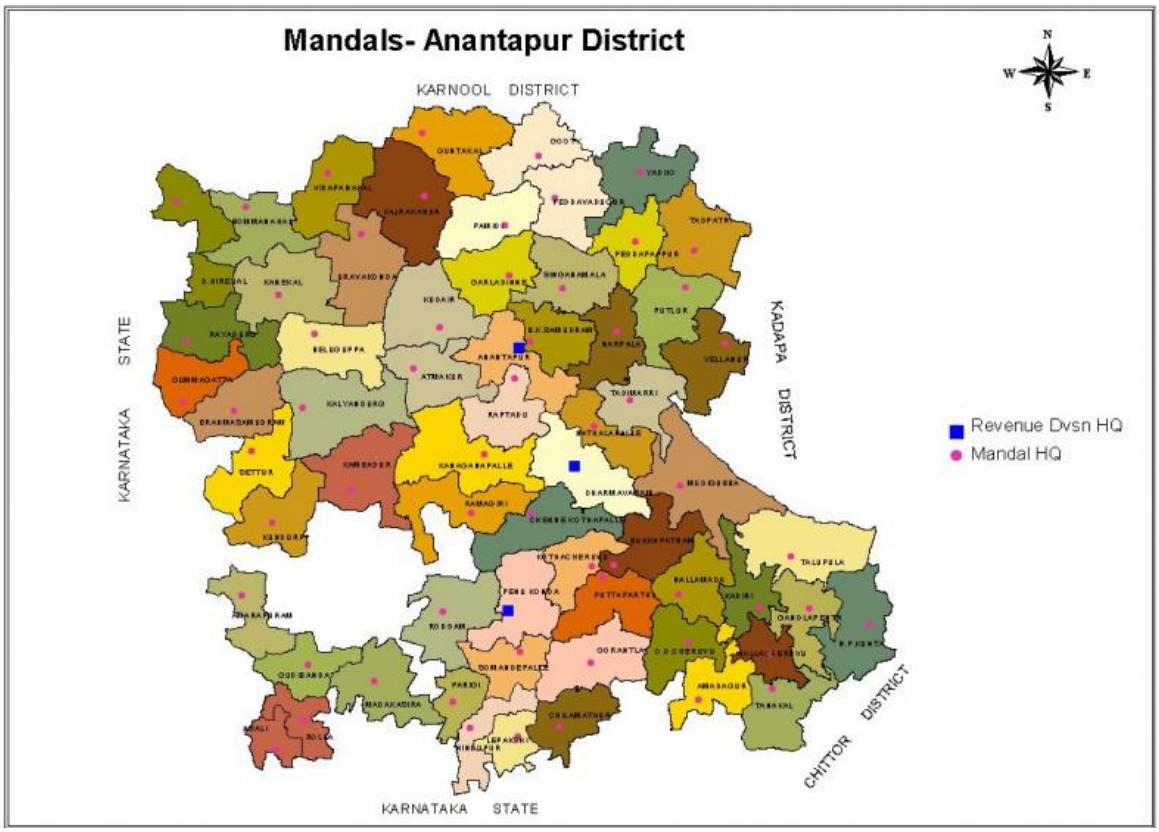


Figure 1: Map of Andhra Pradesh and Anantapur district in which the project will be implemented

A.3. Technologies/measures

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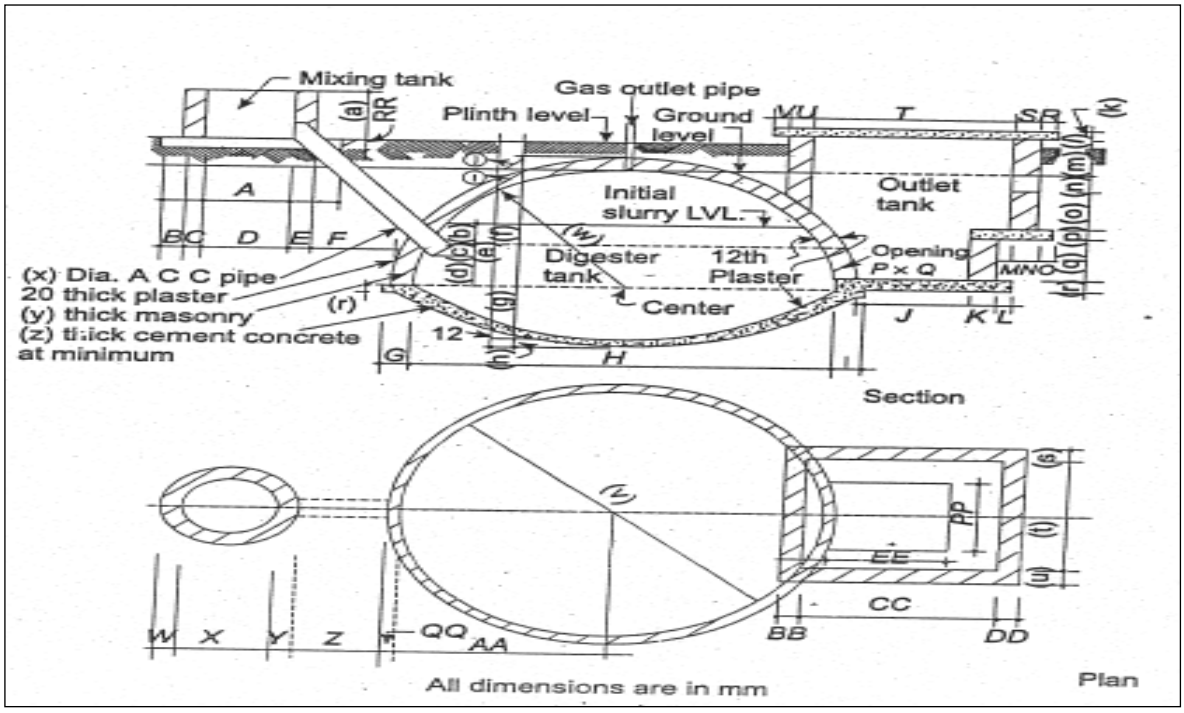
The chosen technology is a domestic biogas plant. It is a small thermal appliance that displaces the use of non-renewable biomass by introducing a system for utilising dung and converting it into renewable energy by means of a digester in which the substrate undergoes acidification and methanation. This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

Technology/measure

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

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 slurry may be re-used in the process. 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[4]. The project activity will organize the 15,000 users to use cattle dung and organic wastes in individual household methane recovery systems of biogas for cooking and water heating. The 15,000 individual plants consist of a mixing chamber where waste water and cow dung are mixed, an inlet pipe to feed the slurry into the reactor, the main biogas reactor / digester where methane formation / recovery takes place, a slurry outlet pipe, an outlet chamber, and a slurry platform. The outlet pipe and tank are provided to remove the digested / treated sludge or fermentation residue and the slurry platform is provided to maintain the treated slurry in clean condition. A pipe leading from the top of the dome to the stove will be provided to supply biogas to a 2-ring stove inside the house.



Plan of Deenabandhu Model Biogas Plant

Constructed Deenabandhu Biogas Unit

Biogas Stove used for Cooking and Heating Water for bath

[4] Approved design by the Ministry of New and Renewable Energy. http://www.mnre.gov.in/

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (Host)	Accion Fraterna Ecology Centre – Private Entity	NO

A.5. Public funding of project activity

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

A.6. History of project activity

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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, Accion Fraterna Ecology Centre has provided a written statement to confirm the above.

A.7. Debundling

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At the time of registration, according to Annex 13, EB 54, "Guidelines on assessment of debundling for SSC project activities", the small-scale project activity is not a de-bundled component of a large project activity since there is no registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category or technology; and
- Registered within the previous two years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

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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

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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 replaces 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 [5] . 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 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.	Not Applicable. 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	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,

[5] 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

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).	the PP, AF Ecology Centre, 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, AF Ecology Centre 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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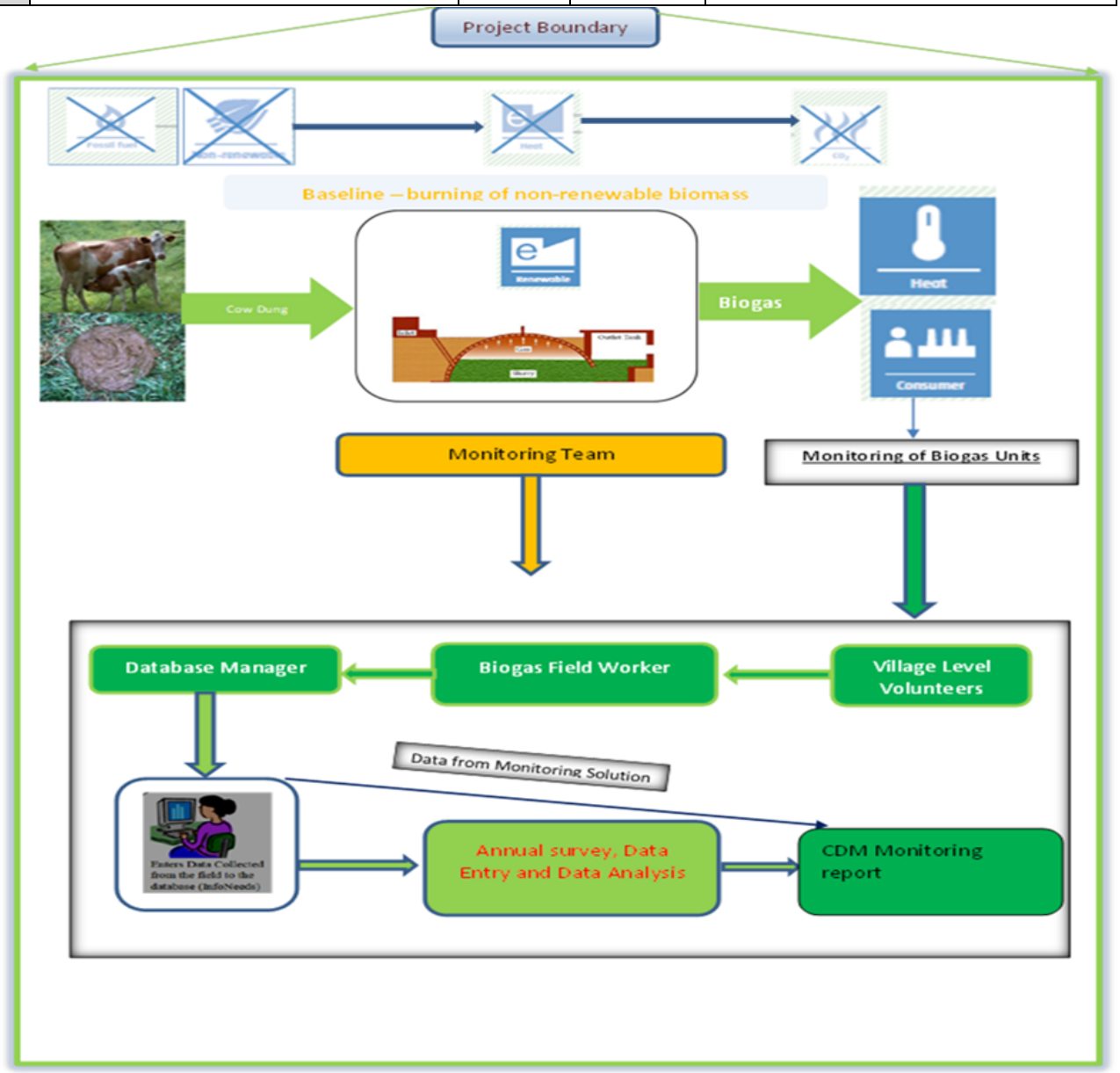
In accordance with Paragraph 16 of the chosen methodology, *The project boundary is the physical, geographic site of the use of biomass or the renewable energy.* The projects boundary will therefore encompass the sum of the 15,000 physical geographical sites of all individual biogas plants (digester system, pipe leading to the stove and the stove itself) realized by the project activity.

	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.
		CH4	Excluded	Not a major source of emission
		N2O	Excluded	Not a major source of emissions



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[6]. 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 Anantapur District, Andhra Pradesh State, India. 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[7]. Based on a study conducted in Andhra Pradesh, 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 cooking. Fuel usage correlates with income levels and lower income households tend to use more fuelwood as cost is still a barrier for use of LPG in rural areas[8]. Based on a national family health survey for Anantapur District, which is the project region, households using clean fuel for cooking accounts for only 55.9%, thus making 44.1% of households in rural areas still using solid

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

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

[8] 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

fuels for cooking[9]. Based on a survey conducted during September 2020 in Anantapur in the project region, surveyed 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. 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. The region is scarce of biomass and non-renewable biomass is part of the biomass used for cooking and heating water. In the project households, the fuel wood is 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

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)

[9] National Family Health Survey – 4, 2015-16. District fact sheet, Anantapur, Andhra Pradesh. International Institute of Population Sciences, Mumbai. http://rchiips.org/nfhs/FCTS/AP/AP_FactSheet_553_Anantapur.pdf

$f_{NRB,y}$	=	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 September 2020 for the renewal of the crediting period. The target population was non-project households in the project region. A pilot survey was conducted to assess the fuelwood use based on which to further select the sample size. Based on the pilot survey of 10 households, 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 2.01 kg/capita/day and standard deviation of 0.71, the sample size at 90/10 confidence/precision level and @80% response rate for infinite sample population it is 42 households.

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

	Value
Mean (kg/capita/day)	2.01
Standard Deviation	0.71
V	0.12433
N	34
@80% response rate	42

The fuelwood use in the baseline was determined by conducting a Kitchen Test in September 2020 to estimate the fuelwood use. Kitchen test was done in 141 non-project households for 3 days to assess the fuel wood use at household level. A total of 141 households were interviewed and kitchen test conducted for the following households:

Mandal	Village	Number of households
Anantapur	Kodimi	10
Athamakuru	Sanapa	10
B S K	Neelampalli	11
Bathapalli	Edula Mustur	5
	Gantapuram	8
	Potlamarri	9
	Siddannagaripalli	8
Dharmapuri	Basam palli	1
	Dharmapuri	2
Dharmavaram	Basam palli	2

	Dharmapuri	4
	Malaka Puram	2
	Malakapuram	2
	Malihehipalli	1
	Malinehipalli	7
	Muchurai	8
	Pothukunta	3
	Ravulacheuvu	6
Kanaganpalli	Mamidipalli	14
	Mukthapuram	7
Singanamalla	Gumepalli	11
	Kalumadi	10
Grand Total		**141**

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:

	Mean Family Members/HH	Fuel wood Use/capita/day
Mean	4.77	1.93
Standard Deviation	1.38	0.64
Count	141	141
Standard error of mean	0.12	0.05
Confidence level (90%)	0.19	0.09
Reliability	4.01%	4.59%

Based on the study conducted, the fuelwood use is 1.93 kg/capita/day and the household size is 4.77 persons and is within 90/10 confidence/precision level. The family size of households is 4.77, while based on the district statistics for Anantapur, 2016, the family size is rural area is 4[10]. To adopt a conservative approach, 4 is considered for the estimation of B_y and emission reduction calculations. Accordingly the fuelwood use is 1.93 kg/capita/day x 4 household size x 365 days = 2.82 t/household/year.

The value considered is 2.82 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;

[10] Handbook of Statistics, Anantapur District, 2016. Page 12.

https://cdn.s3waas.gov.in/s333e8075e9970de0cfea955afd4644bb2/uploads/2019/07/2019071836.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 0.737.

Hence the fraction of non-renewable woody biomass used in the absence of the project activity considered for the project is 0.737.

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)	2.82	Based on sample survey in the project area
$f_{NRB,y}$	0.737	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[11]. Based on the FSI, 1989 (Fig 4)[12], 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.

[11] 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)

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

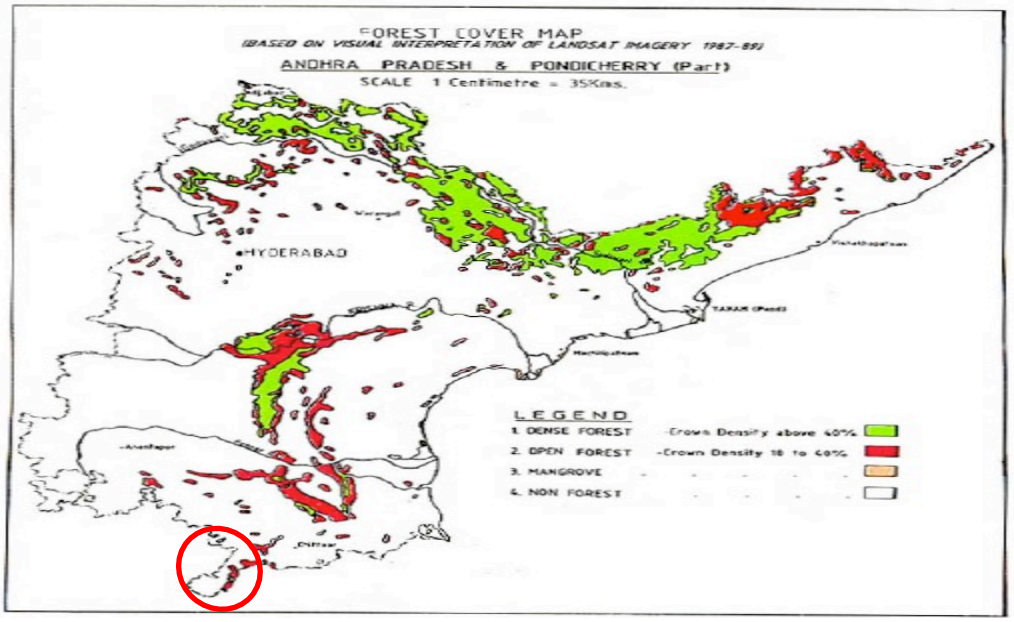

Figure 4: Forest Map of Andhra Pradesh for 1989 showing the project area.

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[13]. 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.

According to Appendix B of the simplified modalities and procedures for small-scale CDM project activities; Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

The alternatives to the project activity are the i) continued use of traditional cook stove for cooking, ii) use of kerosene, iii) use of LPG, iv) implementation of the project in the absence of CDM revenue, all of which are in compliance with mandatory laws and regulations.

Use of coal/charcoal: Coal and charcoal are not considered as an alternative as they are not used by the communities for cooking purposes in this region[14]. This is also evident from the survey conducted (Appendix 4). Thus, this alternative is not included for barrier analysis.

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

[14] NSSO 2007. Energy Sources of Indian Households for Cooking and Lighting, 2004-05 National Sample Survey Organisation Ministry of Statistics and Programme Implementation Government of India, 2007

- *Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;*

i) Continued use of traditional cook stove for cooking: The use of traditional wood stoves represents the baseline situation in the local area leading to 3.97 tCO_2/family/yr. The traditionally used stoves come in 3 basic categories; a traditional 3-stone stove with no associated costs, and a mud/clay or cement stove which is build with local material with no costs to a costing of about Rs.200. The traditional cook stove is fabricated *in situ* by housewives using locally available clay or mud. The fabrication usually involves a labour investment of 3-4 hrs. A traditional cook stove in rural India is usually installed and maintained at zero cost. For maintenance, the traditional cook stove is plastered regularly with fresh clay and water. The opportunity cost for regular construction and maintenance is considered negligible[15]. The running cost of all the above cook stoves is not considered an investment barrier as biomass is collected free from local wasteland, forest land, and agricultural land[16]. The rural poor do not have much cash to spend on energy and use the fuels they collect to meet their cooking needs[15]. Thus self-collected fuels do not have a monetary cost (Reddy, 2009)[17].

A study in Andhra Pradesh shows that around 85% of the households in Andhra Pradesh are dependent on biomass as fuel for meeting cooking and heating purposes. The families using biomass for cooking accounts for 80.85%, followed by 2.76% of cow dung, 0.48% of biogas, 7.75% of kerosene, 5.95% of LPG, 0.86% of coal/coke and 0.12% electricity (Ramachandran, 2004)[18]. Based on a national survey conducted by NSSO, in rural areas, at the national level, 75% of the households and at the state level in Andhra Pradesh, 80.3% of the households use firewood as the primary source of energy (NSSO, 2007[14]). In households from the lower economic strata of rural areas, nearly 98% of households use firewood for cooking (Fig 8). Thus it can be seen that firewood has been the dominant cooking fuel in rural Andhra Pradesh as shown below. The demographic survey in the project area (507 villages) also shows that biomass is used by nearly 95.12% of the families. Thus it can be seen that firewood has been the dominant cooking fuel in the project area.

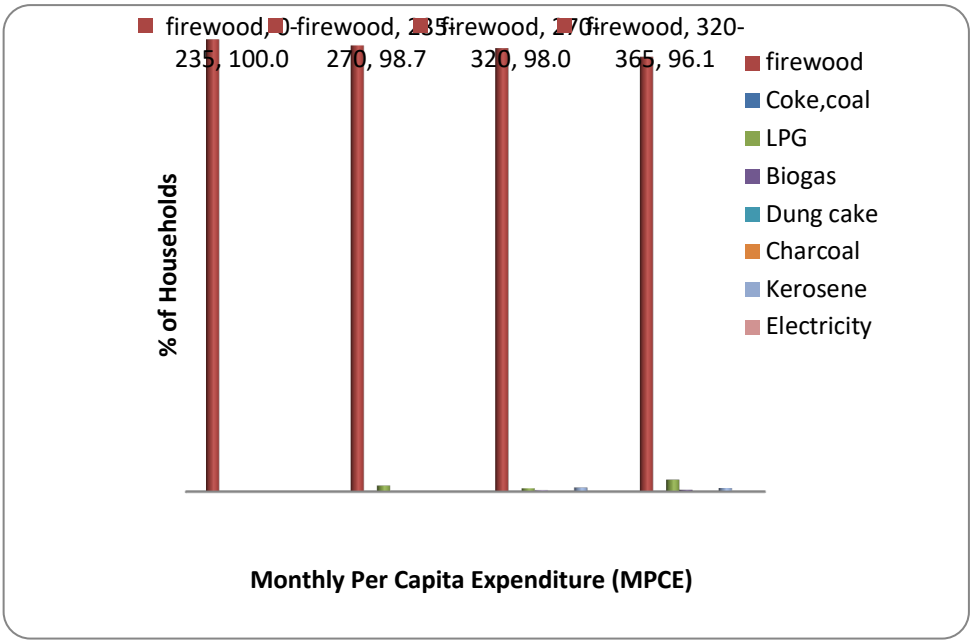

Fig 8: Fuel type used by lower MPCE group in rural areas of Andhra Pradesh (NSSO, 2007)

[15] P.Sharath Chandra Rao, Jeffrey B.Miller, Young Doo Wang, John B. Byrne. Energy microfinance intervention for below poverty line households in India. Energy Policy 37 (2009) 1694 - 1712

[16] N.C. Saxena. Forest, People and Profit net equations for sustainability. Planning Commission, Govt. of India.

[17] Reddy.B.S., Balachandra. P., Nathan.H.S.K. (2009). Universalization of access to modern energy services in Indian households - Economic and policy analysis. Energy Policy 37 (2009) 4645–4657.

[18] http://www.unescap.org/esd/energy/cap_building/integration/egm/documents/G_Ramachandran_paper.pdf

Thus there is no investment barrier to the continued use of traditional cook stoves and non-renewable biomass for cooking.

ii) Use of Kerosene: Kerosene as a cooking fuel is available to families below the poverty line through the public distribution system at subsidized prices. Two litres of kerosene are supplied each month via the public distribution system in Anantapur district at a subsidised rate of Rs.13 per litre to ration card holders[19]. Approximately 24.7 litres of kerosene (Appendix 4) are required to completely replace fuel wood and meet the cooking requirements of an average rural household per month. Additional kerosene has to be purchased from the open market at a rate of Rs.34 per litre[20]. Reliance on kerosene as the sole cooking fuel would equate to a monthly cost of nearly Rs. 800 for the average family and is thus not a viable alternative for any of the participating families. Subsidies for kerosene are limited to amounts sufficient only for lighting homes, and are inadequate for meeting the cooking requirements of poorer women. In spite of such subsidies for many decades they have failed to shift fuel consumption patterns away from biomass in rural areas[21].

Further, the baseline survey revealed an average monthly consumption of only 0.37 litres per household primarily for kindling the fuelwood. The remainder of kerosene obtained via the government distribution service is used as fuel in kerosene lamps for lighting and not for cooking. This is also substantiated by the fact that kerosene is not the primary fuel for cooking in rural households at the national or state level[14].

This proves to be high costs compared to using traditional cook stoves and kerosene is not a financially viable option to completely replace the traditional cook stove. Thus the poor continue to rely on biomass, which are procured with no costs.

iii) Use of LPG: The lump sum initial investment required for LPG installation (including security deposit, regulator, LPG hose, cylinder and gas stove) is Rs. 3000[22]. A 14.2-litre cylinder of LPG costs approximately Rs. 395[23] after subsidy and will last an average family less than a month if used to meet all cooking requirements. An LPG connection (deposit for the pressurised cylinder/canister) and stove constitute a large upfront cost (when compared with the equipment required for other fuels), so that the few who can afford the fuel cannot make the initial investment[24]. The poor rural communities participating in this biogas project are unable to afford the upfront costs of the LPG kit since the majority are agricultural and daily-wage workers with an income of less than 1$/day/capita.

Further, there is also lack of infrastructural support (e.g. lack of facilities for refilling LPG cylinders at the doorstep) that further prohibits the widespread adoption of LPG in the rural context. In India, LPG is supplied through distribution outlets of oil marketing companies. Currently, rural areas of the country are located far from such distribution centres, so that users have to pay for the extra costs of cylinder supply. For the project area, the additional cost for transportation of cylinder to the doorstep is approximately Rs.50. Thus the total cost will work out to Rs.450/- per month. Moreover, for small and remote markets, refills often take more than a week. For those users that do not keep a second cylinder, this could mean going without fuel for as long as two weeks. Signing up for two cylinders to avoid running out of cooking fuel would further increase the start-up cost of LPG service. Again, this infrequent delivery of refill cylinders serves as a disincentive against switching entirely to

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[19] http://anantapur.gov.in/images/inner/district_intiatives/k-oil-05-08-2010.pdf

[20] http://www.hindu.com/2006/04/20/stories/2006042009960200.htm

[21] Shubhashis Gangopadhyay, Bharat Ramaswami,and Wilima Wadhwa. 2005. Reducing subsidies on household fuels in India: how will it affect the poor? Energy Policy 33 (2005) 2326–2336.

[22] http://www.iocl.com/Products/LiquefiedPetroleumGasFAQ.aspx shows the investment cost for LPG connection. Additionally, LPG hose pipe is Rs. 200 and stove cost is Rs. 1000.

[23] http://www.deccanchronicle.com/channels/cities/hyderabad/lpg-price-hiked-rs-50-diesel-costlier-rs-3-480

[24] Antonette D'Sa and K.V.Narasimha Murthy. 2004. Report on the use of LPG as a domestic cooking fuel option in India. International Energy Initiative.

LPG[25]. Due to logistical problems the few rural LPG users that exist often have to wait for long duration to get a cylinder refilled. Due to such circumstances it is impossible for even a wealthy rural household to rely on LPG as its main cooking fuel.

Presently, Government of India is planning a large scale implementation of distributing LPG cylinders in rural households. Locations for setting up of Rajiv Gandhi Gramin LPG Vitrak (RGGLV)[26] are identified broadly based on potential of average monthly sale of 600 LPG cylinders of 14.2 kg and 1800 customers with monthly per capita consumption of about 5 Kg, The assessment of refill sale potential is based on several factors including population, population growth rate, economic prosperity of the location and the distance from the existing nearest distributor. Setting up of RGGLV at the identified location is still a business proposition. Thus it is not a scheme, wherein there is a reach to all the rural households irrespective of their economic conditions. The initial investment barrier would still prevail making it difficult for the rural population to adopt LPG as cooking fuel. Among the distributors' list announced at the national level, Anantapur does not have any distributor appointed under the scheme[27].

The Government of Andhra Pradesh launched a targeted subsidy programme called the Deepam Scheme, to encourage the uptake of LPG among low-income households in July 1999. In this Scheme, the Government pays the LPG connection fee for women who belong to Self-Help Groups (SHGs) and whose households are classified as being below the poverty line (BPL). The Deepam scheme differs from traditional fuel subsidies in two respects: (1) it is targeted; and (2) it is a one-time capital subsidy in that it subsidies LPG connection rather than LPG refill as with price subsidies. Deepam beneficiaries have to cover other upfront costs of taking up LPG purchase of a stove and connecting accessories amounting to about Rs.1, 000. A World Bank evaluation study of the scheme showed that the scheme had not made an impact due to lack of adequate LPG distribution network, lack of refilling of cylinders at doorstep, the higher refill cost depending on the distance to the dealer[28].

Thus in rural areas, the penetration of LPG, especially in the lower MPCE class is negligible, due to high initial investment and recurring costs. Thus investment barrier prevents the adoption of LPG.

iv) Implementation of the project in the absence of CDM revenue: An individual 2 meter cubed biogas unit costs approximately Rs. 16,200[29]. This is a sum that far exceeds what the target population of this project can afford. They are not able to save or get personal loans to meet this cost. Even though all the project participants are aware of the potential of biogas technology, they continue to put up with the adverse health effects caused through the use of traditional wood stoves in unventilated kitchens. This can be evidenced by the low rate of biogas units installed and running so far in the project area.

A National Programme for Biogas Development (NPBD) is implemented by the Government of India that offers subsidy for installing biogas units. The NPBD of the Ministry of New Renewable Energy (MNRE) was started in 1981-82 for promotion of family type biogas plants, the current potential of which is estimated at 12 million, to provide clean alternate fuel to the rural masses and enriched organic manure for agriculture. The implicit objective of the programme is to reduce the use of fuel wood[30]. It is a central sector scheme covered under 20-point programme. According to Non-

[25] http://siteresources.worldbank.org/INDIAEXTN/Resources/Reports-Publications/Access-Of-Poor/KeroseneLPG.pdf

[26] http://www.iocl.com/Talktous/Brochure_RGGLV1261009.pdf

[27] http://www.ebharatgas.com/ebgas/pages/general/gen_result_rgglv.jsp

[28] http://www.unescap.org/esd/energy/cap_building/integration/egm/documents/G_Ramachandran_paper.pdf

[29] Dr. K. C. Khandelwal. 2008. Country Report on Financing of Domestic Biogas Plants in India. International Workshop on Financing of Domestic Biogas Plants Bangkok, Thailand. Asia Biogas Programme, SNV Netherlands Development Organisation

[30] Ministry of New and Renewable Energy. http://www.mnre.gov.in/

conventional Energy Development Corporation of Andhra Pradesh Limited (NEDCAP), the state nodal agency responsible for the implementation of the NPBD programme, 2.5 lakh family biogas plants have been installed within the state of Andhra Pradesh to date, while the overall potential is 10.9 lakh units[31].

In Anantapur district, in the past 28 years ever since the scheme started, 18,585 biogas units have been built on an average of 664 biogas units/year[32] whereas based on the livestock population the potential in the district is approximately 5 lakhs[33].

To date, even with subsidies, this programme has resulted in very less penetration of biogas at the national, state, district or project area level. Even with subsidies it is beyond the reach of the rural poor communities. The subsidy from the Government ranges between Rs.2, 100-Rs.2, 700 depending on beneficiaries economic status[34]. Even with subsidies, it is beyond the reach of the poor rural communities as they will still have to spend Rs.13, 000 -14,000 as capital cost for construction of a biogas unit. An evaluation study undertaken by the Government of India found that majority of biogas users benefiting from the scheme are well-to-do farmers holding a sizeable amount of agricultural land[35]. Thus based on NSSO study, in Andhra Pradesh, 0.02% of rural households and at the lower MCPE households, approximately 0.2% of rural households use biogas[14].

Further the government programme for providing biogas plants for the poor has been reduced at the State level, and thus the capital shortfall prevents the continued expansion of the biogas programme in India. The common practice for poor households is to depend on free sources of firewood. The evaluation concludes that the impact of the NPBD programme is not significant even though the programme has remained operational for about two decades.

Taking all of this into account it can be concluded that the target population of this project in the absence of CDM financing would not find themselves of fully functioning biogas that could be utilized to meet their cooking energy requirements. In the absence of the project the baseline situation would prevail where by the target population will continue to resort to non-renewable biomass as the chief source of their cooking and hot water energy requirements.

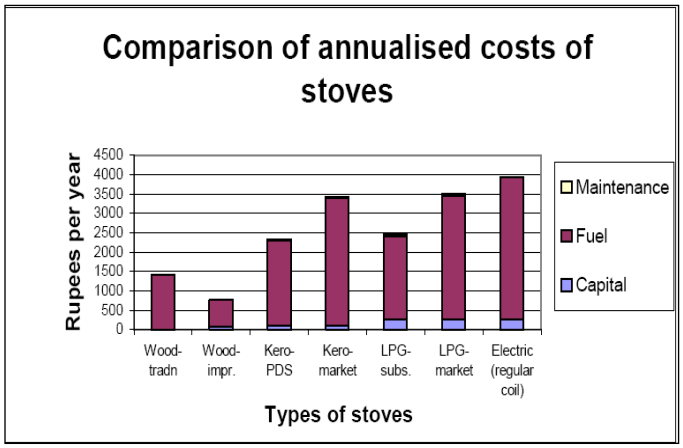

Figure 9: Comparison of annualized costs of stoves for cooking[24]

[31] http://www.nedcap.gov.in/Biogas_and_Bioenergy.aspx?ID=35

[32] NEDCAP, Anantapur District, 2010

[33] @ the rate of 2 adult cattle/biogas and 4 calf/biogas

[34] Ministry of Non-Conventional Energy, National biogas and manure management programme, http://www.mnre.gov.in/adm-approvals/prog-ftbp.htm

[35] http://planningcommission.gov.in/reports/peoreport/peoevalu/peo_npbd.pdf

Thus the continued combustion of non-renewable biomass fuel for cooking and water heating is the cheapest option (Figure 9), leading to higher GHG emissions. Thus even now all the households use traditional fuel wood stoves for cooking and water heating in the mandals. Poorer households in rural areas in India still have very little access to formal finance. A Rural Finance Access Survey, conducted jointly by the World Bank and the National Council of Applied Economic Research, India, indicates that rural banks serve primarily the needs of the richer rural borrowers: some 66% of large farmers have a deposit account; 44% have access to credit. Meanwhile, the rural poor face severe difficulties in accessing savings and credit from the formal sector: 70% of marginal/landless farmers do not have a bank account and 87% have no access to credit from a formal source. Thus, access to formal credit for farmers to implement energy saving devices is an issue[15]. As such, the communities prefer to use the traditional cook stove instead of building a biogas plant which involves highest initial capital cost of all energy options for cooking. Similar activities in the region have been only implemented with subsidies under the National Programme for Biogas Development. Even with subsidies, the cost to build a biogas unit will be very high in the project area for the rural poor.

AF Ecology Centre being a NGO does not have access to capital. There is an investment barrier preventing this project activity taking place in the absence of CDM: no debt funding is available. Individual loans to poor farmers for building biogas plants are not available. AF Ecology Centre approached the local banks for a loan for the construction of the biogas plants based on CERs revenue. The banks refused to provide loans without guarantee. The combination of no guarantees, no equity, no security, and CER price risk means the loan is not available. No banks are willing to gamble on CER price and thus there is no risk-free income stream in this project and banks are not willing to lend anyway, even leaving aside the problem of guarantees. This project will be implemented exclusively with carbon finance through forward sale of CERs after registration of the project as a CDM activity.

- *Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;*

There are no technological barriers preventing the use of the traditional stoves for cooking which are widely available in regional market towns and the basic 3-rock stove usually used by the rural women can be built by the women themselves without any special skills.

Biogas plants have to be constructed very carefully. This takes skill, diligence, careful working with acute attention to detail and the careful design of each plant as shown in section A.3 so that it is suited to the local conditions at each plot of land where it is to be constructed[36]. At present there is a shortage of adequately trained biogas masons capable of constructing and maintaining high quality functioning biogas units.

Taking all of this into account it can be concluded that the target population of this project in the absence of CDM financing would not find themselves of fully functioning biogas that could be utilized to meet their cooking energy requirements. In the absence of the project the baseline situation would prevail where by the target population will continue to resort to non-renewable biomass as the chief source of their cooking energy requirements.

Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

One of the barrier to successful implementation of a biogas project is good maintenance; attending to structural and operational problems of the biogas units for continuous operation of the biogas units. The success or failure of any biogas plant mainly depends upon the quality of construction

[36] Shaikh et al. Barriers to dissemination of renewable energy technologies for cooking. Centre for Energy Studies, Indian Institute of Technology, Delhi, Hauz Khas, New Delhi – 110016, India.

works. To successfully construct a biogas plant, the mason should not only respect the dimensions as indicated on the drawing (section A.3) but also follow the correct construction method. It takes organizational and management skills and coordination to organize construction and continued use of the biogas units[37]. Not only do the plants have to be built to suit local soil conditions, but service and maintenance crews have to be trained and stationed in all the villages to ensure smooth running of the plants. Emissions from the combustion of non-renewable biomass fuel can only be avoided through professional attention to this rural renewable energy technology and manage it efficiently with sufficient resource – financial, technical, operational and managerial. Ineffective repair and maintenance strategy, poor service backup to handle the technical hiccups in field during operation are the main institutional barriers to this technology[38]. The Government evaluation studies shows that 55% of the biogas plans built are non-functional due to structural and operational problems, failure of dissemination strategy, lack of users training and follow-up services[35]. These services are required for continuous operation of the biogas units.

Thus, proper extension and support services will be provided by AF Ecology Centre at the village level as described in section B.7.3. At each village, the biogas units will be monitored for its usage. If any biogas unit falls to despair, it will be repaired immediately to make it functional. Thus, in this way, plants will not be allowed to fall into disrepair, when their functioning will depend upon adequate maintenance skills, which should be available in every village. The emphasis will be to promote the participation of local people in the whole process of education, planning and monitoring, so that the renewable technology is viable and sustainable to the communities it is designed to serve. Coordinated management information systems will be developed as part of biogas development, in order to identify problems and undertake remedial measures. A portion of the CER revenues received as forward funding for the project will be set aside to undertake repair and maintenance of biogas units.

Construction of a Deenabandhu 2 cum model costs Rs. 16,200[39]. Thus as per EB 59, Para 36, applying simple cost analysis for the project activity, the cost of implementation of the project activity for 15,000 households in a span of 3 years is Rs. 243 million.

Year	Cost of stoves	Total (Rs)
Year 1	Rs. 16,200/biogas/family @ 5000 constructed per year	81,000,000
Year 2	Rs. 16,200/biogas/family @ 5000 constructed per year	81,000,000
Year 3	Rs. 16,200/biogas/family @ 5000 constructed per year	81,000,000
Total Cost		243,000,000

This does not take into account price escalation of building materials such as cement, bricks, sand, labour, steel, pipes, stoves, etc. and associated maintenance costs. This also does not take into account the costs involved with CDM registration process (i.e. pre-project costs, documentation, monitoring costs, validations and verifications etc.). The project activity does not produce any economic benefit other than CDM revenues, which would be Rs. 204,314,400 (@10 Euros/CER) for the crediting period.

AF Ecology Centre as an NGO would not be able to finance; the training of its field staff, the end users of the biogas units, the proposed biogas mason apprenticeship scheme and the training of a biogas maintenance team, with out CDM revenue. It would also not be able to attract the managerial resources and undertake the required organizational building required.

Conclusion

[37] N.H. Ravindranath and D.O. Hal. M 1995. Biomass, Energy and Environment: A developing Country Perspective from India, Oxford University Press.

[38] Ramachandra, T.V. 2008. Geographical Information System approach for regional biogas potential assessment. Research Journal of Environmental Sciences 2 (3): 170-184.

[39] http://www.mnre.gov.in/adm-approvals/prog-ftbp.htm

The project is implemented among the End User Group formed at the village level in the Mandals of Anantapur District. Taking into account the national and sectoral policies and circumstances, the emissions reductions will not occur in the absence of the proposed small-scale project activity. The proposed project has to overcome various barriers as mentioned above and displace economically viable options which lead to higher emissions. Barriers make it unlikely that biogas plants will be built and in the absence of CDM revenue, these barriers would automatically lead to an implementation of a technology with higher emissions. In the absence of this CDM project, the above barriers would prevent the construction and maintenance of the proposed biogas units. Thus the traditional stone/mud stove which is financially a more viable alternative to the project activity and is less technologically advanced has lower risks to performance uncertainty leading to higher emissions. On the other hand, the project activity has low market share and is technologically more advanced, requiring skilled labour to build them. The aim is that CDM revenue will enable biogas technology for cooking to overcome the described barriers and promote biogas plants in the project area. The CDM project will overcome this barrier by providing upfront CER revenue for construction of the biogas units and continuous support for monitoring and maintenance of the units.

The described project activity is clearly additional because it will be financed completely through the revenues from forward financing of CER sales, and cannot be realized without the revenues from carbon credits. Thus it is clear that, in the absence of CDM project, which will provide the upfront investment for the establishment of 15,000 biogas plants for the rural poor, this project will not happen.

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.

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:

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

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:

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

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 6 above, 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.

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/digester
Description	Capacity of a digester
Source of data	Calculated as shown in Section B.2
Value(s) applied	1.78
Choice of data or measurement methods and procedures	Calculated as shown in Section B.2.
Purpose of data	According to the "Instructions for filling out the project design document form for CDM project activities", the purpose of data needs to be in terms of calculation of baseline emissions, project emissions or leakage. But this parameter calculated in order to establish the capacity of the digester and scale of the project activity. And it is not used in calculation of baseline emissions, project emissions or leakage.
Additional comment	Qualifies as a small-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	2.82 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 1.93 kg/capita/day. The adult equivalent per family in the project area is considered as 4 based on census data for Anantapur. By = 1.93 kg/capita/day x 365 days x 4/family = **2.82 t/household/yr**.
Purpose of data	Estimation of Baseline Emissions
Additional comment	This parameter is fixed for the entire crediting period

Data / Parameter	$f_{NRB, y}$
Unit	-
Description	Fraction of woody biomass used in the absence of the project activity in year y that can be established as non-renewable biomass
Source of data	Calculated based on following sources of data: 1. State of Forest Report, Forest Survey of India, 2019. 2. FSI, 1995 3. Population Data, % of HHs using clean energy from National Family Health Survey Data 4. IPCC, 2019 Report 5. FSI, 2020, Trees outside forest resource in India
Value(s) applied	0.737
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	$NCV_{biomass}$
Unit	TJ/tonne
Description	Net Calorific Value of Non-Renewable Woody Biomass
Source of data	I.E Methodology, Version 11
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	$EF_{projected\_fossilfuel}$
Unit	tCO_2/TJ

Description	Emission factor for substitution of non-renewable woody biomass by similar consumers.
Source of data	IPCC I.E Methodology, Version 11.
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**
Unit	t/HH/yr
Description	woody biomass
Source of data	AMS I.E. Methodology
Value(s) applied	0.14 for household fuelwood use of 2.82 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	31,352.22	Baseline emissions during the year *y* in t CO_2e	Calculated
B_y	42343.85	Quantity of woody biomass that is substituted or displaced in tonnes	Based on survey value of per capita value and conservative HH size (1.93 kg/HH/day and 4 HH size
$f_{NRB,y}$	0.737	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	42,343.85	Quantity of woody biomass that is substituted or displaced in tonnes	Calculated
N_{HH}	15,000	Number of households in the project activity, number	PDD
$BC_{BL,HH,y}$	2.82	Average annual consumption of woody biomass per household before the start of the project activity, tonnes/household/year	Based on survey value non-project households for per capita value and conservative HH size (1.93 kg/HH/day and 4 HH size)
$BC_{PJ,HH,y}$	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

After considering Leakage			
Activity Data	Value	Description	Source
BEy	29,784.61	Baseline emissions during the year *y* in t CO_2e	Calculated
B_y	40226.66	Quantity of woody biomass that is substituted or displaced in tonnes	Based on survey value non-project households for per capita value and conservative HH size (1.93 kg/HH/day and 4 HH size) and applying leakage factor
$f_{NRB,y}$	0.737	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	40,226.66	Quantity of woody biomass that is substituted or displaced in tonnes	Calculated
N_{HH}	15000	Number of households in the project activity, number	PDD
$BC_{BL,HH,y}$	2.82	Average annual consumption of woody biomass per household before the start of the project activity, tonnes/household/year	Based on sample survey of non-project households

$BC_{PJ,HH,y}$	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	1568	Leakage as tCO_2 due to reduction of By by 5%	Calculated as (BE_y-$BE_{y,with\ leakage}$)

BEy	31,352	Baseline emissions during the year *y* in t CO_2e
PEy		Project emissions during the year *y* in t CO_2e
LEy	1,568	Emissions due to leakage during the year *y* in t CO_2e
ERy	29,784	Emission Reduction during the year *y* in t CO_2e for 15,000 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)
2021-22 (31st May 2021)	31,352	0	1,568	29,784
2022-23	31,352	0	1,568	29,784
2023-24	31,352	0	1,568	29,784
2024-25	31,352	0	1,568	29,784
2025-26	31,352	0	1,568	29,784
2026-27	31,352	0	1,568	29,784
2027-28	31,352	0	1,568	29,784
Total	219,464	0	10,976	208,488
Total number of crediting years				7
Annual average over the crediting period	31,352	0	1,568	29,784

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 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 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	15,000
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	15,000
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

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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 Anantapur 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 Anantapur 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 Anantapur 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

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1. Implementation Plan

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

A CDM Team facilitates construction and maintenance of the biogas units as described below.

2. Project Management and Monitoring

This Biogas CDM project is implemented and monitored by AF Ecology Centre for 15,000 domestic biogas units of $2m^3$ capacity, for as many farmer families in the Mandalams of Anantapur district, A.P., India.

AF Ecology Centre 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 crops up.

2.1. Biogas Project Management Unit within AF Ecology Centre

A dedicated team is set up within AF Ecology Centre for management and monitoring of the Biogas CDM Project. This Project Management & Monitoring Unit consist of the following staff:

1. **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 of the project and meeting the requirements of monitoring protocol thereafter. His main function will be as follows:

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

2. **IT Professional:** The IT profession 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

3. **Accountant:** The account is responsible for ensuring a strict and diligent spending of CER Revenues and the recording thereof in a computerised accounting package. He is an integral part of the general finance team of the Centre. He administers the following tasks:
   - Arrange for the bulk purchase of cement and hardware and transfer them to the Mandalam 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

-

4. **Biogas Field Workers:** Biogas field workers oversee the construction of biogas units. Each field worker is in-charge of construction of approximately 500 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 Mandalam 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 were trained at ongoing Biogas CDM Projects in the neighbourhood. They are assigned to each Biogas Field Worker. They are paid a piece rate for each unit they build 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 are also recorded, along with their bank account numbers. Payments are made only by crossed cheque.

Post construction of the biogas units for the initial three years, the biogas field workers 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 institutions

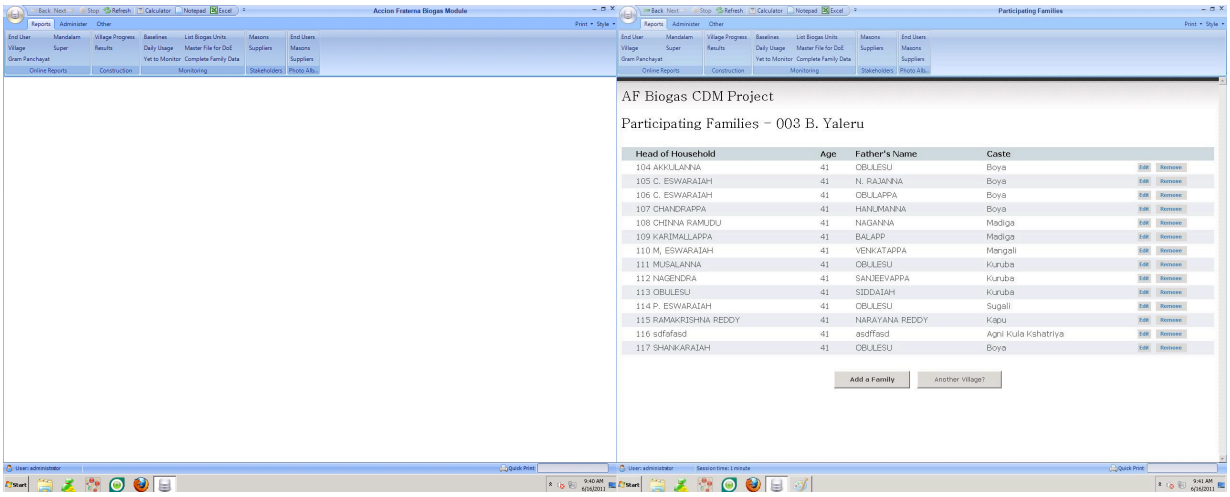
2.2. Management system at village level:

Village level Volunteers maintain the Daily Monitoring Books where usage hours and reasons for non-usage are recorded every single day. Every participating village have a Volunteer to monitor usage of about 30 biogas units. They are usually women, schooled, selected by the end users of her village. She is responsible for post construction monitoring of usage and is the first to identify dysfunctional units. The Volunteer either prompts the End User to set right a problem or bring it to the notice of the Biogas Field Worker.

2.3 Digitized Monitoring system

A customised Biogas CDM Monitoring Solution developed and tested by Tristle Technologies Pvt. Ltd., is used to maintain demographic data, construction processes, and the regular monitoring.

Tristle Technologies Pvt. Ltd. has developed a web based solution which is permission driven, intuitive and easy to use by Project Staff and Volunteers. All activity processes, including financial transactions, is digitally monitored using an Intranet solution. Open and transparent online reports is used by all the Project Staff and secondary stakeholders to know the Progress and Results. Reports can be generated at all levels – Project, Mandal, Gram Panchayat, Village and Participating Family. The database is updated on an everyday basis, as and when Project Staff return from their respective villages.



Progress Reports: Real-time Progress Reports is 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

Process: The solution will be used to:

- Record the Mandalams, 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 the Construction Phase**

Construction of Biogas Units is in a phased manner. 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 Gobar
  - 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 and date of construction. Along with the Village Code and Family Code, these irrefutably identify each of the constructed Biogas Units.

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.

2.5 Monitoring after Commissioning of biogas units

A Daily Monitoring Book is maintained in each of the village. This data is fed into the individual Biogas User's on-line database, 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. is used to measure their performance.

The totally open and transparent reports track progress from marking to commissioning. These, along with budget realisations, keeps 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. All data are archived and stored throughout the crediting period and an additional 2 years.

3. 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 (AF Ecology Centre) and every single End User. These formally spell out the roles, entitlements and responsibilities of both parties.

4. Maintenance, Servicing & dealing with Emergencies

From the forward sale of CERs mentioned earlier, maintenance and servicing of biogas units are done. Volunteers visit the biogas units and record units that are dysfunctional. They are the point persons who immediately identify problems. Minor repairs are conducted 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 and is beyond their scope, the Biogas Field Worker is informed and the problem attended to.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>
01/04/2014

C.2. Expected operational lifetime of project activity

>>
25y-0m[40]

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: 31/05/2014
Second Crediting Period: 31/05/2021

C.3.3. Duration of crediting period

>>
7Y-0M
First Crediting Period: 7 years, 0 months – 31/05/2014 to 30/05/2021
Second Crediting Period: 7 years, 0 months – 31/05/2021 to 30/05/2028

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
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.

D.2. Environmental impact assessment

>>

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 Lalitha Kala Parishad, Anantapur District, Andhra Pradesh on the 15th September 2010 between 10.00–13.00 hours.

Notification was sent through letters, emails and personally to various categories of stakeholders 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. The AF Ecology Centre field staff also spread word of the meeting to all village members they encountered in the weeks

[40] http://www.inseda.org/Additional%20material/Environmental%20and%20social%20Impact%20-%20biogas.pdf

preceding the meeting. An open invitation to the meeting was published in the local newspaper "Eenadu & Deccan Chronicle" dated 10.09.2010 and 11.09.2010.

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 nearly 660 people. The various stakeholders for the meeting were as follows:

Local Communities: The local communities attending the meeting were from the Village Level Federations which are group of 8-10 farmers. Each group was represented by the Convenor and Co-convenor. The meeting was also attended by media and members from Rural Development Trust.

Local Policy Makers, Representative of Local authority and Official Representatives: The local policy makers, representatives of local authority and official representatives from the Andhra Pradesh Government attended the meeting. Representatives from the Department of Renewable Energy (NEDCAP), Forest Department and Revenue Departments along with Mandal, Zilla and Gram Panchayats members attended the stakeholder's meeting.

Local NGOs: The invitees of local NGOs include those working in Anantapur district, the neighbouring Chickballapur district and NGOs from the Fair Climate Network (FCN). The FCN is a network of grassroot NGOs working on CDM issues, many of whom have taken up CDM projects for the rural communities. There was representation from the NGOs for the meeting

GS NGOs: There are 8 GS NGOs in India. All of them were sent invitations for the meeting. Also international Gold Standard NGOs' 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. An invitation to Ministry of New and Renewable Energy was also sent.

For those who were not able to attend the meeting, written comments were invited from them through email and letters. In total, 5 emails were received from NGOs and 33 written comments were received from local authorities and government officials.

E.2. Summary of comments received

>>

The local communities were very happy about the introduction of the project. During the meeting, many questions about the technology were clarified. The local policy makers, representative of local authority and official representatives were very happy of this initiative. The district level NEDCAP officer offered his encouragement for the project. He praised the initiative of the organisation in making the merits of clean cooking technologies available to all segments of society. The local NGO's said it was an excellent initiative to help the most vulnerable sector-the rural women and wished AF Ecology Centre all the best in implementing the program.

The overall comments received on the project activity are as follows:

- The project activity will reduce dependency on firewood and check the destruction of trees.
- The activity will reduce health hazards and prevent environment pollution.
- Women will have enough time to concentrate on children's education and health.
- Biogas project will be more useful to poor women who cannot afford LPG cooking gas. It is nature friendly.
- Project will enhance the socio-economic development of the people.
- Encourages gender equality by sharing biogas preparation responsibilities
- Time saving and reduced expenditure on firewood for cooking purposes
- Using of biogas slurry will increase crop yields. More rainfall and more recharge of ground water due increase of vegetation.
- The project activity will not only provide clean energy for cooking, but will also provide employment.

An analysis of the evaluation forms shows the following responses from the stakeholder's meeting. There were no negative comments.

Questions	Responses
What is your opinion on this meeting?	Construction of bio-gas solves all the problems of women in cooking. Especially during rainy season it will be very difficult for them to cook with the wet fire wood or to collect and store the firewood in the rain. Now it will become easy for both women & men to cook on bio-gas stove
	Today's meeting is an ideal one. Protection of tree wealth is everybody's responsibility. It is a good opportunity to save the trees by establishing bio-gas unit for each family and reduce atmospheric pollution.
	Good for Anantapur district and is useful to the rural families in many ways. Improves education of children and women health
	This program is good, because it is saying about how to protect our environment by safeguarding the existing trees. I learned that the dung used for producing gas is not going to be a waste product, but the extract can be again used to the fields and vermi compost units.
	Good program because its main aim is to reduce the pollution. Tree cutting leads to low rainfall and in turn leads to less yields and more loss. This was explained very well by the dignitaries.
What did you like in the project?	Use of bio-gas reduces lung diseases, eye infections, sight problems etc; Improves health, environment and living standards. Time will be saved and is boon to rural households.
	Appreciate Mr. Malla Reddy (Director) for taking up such a great program. It is good fortune to Anantapur, Rural Women & Climate.
	Installation of 15,000 bio-gas plants which in turn are connected to the increased access for sustainable agriculture. Helpful for poverty reduction.
	No need for me to make any investment in the establishment of the unit. No smoke will be exhausted, trees can be protected, health will be improved. More over cutting trees is against to Indian culture. Increased timely rains leads to high yields. Droughts will be controlled
What do you dislike in the project?	Only people with two cattle can construct a bio-gas plant. Poor people who do not have cattle also wish to have a bio-gas unit. This project will not help families without cattle.

	Presence of women in the meeting was very low.
	No Comments.

No adverse comments were received for the project activity.

E.3. Consideration of comments received

>>

The questions from the stakeholders were clarifications regarding project implementation, construction of biogas units, and service and maintenance. All the clarifications requested by the communities were provided during the stakeholder's meeting.

Further trainings will be conducted especially for orientation to end users on the effects of climate change, CDM processes (end user agreements, roles and responsibilities) and on biogas technology. Training particularly for women will be conducted on use, repair and maintenance of biogas units and maintaining monitoring records of usage of bio-gas stoves by the families.

There were no negative comments requiring mitigation measures.

SECTION F. Approval and authorization

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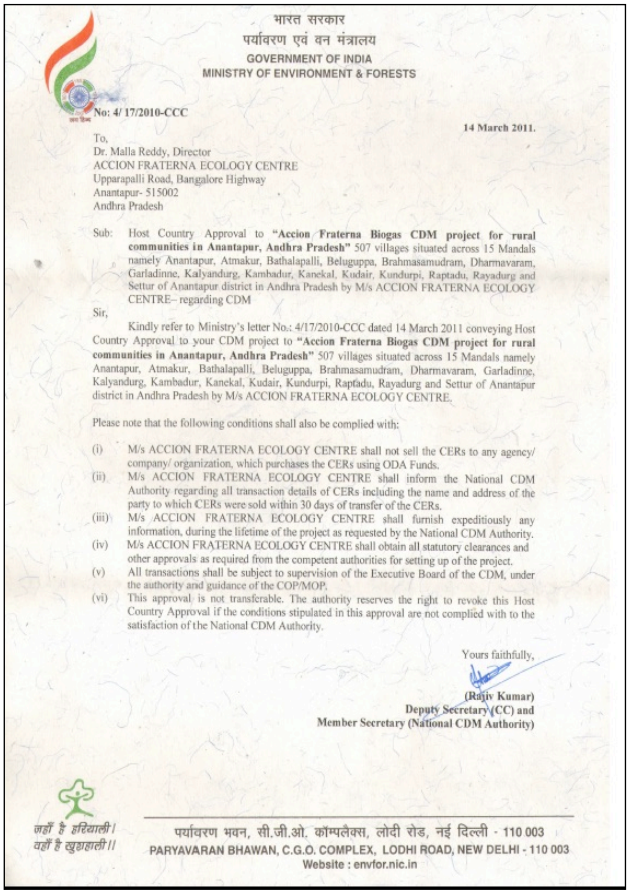

भारत सरकार
पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT & FORESTS

No: 4/ 17/2010-CCC

14 March 2011.

To,
Dr. Malla Reddy, Director
ACCION FRATERNA ECOLOGY CENTRE
Upparapalli Road, Bangalore Highway
Anantapur- 515002
Andhra Pradesh

Sub: Host Country Approval to **"Accion Fraterna Biogas CDM project for rural communities in Anantapur, Andhra Pradesh"** 507 villages situated across 15 Mandals namely Anantapur, Atmakur, Bathalapalli, Beluguppa, Brahmasamudram, Dharmavaram, Garladinne, Kalyandurg, Kambadur, Kanekal, Kudair, Kundurpi, Raptadu, Rayadurg and Settur of Anantapur district in Andhra Pradesh by M/s ACCION FRATERNA ECOLOGY CENTRE– regarding CDM

Sir,

Kindly refer to Ministry's letter No.: 4/17/2010-CCC dated 14 March 2011 conveying Host Country Approval to your CDM project to **"Accion Fraterna Biogas CDM project for rural communities in Anantapur, Andhra Pradesh"** 507 villages situated across 15 Mandals namely Anantapur, Atmakur, Bathalapalli, Beluguppa, Brahmasamudram, Dharmavaram, Garladinne, Kalyandurg, Kambadur, Kanekal, Kudair, Kundurpi, Raptadu, Rayadurg and Settur of Anantapur district in Andhra Pradesh by M/s ACCION FRATERNA ECOLOGY CENTRE.

Please note that the following conditions shall also be complied with:

(i) M/s ACCION FRATERNA ECOLOGY CENTRE shall not sell the CERs to any agency/ company/ organization, which purchases the CERs using ODA Funds.
(ii) M/s ACCION FRATERNA ECOLOGY CENTRE shall inform the National CDM Authority regarding all transaction details of CERs including the name and address of the party to which CERs were sold within 30 days of transfer of the CERs.
(iii) M/s ACCION FRATERNA ECOLOGY CENTRE shall furnish expeditiously any information, during the lifetime of the project as requested by the National CDM Authority.
(iv) M/s ACCION FRATERNA ECOLOGY CENTRE shall obtain all statutory clearances and other approvals as required from the competent authorities for setting up of the project.
(v) All transactions shall be subject to supervision of the Executive Board of the CDM, under the authority and guidance of the COP/MOP.
(vi) This approval is not transferable. The authority reserves the right to revoke this Host Country Approval if the conditions stipulated in this approval are not complied with to the satisfaction of the National CDM Authority.

Yours faithfully,

(Rajiv Kumar)
Deputy Secretary (CC) and
Member Secretary (National CDM Authority)

जहाँ है हरियाली।
वहाँ है खुशहाली।।

पर्यावरण भवन, सी.जी.ओ. कॉम्पलैक्स, लोदी रोड, नई दिल्ली - 110 003
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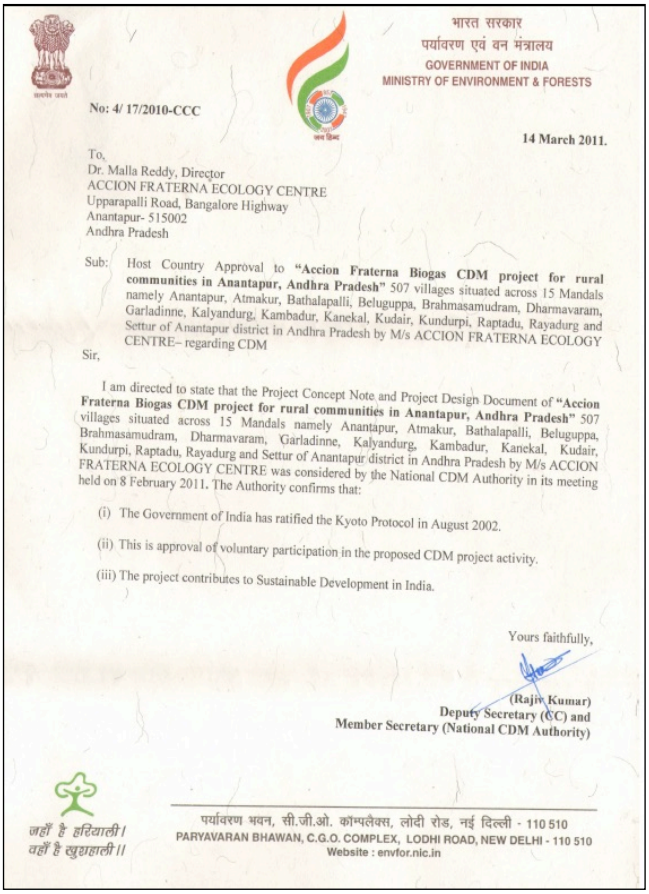
Website : envfor.nic.in



भारत सरकार
पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT & FORESTS

No: 4/ 17/2010-CCC

14 March 2011.

To,
Dr. Malla Reddy, Director
ACCION FRATERNA ECOLOGY CENTRE
Upparapalli Road, Bangalore Highway
Anantapur- 515002
Andhra Pradesh

Sub: Host Country Approval to **"Accion Fraterna Biogas CDM project for rural communities in Anantapur, Andhra Pradesh"** 507 villages situated across 15 Mandals namely Anantapur, Atmakur, Bathalapalli, Beluguppa, Brahmasamudram, Dharmavaram, Garladinne, Kalyandurg, Kambadur, Kanekal, Kudair, Kundurpi, Raptadu, Rayadurg and Settur of Anantapur district in Andhra Pradesh by M/s ACCION FRATERNA ECOLOGY CENTRE– regarding CDM

Sir,

I am directed to state that the Project Concept Note and Project Design Document of **"Accion Fraterna Biogas CDM project for rural communities in Anantapur, Andhra Pradesh"** 507 villages situated across 15 Mandals namely Anantapur, Atmakur, Bathalapalli, Beluguppa, Brahmasamudram, Dharmavaram, Garladinne, Kalyandurg, Kambadur, Kanekal, Kudair, Kundurpi, Raptadu, Rayadurg and Settur of Anantapur district in Andhra Pradesh by M/s ACCION FRATERNA ECOLOGY CENTRE was considered by the National CDM Authority in its meeting held on 8 February 2011. The Authority confirms that:

(i) The Government of India has ratified the Kyoto Protocol in August 2002.

(ii) This is approval of voluntary participation in the proposed CDM project activity.

(iii) The project contributes to Sustainable Development in India.

Yours faithfully,

(Rajiv Kumar)
Deputy Secretary (CC) and
Member Secretary (National CDM Authority)

जहाँ है हरियाली।
वहाँ है खुशहाली।।

पर्यावरण भवन, सी.जी.ओ. कॉम्पलैक्स, लोदी रोड, नई दिल्ली - 110 510
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Website : envfor.nic.in

Appendix 1. Contact information of project participants

Organization name	**ACCION FRATERNA ECOLOGY CENTRE**
Country	INDIA
Address	Upparapalli Road, Bangalore Highway, Anantapur, Andhra Pradesh, 515002
Telephone	+918554244222
Fax	+918554244990
E-mail	mallareddy@accionfraterna.org
Website	www.af-ecologycentre.org
Contact person	Dr. Malla Reddy

Appendix 2. Affirmation regarding public funding

No ODA will be diverted for this project.

Appendix 3. Applicability of methodologies and standardized baselines

Referring to Section B.2 of PDD, the applicability criterions are met for the project activity.

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 total consumption of woody biomass (H) is calculated using the following equation, accounting for all consumption within the applicable area (not only wood fuel but also timber and industrial consumption):

$$H = HW \times N + CE + NE \qquad \text{Equation (3)}$$

Where:

HW	=	Average consumption of wood fuel per household, including fuelwood and charcoal, in the applicable area in the relevant period (tonnes//household)
CE	=	Commercial woody biomass consumption for energy applications (e.g. commercial, industrial or institutional uses of woody biomass in ovens, boilers etc.) that are extracted from forests or other land areas in the applicable area in the relevant period (tonnes)
NE	=	Commercial woody biomass consumption for non-energy applications (e.g. construction, furniture) that are extracted from forests or other land areas in the applicable area in the relevant period (tonnes)
N	=	Number of households consuming wood fuel within the applicable area in the relevant period (number)

The f_{NRB} calculations is done for erstwhile Andhra Pradesh, which includes the present states Andhra Pradesh and Telangana. In 2014, Andhra Pradesh was separated from the north western part as the newly formed state of Telangana. Hence the data and analysis are done inclusive of Telangana as much of the data available prior to 2014 is inclusive of Andhra Pradesh and Telangana.

The total population of Andhra Pradesh and Telangana is 91.35 million in 2019/20. Based on latest survey conducted by National Family Health Survey conducted, about 96% of urban households and 82% of rural households use clean cooking fuel, which is LPG, electric stove or biogas.

% HHs using clean cooking source				
State	**Population**	**Urban**	**Rural**	**Source**
Andhra Pradesh	5,28,83,163	95.30%	77.30%	https://www.thehindu.com/data/data-most-homes-have-lpg-connection-but-a-significant-share-dont-use-it/article34855341.ece
Telangana	3,84,72,769	96.80%	87.80%	
Average	9,13,55,932	96.05%	82.55%	Average
Population data: Andhra Pradesh Population 2020/2021 (Maps, Districts, Cities, Language) (indiagrowing.com); Telangana Population 2020/2021 (Maps, Districts, Cities, Language) (indiagrowing.com)				

Based on several studies, though LPG is promoted by the Government, easy access to firewood without additional costs significantly contributes to continued use of firewood for cooking. Fuel usage correlates with income levels and lower income households tend to use more fuelwood as cost is still a barrier for use of LPG in rural areas[41]. 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. Based on a study conducted by Gould et al., 2018[42]., shows that only 22% of households in this rural sample use LPG and most regions have populations heavily reliant on solid fuels. The most common reasons for non-adoption are installation cost and monthly cost of fuel. Based on a study conducted in Andhra Pradesh by Kumar *et al*., 2020[43]., nearly 50% of households having LPG were not using it and reverted back to solid fuels. Accordingly, 50% of households reporting using clean fuel were considered to have reverted back to solid fuels for cooking.

[41] 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

[42] https://www.researchgate.net/publication/327139476_LPG_as_a_Clean_Cooking_Fuel_Adoption_Use_and_Impact_in_Rural_India

[43] sustainability-12-04790-v2 (4).pdf

Accordingly, the number of households using fuelwood in Andhra Pradesh is 36.89 million.

Number of households consuming woody fuel				
	Total	**Rural**	**Urban**	**Source**
Population (2019)	9,13,55,932	6,07,61,631	3,05,94,301	
Number of persons using fuelwood for cooking in Andhra Pradesh	**3,68,90,743**	**58.73%**	**3.95%**	FactSheet_AP.pdf (rchiips.org) and field studies which shows that only 50% HHs with LPG use clean energy in rural areas

Based on the survey conducted by the PP, the fuelwood consumption per family @4 persons/year is 2.82 t.

Based on Energy Statistics of UN the roundwood consumption in India is as follows. At Indian population of 1.36 billion population, the per capita industrial roundwood consumption is 0.204 t/capita. Accordingly, the consumption for Andhra Pradesh was determined as 18.63 t.

Industrial Roundwood (m3)	
Year	**Value**
2019	352,856,168
2018	352,856,168
2017	353,953,052
2016	355,051,309
2015	356,150,908
2014	356,689,633
2013	357,226,300
2012	357,760,881
2011	358,293,349
2010	358,065,678
UNSD — Energy Statistics	

Indian Population (2019)	1,36,64,17,754	India - Place Explorer - Data Commons
Total Industrial roundwood Consumption (t)	27,87,56,373	Consumption in 2019 x wood density (0.79)
Per Capita Consumption of Industrial roundwood (t)	0.204	Consumption/total population in India
Total industrial roundwood for Andhra Pradesh	1,86,37,088.22	Per capita x population of Andhra Pradesh

Applying equation 3 of Tool30, the total woody biomass consumption for Andhra Pradesh is 44.64 Mt.

Total consumption of woody biomass in the applicable area in the relevant period (t/yr)	H	**4,46,45,062**
Average consumption of wood (t/family/yr)	HW	**2.82**
Number of households consuming woody fuel (Number)@4/family	N	**92,22,686**
Commercial woody biomass consumption for non-energy applications	NE	**1,86,37,088.22**

Determining MAI_{forest}

$$RB = \sum (MAI_{forest,i} \times (F_{forest,i} - P_{forest,i})) + \sum (MAI_{other,i} \times (F_{other,i} - P_{other,i}))$$

There are no recent MAI values for the region. The MAI values are derived from various other parameters available. Accordingly, the MAI values range from 0.763 to 1.50 t/ha/yr. The various calculations are shown below.

1.IPCC, 2019. Based on the ecological zones of forests in Andhra Pradesh[44] (2011 gives the value of united Andhra Pradesh), the mean annual increments of primary forests are applied. The weighted average of MAI for natural forest is 1.5 t/ha/yr.

Country/area	**Tropical**				
Ecological Zones	**Rain forest**	**Moist**	**Dry**	**Shrub**	
Andhra Pradesh (2011)	**1.08%**	**5.62%**	**88.78%**	**4.52%**	SFR Chapter 9.pdf (fsi.nic.in), page 95
MAI[45]	**0.7**	**0.4**	**1.6**	**1**	
Average (t/ha/yr)	**1.50**				

2.Kaul., et al., 2008. The MAI value from Kaul et al, 2008 is derived from Lal and Singh, 2000 and Forest Survey of India (FSI), Government of India. 1995. Accordingly, the value is 0.763 t/ha/yr.

MAI_{forest} (t/ha/yr)	**0.763**	**Kaul et al, 2008., Page 9**

3.The Asia Pacifc Forestry Sector Outlook Study-II Country Report Ministry of Environment & Forests Government of India, determined the growing stock and the annual increment of growing stock of Andhra Pradesh. Accordingly, the growing stock in Andhra Pradesh is 291.39 Million cum, annual increment in forest area is 5.9 Million cum in 4.71 Mha. The annual increment is about 2.03% of the growing stock. Accordingly, the MAI_{forest} in this method is 0.994 t/ha/yr.

Andhra Pradesh Growing stock (1995) cum	29,13,94,000	
Andhra Pradesh annual increment (cum)	59,29,000	Asia Pacifc Forestry Sector Outlook Study-II Country Report Ministry of Environment & Forests Government of India, Page 16. Asia-Pacific Forestry Sector Outlook Study II (moef.gov.in)
Andhra Pradesh (Forest Area - 1995) ha	47,11,200	FSI, 1995; Page 12 sfr_1995_hindi.pdf (fsi.nic.in)
Andhra Pradesh annual increment (t)	46,83,910	Calculated
Increment Percent of growing stock	2.03%	
MAI_{forest} (t/ha/yr)	**0.994**	Calculated

[44] Forest Survey of India, 2011/2019 Report for Andhra Pradesh and Telangana.

[45] Table 4.7; chapter 4, Forestland, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories; https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch04_Forest%20Land.pdf

Based on the various calculations, the most conservative value (i.e. which gives conservative f_{NRB} value is 1.50 t/ha/yr, which is considered for the f_{NRB} calculations.

Mean Annual Increment Calculations		
1	0.763	Kaul et al., 2008, Derived from Lal and Singh (2000) and FSI (1995a, b)
2	0.994	Foret Survey of India (FSI), Government of India, 1995 data
3	**1.50**	**2019 Refined IPCC guidelines and FSI, 2019/2011 Report**

Calculations of RB:

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 calculations of MAI, a value of 1.50 t/ha/yr, the total renewable biomass from forests is 7.58 million t/yr. Trees outside forest (TOF) play an important role in providing biomass, especially for fuelwood and small timber. Based on FSI, 2019, the FSI determined the potential mean annual increment from trees outside forest. Accordingly, the mean annual increment in Andhra Pradesh and Telangana is 3.14 and 2.12 million cum/yr[46] accounting for 5.26 million cum/yr. Conversion of cum to t using the wood density of 0.79 (Kaul et al, 2008), the mean annual increment is 41,55,400 t/yr. This is from an area of 893,200 ha and 482,700 ha of trees outside forests in Andhra Pradesh and Telangana respectively[47]. The MAI accordingly per ha is 3.02 t/ha/yr.

		Year (2019)	
Quantity of renewable biomass consumed in the applicable area in the relevant period (tonnes)	RB	**1,17,42,639**	Calculated
MAI of forest areas (t/ha/yr)	MAI_{forest}	1.50	2019 IPCC Report
MAI of other lands (t/ha/yr) TOF	MAI_{other}	3.02	Source: FSI, 2020. Trees outside forest resources in India, Forest Survey of India, Ministry of Environment, Forest & Climate Change, Government of India. FSI Technical Information Series, Volume 2., No.1, 2020[46].
Extent of forest (ha)	F_{forest}	61,58,959	Chapter 11.1, Andhra Pradesh Page 4, & Chapter 11.26, Telangana, Page 3. FSI, 2019
Extent of non-accessible area	P_{forest}	11,00,800	Chapter 11.1, Andhra Pradesh, Page 3, and Chapter 11.26, Telangana, Page 2. FSI, 2019
Extent of other lands (ha) (Trees outside the forest TOF)	F_{other}	13,75,900	Chapter 11.1, Andhra Pradesh, Page 3, and Chapter 11.26, Telangana, Page 2. FSI, 2019

Based on the value of H and RB determined, the NRB value is calculations as

$$NRB = H - RB$$

[46] FSI, 2020. Trees outside forest resources in India. FSI Technical Information Series, Vol 2, No.1, Forest Survey of India, Ministry of Environment, Forest and Climate Change, Government of India, 2020.

[47] FSI, 2019. India State of Forest Report, Volume II, Forest Survey of India, Ministry of Environment, Forest and Climate Change, Government of India, 2019. https://fsi.nic.in/isfr19/vol2/isfr-2019-vol-ii-andhra-pradesh.pdf; https://fsi.nic.in/isfr19/vol2/isfr-2019-vol-ii-telangana.pdf

The NRB value is 34.90 Mt.

Quantity of non renewable biomass consumed in the applicable area in the relevant period (tonnes)	NRB	3,29,02,423
Total consumption of woody biomass in the applicable area in the relevant period	H	4,46,45,062
Quantity of renewable biomass consumed in the applicable area in the relevant period (tonnes)	RB	1,17,42,639

Based on Equation 1 of Tool30, the f_{NRB} for Andhra Pradesh is calculated as follows:

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

Determination of f_{NRB} for erstwhile Andhra Pradesh (AP + Telangana)		
Parameter		**Andhra Pradesh (2019)**
Fraction of non-renewable biomass in the applicable area in the relevant period (%)	f_{NRB}	**0.737**
quantity of non-renewable biomass consumed in the applicable area in the relevant period (tonnes)	NRB	3,29,02,423
quantity of renewable biomass consumed in the applicable area in the relevant period (tonnes)	RB	1,17,42,639

Based on the calculations of TOOL30, the f_{NRB} is 0.737.

Data Sources for parameters that were used to calculate fNRB values are as follows:

HW	Results of a sampling survey conducted by PP as per "Standard for sampling and surveys for CDM project activities and programmes of activities for 2019
NE	UN Data for India 2019 and applied per capita value to the state of Andhra Pradesh
N	Based on population data from government of India for 2019; Government Survey data on households using clean fuel for cooking and existing studies on the adoption rate of clean energy to determine use of population using wood fuel.
MAI value	Average MAI_{forest} based on ecological forest type, % of forest area and MAI based on IPCC 2019 Report and MAI_{other} for Trees outside Forest based on FSI Report. Hence the source of information is IPCC 2019 and Government Data of Forest Survey of India, Government of India.
$F_{forest,i}$, $F_{other,i}$	Forest Area is based on FSI Report, 2019, Government Data.

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

The ex-ante calculation of emission reductions is provided in section B.4.

Appendix 5. Further background information on monitoring plan

The information on monitoring plan is included in section B.7.

Appendix 6. Summary report of comments received from local stakeholders

The information is included in section E.

Appendix 7. Summary of post-registration changes

This 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.
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.

Version	*Date*	*Description*
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.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project activities, project design document