

**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006**

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Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	<ul style="list-style-type: none">• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at http://cdm.unfccc.int/Reference/Documents.
03	22 December 2006	<ul style="list-style-type: none">• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

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SECTION A. General description of small-scale project activity
A.1 Title of the small-scale project activity:

Social Education and Development Society (SEDS) Biogas CDM project for the rural poor
 Version: 6
 Date: 18 March 2010

A.2. Description of the small-scale project activity:

The Social Education and Development Society (SEDS) is a grass-root Non-Governmental Organization (NGO) working for the past 28 years in Anantapur District which is in South Western part of Andhra Pradesh, Southern India. The district is a drought-prone area. The main focus of SEDS is to help the poorest of the poor through integrated rural development activities with an emphasis on women's empowerment, watershed programmes, reforestation and natural resource management. SEDS is currently working in 128 villages, supporting 12,000 women and their families, 980 Self Help Groups, 120 Village Organizations & 5 Mandal Mahila Samakhya. Through its sustained efforts, SEDS has made a significant impact on the lives of the people in the area and the local environment with a motive to make a greener tomorrow¹.

The purpose of this Biogas CDM Project activity is to set up 5,000 biogas plants (digesters) of 2 m³ capacity each for single households in 5 Mandals of Anantapur District. Each household will install a 2 m³ biogas plant and feed cattle dung and other organic waste into the anaerobic digester for the production of biogas for cooking purpose and heating of hot water. 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 hot water heating.

By utilizing cattle dung in a controlled anaerobic digestion and combustion system, biogas will be available for cooking energy and heating hot water. The biogas will be used on a two-ring gas stove with a flame temperature of 870°C, supplied as part of the project activity. Households having cattle or willing to collect cattle dung will participate in the project. A list of 5,337² suitable and interested households is given in Appendix 1. The project would be implemented upon registration of the project as a CDM project activity, as the project will be financed completely from carbon revenues. 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 smoke in kitchen, thus eliminating health hazards from indoor air pollution.
- Energy supply security

¹ <http://sedsngo.org/>

² A list of 5,337 interested beneficiaries have been identified expecting some drop outs due to technical or other feasibility issues. Only 5,000 will be built under the project.

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- Better management of dung and organic wastes
- Improves education of children as women have more time and resources to nurture their children and send them to school

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 and reduced soil erosion.

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 other activities.

Technological benefits:

- Better biogas digester models, thus improving biogas yield.
- Training in chemistry of biogas for masons and users leading to improved scientific temper in community and more jobs.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or/public entity(ies) Project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as a project participant (Yes/No)
India (host)	Social Education and Development Society (SEDS)	No

(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.

A.4. Technical description of the small-scale project activity:**A.4.1. Location of the small-scale project activity:**

121 villages situated across the 5 Mandals of Roddam, Somandepalli, Penukonda, Chilamathur and Gorantla Mandals of Anantapur district. The list of 121 villages and 5,000 participating households is given in Appendix 1.

A.4.1.1. Host Party(ies):

India

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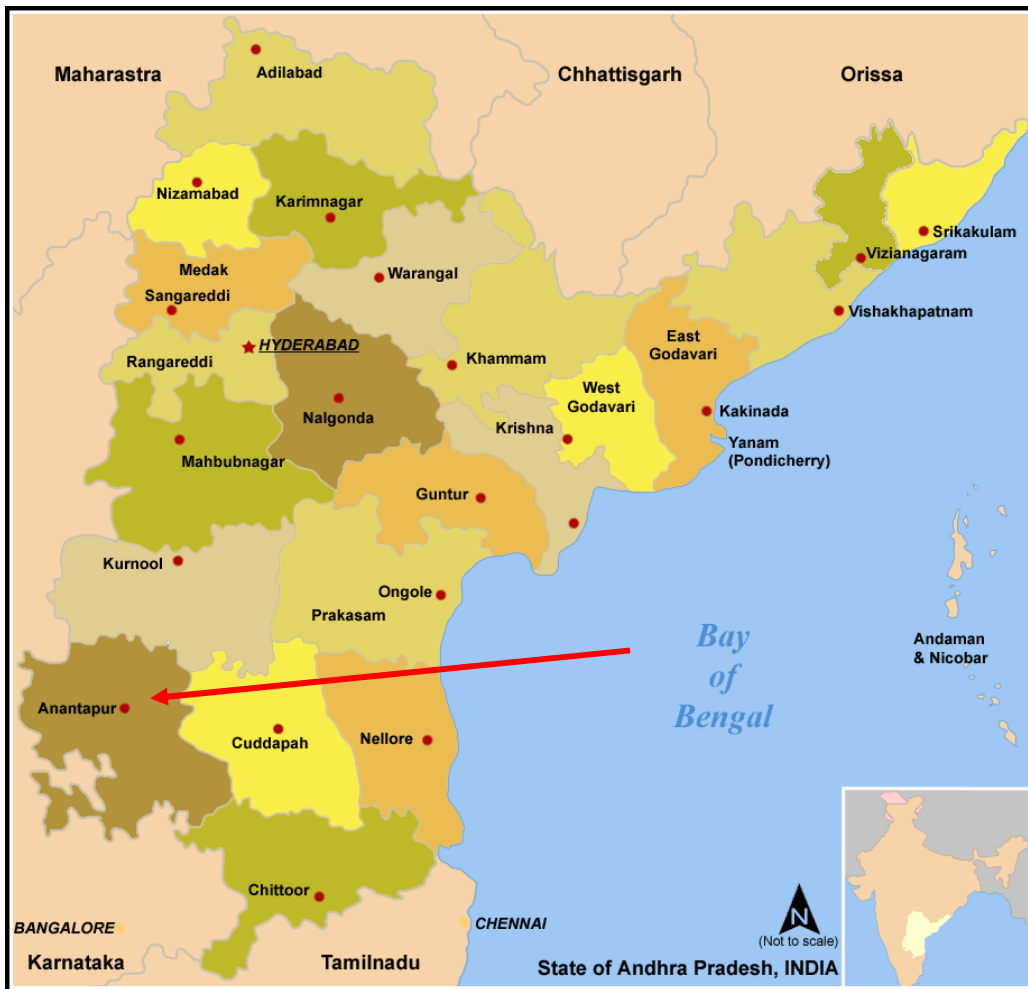
A.4.1.2. Region/State/Province etc.:

Andhra Pradesh

A.4.1.3. City/Town/Community etc:

121 villages in 5 Mandals of Anantapur District – Appendix 1

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :



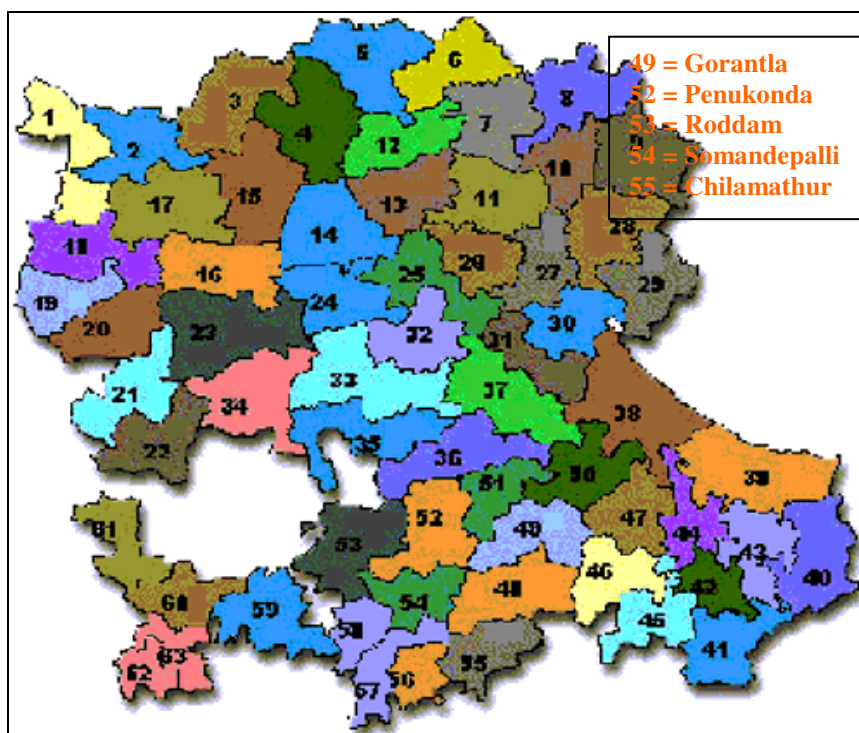


Figure 1: Map of Andhra Pradesh with an arrow indicating the location of Anantapur district and Anantapur district showing the Mandals in which the project will be implemented

Anantapur District lies between 13'- 40' and 15'-15' Northern Latitude and 76'-50' and 78'-30' Eastern Longitude. It is bound by Bellary, Kurnool District on the North, Cuddapah and Kolar Districts of Karnataka on South East and North respectively. The coordinates of the Mandals are as follows:

Mandals	Co-ordinates
Penukonda	14° 05' 00" North, 77° 35' 00" East
Roddam	14° 06' 00" North, 77° 26' 00" East
Somandepalle	14° 00' 44" North, 77° 36' 30" East
Gorantla	13° 59' 21" North, 77° 46' 13" East
Chilamathur	13° 34' 25" North, 80° 00' 12" East

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

The chosen type and category is TYPE I - RENEWABLE ENERGY PROJECTS, I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 01, EB 37. 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: biogas stoves are deemed a measure that involves the switch to renewable energy sources from non-renewable biomass in the baseline.

Technology/measure:

Biogas is a mixture of methane and carbon dioxide. It also has traces of hydrogen sulphide, 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 India³. The project activity will organize the 5,000 users to use cattle dung and organic wastes in individual household methane recovery systems of biogas for cooking and water heating. The 5,000 individual plants consist of a mixing chamber where 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.

A.4.3 Estimated amount of emission reductions over the chosen <u>crediting period</u>:

Please indicate the chosen crediting period and provide the estimation of total emission reductions as well as annual estimates for the chosen crediting period. Information of the emission reductions shall be indicated using the following tabular format.
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Years	Estimation of annual emission reductions in tonnes of CO ₂ e
2011	8,132
2012	16,264
2013	16,264
2014	16,264
2015	16,264
2016	16,264
2017	16,264
Total estimated reductions (tonnes of CO ₂ e)	105,716
Total number of crediting years	7
Annual average of the estimated reductions over the crediting period	15,102

³ Approved design by the Ministry of New and Renewable Energy. <http://mnes.nic.in/> <http://mnes.nic.in/>

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After registration of the project and securing CER forward finance funding, the project will be implemented in phases. During the first year 2,500 units will be built followed by another 2,500 in the second year totalling to 5,000 biogas units.

A.4.4. Public funding of the small-scale project activity:

There will be no public funding involved in the project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

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 a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

TYPE I - RENEWABLE ENERGY PROJECTS, I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 01, EB 37.

B.2 Justification of the choice of the project category:

This project is applicable as per the definition in the Annex B of the simplified methodologies for selected small-scale CDM project activity categories, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 01:

- The project activity comprises of biogas units that displaces the use non-renewable biomass by introducing new renewable end-user technology, the biogas stoves.
- There are no registered small-scale CDM projects existing in the same region as the proposed project activity. Thus the proposed project activity will save non-renewable biomass which is currently being used in the baseline by the beneficiaries.
- As shown in section B.4, the communities are using the non-renewable biomass since 31st December 1989.
- The capacity of the project activity is below 45 MW_{th} and will remain under the limits of small-scale project activity during every year of the crediting period as shown below.

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Activity Data	Value	Unit	Reference
$E = \eta \cdot H_b \cdot V_b$			
Where:			
E = Energy available from a biogas digester			
η = combustion efficiency of burners	60%		Reference: Biogas Technology, B.T. Nijajuna, New Age International Publishers, New Delhi, 2002
H_b = heat of combustion per unit volume of biogas	22.1	MJ/m ³	Deenabandhu Model, of 2 cum, construction
V_b = Volume of the biogas	2	m ³ /day	
	E =	26.52 MJ/day	Calculated $E = \eta \cdot H_b \cdot V_b$
	E =	7.37 kWh/day	Calculated @ 1 megajoule = 0.277 777 777 78 kilowatt hour
	E =	1.78 kW thermal Capacity	Calculated installed capacity of biogas
	E =	9 MW, thermal	Calculated for 5000 biogas units

B.3. Description of the project boundary:

In accordance with Paragraph 4 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 01:

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

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

B.4. Description of baseline and its development:

The baseline of the project is the usage of fuel wood. The project activity will replace the usage of non-renewable biomass.

In accordance with Paragraph 5 and 6 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 01:

It is assumed that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs.

And

Emission reductions would be calculated as:

$$ER_y = B_y * f_{NRB,y} * NCV_{Biomass} * EF_{projected_fossilfuel}$$

Where:

$$ER_y = \text{Emission reductions during the year } y \text{ in } tCO_2e$$

$$B_y = \text{Quantity of biomass that is substituted or displaced in tonnes}$$

$$f_{NRB,y} = \text{Fraction of biomass used in the absence of the project activity in year } y \text{ that can be established as non renewable biomass using survey methods}$$

$NCV_{Biomass}$ = Net calorific value of the non-renewable biomass that is substituted (IPCC default for wood fuel, 0.015 TJ/tonne)

$EF_{projected_fossilfuel}$ = Emission factor for the projected fossil fuel consumption in the baseline. The fossil fuel likely to be used by similar consumers is taken: 71.5 tCO₂/TJ for Kerosene.

Step 1: B_y is determined:

According to Paragraph 6 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 01:

B_y is determined by taking one of the two following options:

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

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

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

Where:

$HG_{p,y}$ = Quantity of thermal energy generated by the new renewable energy technology in the project in year y (TJ)

η_{old} = Efficiency of the system being replaced measured using representative sampling methods or based on referenced literature values

Adopting Option A:

The average annual consumption of biomass per appliance (t/yr) was derived from survey methods done scientifically. A sample survey was conducted covering 500 households or 10% of the project beneficiaries. The per capita fuelwood consumption is 1.85±0.04 t/year at 95% confidence level. The methodology adopted to conduct the survey is described in Annex 3. According to the survey, the annual consumption of biomass per appliance i.e. per family is **3.37 t/yr (average family size is 5 members)**.

Conservativeness of biomass consumption estimate

There are no published data on the fuelwood consumption in the project area, i.e. at the mandals or Anantapur district. But an exhaustive study was conducted in the neighbouring district of Kolar, Karnataka, with similar agro-ecological situation⁴, which is 30 kms away from the project area. The results from this study are compared to the sample survey. The fuelwood and kerosene use for cooking in

⁴ T V Ramachandra , S Vamsee Krishna and B V Shruthi. Decision Support System for Regional Domestic Energy Planning. Journal of Scientific & Industrial Research Vol. 64, March 2005, pp 163-174.

kolar district is shown in Table 1. Of course this survey was conducted across all socio-economic sections of rural Kolar.

Table 1: Fuelwood and kerosene usage in the neighbouring Kolar district of the project area

	Fuelwood for cooking (t/family/yr)	Kerosene for cooking (lts/family/yr)	Energy Equivalent (MJ)	Resource/Demand⁵
Bagepalli	3.69	101.00	7355	0.1490
Bangarpet	2.42	89.00	5240	0.1518
Chikballapur	3.32	56.60	5996	0.4220
Chintamani	2.48	59.80	4803	0.1200
Gauribidanur	3.69	26.60	6019	0.1550
Gudibanda	3.58	49.40	6267	0.1590
Kolar	2.32	90.40	5119	0.3259
Malur	2.46	69.00	4933	0.2122
Mulbagal	3.27	52.20	5852	0.1840
Sidlaghatta	2.30	37.80	4132	0.1730
Srinivasapur	3.33	34.40	5613	0.3858
Average	2.99	60.56	5,575	22%

The study shows that the average annual fuelwood use is 2.99 t/family/yr and kerosene use is 60 lts/family/yr. Together it provides an energy equivalent of 5,575 MJ/year.

Comparatively, in the project area, the sample survey shows fuelwood use of 3.37 t/family/yr and negligible kerosene usage (0.93 lts/family/yr), providing energy equivalent of 5,072 MJ/yr (Table 2). The families use less of kerosene and more of biomass for cooking. This is due to the fact that availability of kerosene is limited to just 2 litres in the PDS system and they are not able to procure from the open market at higher prices. The beneficiaries are from the lower economic strata and will not spend on buying kerosene from the open market (at the rate of Rs.30/ltr) and rather collect biomass with no costs. This is evidenced by the fact that the per capita income of families is far less than 1\$/day.

A survey by the Government of India showed that rural households belonging to the lower MPCE (Monthly Per Capita Expenditure) classes used more firewood than any other fuel type (Figure 2) and among different household occupational types in rural India, the percentage of households using firewood was highest for agricultural labour households⁶. This is in concurrence with the survey conducted in the project area. Thus the fuelwood use of **3.37 t/family/yr** can be taken as conservative.

⁵ T.V. Ramachandra and G.R.Rao, 2005. Inventory, Mapping and Monitoring of Bioresources using GIS and remote sensing. In: Geospatial Technology for Developmental Planning. Pp 49 – 76.

⁶ 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

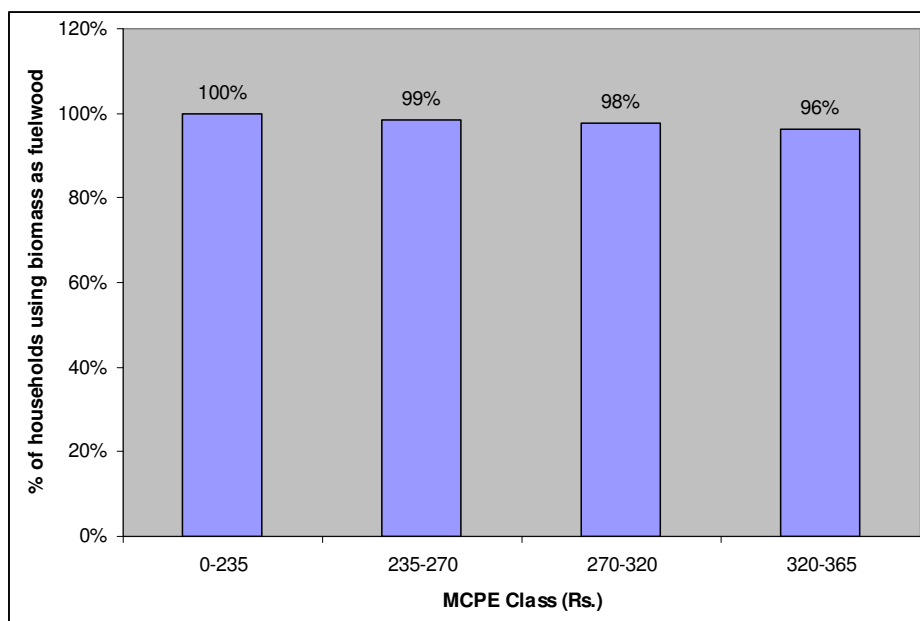


Figure 2: Percent of families using biomass as fuelwood in the lower income group in rural areas of Andhra Pradesh, India based on NSSO data, 2007

Table 2: Comparative energy use in the project area and neighbouring district

Parameters	In the project area based on survey	Third party study in the neighbouring district
Total Fuelwood Use/family/year (t)	3.37	2.99
NCV of wood GJ/ton	15	15
Efficiency of traditional Stove (%)	10%	10%
Energy delivered to the pot MJ	5,055	4481
Kerosene used (litres/yr)	0.93	60.56
Density of kerosene (kg/l)	0.75	0.75
NCV of kerosene (TJ/Gg)	43.8	43.8
Efficiency of kerosene stove (%)	55%	55%
Energy delivered to the pot (MJ)	17	1094
Total energy used for cooking (MJ)	5,072	5,575

Adopting option a, the B_y value is shown below

Amount of Biomass using survey method - option a)	
Item	Value
Number of Biogas Units	5,000
Average annual biomass consumption per biogas Unit (tonnes/year)	3.37
B_y = Quantity of Biomass that is substituted or displaced (in tonnes)	16,850

The quantity of biomass that will be substituted or displaced is 16,850 t/year.

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

In accordance with Paragraph 7 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 01:

Project participants must determine the share of renewable and non-renewable biomass in the total biomass consumption using nationally approved methods (e.g. surveys or government data if available) and determine $f_{NRB,y}$.

To operationalize the concept of non-renewable in the context of household energy i.e. biogas unit for cooking and hot water bath, the following step-wise approach was followed:

- The notion of non-renewable in the context of fuelwood consumption is understood as fuelwood consumption that contributes to deforestation or degradation. The critical factor is whether the consumption is greater than the increase in sustainable biomass growth. Biomass would be reduced in absolute terms beginning at the point where the consumption exceeds the rate of growth, as shown below:

$$\frac{G_b}{D_b} < 1; \text{ Where } G_b = \text{growth in biomass}; D_b = \text{use of biomass}$$

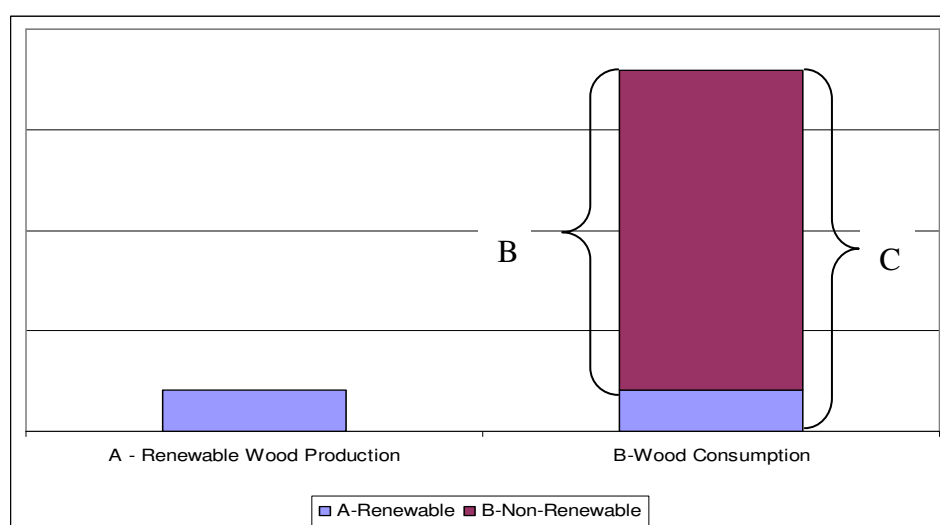


Figure 3: Concept of renewable and non-renewable wood

- As shown in Figure 3, non-renewable fuel wood consumption (B) is defined as any wood consumption (C) beyond the level of renewable wood production (A). The household fuelwood consumption in India is a driver for forest deforestation / degradation. The household fuelwood consumption is far greater than the annual increment of wood in forests and on non-forest land.
- It is this concept based on which national study was conducted by the Forest Survey of India, Ministry of Environment and Forests, Government of India to assess the fuelwood demand and availability at the state and national level in India during 1995.

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- Based on national, local, remote sensing data and peer-reviewed research papers, the renewable and non-renewable component of biomass has been established as detailed below and shown in Table 3.

Renewable Biomass

The land use pattern for the 5 mandals⁷ in which the project will be implemented is as follows:

Table 3 – Mandal wise land utilization pattern for 2008⁸ (ha)

Name of the mandal	Penukonda	Somand epalli	Roddam	Chilamathur	Gorantla	Total	% of Geographic area
Forest	6,180	1,525	1,817	2,192	5,296	17,010	11%
Barren & uncultivable land	8,276	2,000	3,928	1,512	2,013	17,729	12%
Land put to agricultural use	1,107	2,730	1,201	1,864	2,499	9,401	6%
Permanent pastures & other grazing lands				395	316	711	1%
Misc. Tree crops & groves not included in net area sown	209	64	182	735	16	1,206	1%
Cultivable waste	562	307	475	800	140	2,284	2%
Other fallow lands	949	4,359	4,004	1,425	439	11,176	7%
Current fallows	3,421	2,921	1,494	3,000	2,802	13,638	9%
Net area sown	12,134	7,969	22,736	12,150	21,345	76,334	51%
Geographical area	32,838	21,875	35,837	24,073	34,866	149,489	100%

I. The biomass is originating from land areas that are forests where:

- The land area remains a forest; and
- Sustainable management practices are undertaken on these land areas to ensure, in particular, that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and
- Any national or regional forestry and nature conservation regulations are complied with.

The area classified as forests is as follows:

- The total area under forests is 17,010 ha (Table 3). This area will remain as forests.
- These forests are classified as Tropical Dry Deciduous. Undertaking sustainable management practices on these land areas to ensure that there is no systematic decrease of carbon stocks, the sustainable rate of extraction from tropical dry deciduous forests are 0.22 t/ha/yr (Ravindranath *et al.* 2001⁹).

⁷ Mandal: Administrative unit below the district consisting of a group of villages with administrative and local government functions.

⁸ Hand Book of Statistics – Anantapur District, Chief Planning Officer, Anantapur, 2008

⁹ Ravindranath, N.H., Sudha, P & Sandhya Rao. 2001. Forestry for sustainable biomass production and carbon sequestration in India. Mitigation and Adaptation Strategies for Global Change 6: 233-256.

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- (c) Thus the renewable biomass component from the project area is Area (ha) x sustainable harvest (t/ha/yr) = 17,010 x 0.22 = 3742.2 t/year.
- (d) This estimation is conservative as the legal area classified as forests is considered. The actual area under forest vegetation according to satellite imagery is far lesser. For Anantapur district, the total area officially under forests is 10%⁸, while according to satellite imagery the actual area under forest vegetation is 2.14% of geographic area¹⁰.

II. The biomass is woody biomass and originates from croplands and/or grasslands where:

- i. The land area remains cropland and/or grasslands or is reverted to forest; and
- ii. Sustainable management practices are undertaken on these land areas to ensure in particular that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and
- iii. Any national or regional forestry, agriculture and nature conservation regulations are complied with.

Here along with cropland, all other land use categories that have woody biomass are considered. Accordingly the following land use classification as given in Table 3, are considered under this category:

- (a) Land put to agricultural land; (b) Permanent pastures & other grazing lands, (c) Cultivable waste (d) Other fallow lands, (e) Current fallows and (f) Net area sown
- The total area under (a) to (f) is 131,273 ha.
 - The total number of trees on these lands is 12.76 trees/ha¹¹. This is based on studies conducted by Forest Survey of India, Ministry of Environment and Forests, Govt. of India, for the trees on culturable non-forest land (FSI, 2007).
 - Total Culturable Non-Forest land¹² (CNFA) is defined as the net geographical area lying outside recorded forest and forest cover, which can support tree vegetation (excluding areas under wetlands, riverbeds, perennial snow covered mountains, etc.). Thus this area includes all lands other than forests.
 - Average standing biomass of CNFA in the project area is 3.06 t/ha. This is based on the following calculations:
 - o The project area falls under SOUTH DECCAN physiographic zone (FSI, 2007)
 - o Based on the number of trees and standing stock of South Deccan, the standing biomass per tree is 0.24 t (FSI, 2007¹³)
 - o Thus total standing biomass is 12.76 trees/ha x 0.24 t/tree = 3.06 t/ha
 - The mean annual increment is 2.84% of the standing biomass (Shailaja and Sudha, 1997¹⁴). Thus the mean annual increment is 0.087 t/ha/yr
 - The sustainable harvest = mean annual increment = 0.087 t/ha/yr
 - Thus the renewable biomass component for this land use for the project area is

¹⁰ <http://www.fsi.nic.in/sfr2005/Chapter%208/Andhra%20Pradesh.pdf> Satellite imagery information by FSI is given at district level.

¹¹ FSI, 2007. <http://www.fsi.nic.in/sfr2005/chapter5.pdf>

¹² FSI, 2007. <http://www.fsi.nic.in/sfr2005/glossary.pdf>

¹³ FSI, 2007. <http://www.fsi.nic.in/sfr2005/chapter6.pdf>

¹⁴ Shailaja Ravindranath and Sudha Premnath. 1997, Biomass Studies. Field Methods for Monitoring Biomass. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

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Area (ha) x sustainable harvest (t/ha/yr) = 131,273 ha x 0.087 t/ha/yr = 11,417 t/year.

- (b) Misc. Tree crops & groves not included in net area sown
- The total area under tree crops is 1206 ha.
 - Sustainable extraction rate is 2 t/ha/yr (Ravindranath *et al.*, 2001)⁹.
 - Total sustainable biomass is 1206 ha x 2 t/ha/yr = 2412 t/yr.

Thus summarizing the above steps, Table 4 below shows the renewable biomass available as fuelwood.

Table 4: Renewable Biomass Calculations for the project area

Activity Data	Value	Source
RENEWABLE BIOMASS IN THE PROJECT AREA		
Geographical Area of 5 Mandals (ha)	149,489	Hand Book of Statistics, 2008 ⁸
I. Renewable biomass from forests		
Forest Land (ha)	17,010	Hand Book of Statistics 2008 ⁸
% of forest land classified as tropical dry deciduous	100%	Anantapur Forest Department
Sustainable rate of fuelwood extraction from Tropical Dry Deciduous Forests (t/ha/yr)	0.22	Ravindranath <i>et al.</i> 2001 ⁹
Renewable biomass extraction from forests (t/ha)	3,742	Area x sustainable rate of extraction
II. Renewable biomass from Culturable non-forest land		
Total Culturable Non-Forest land (ha)	131,273	Hand Book of Statistics 2008 ⁸
No of trees/ha of Culturable Non Forest Area (trees/ha)	12.76	FSI, 2007¹¹
Mean Annual Increment (as % of standing biomass)	2.84%	Shailaja and Sudha, 1997 ¹⁴
Average Standing biomass/tree (t)	0.24	FSI, 2007
Average Standing biomass/ha (t)	3.06	Calculated (No of trees/ha x standing biomass/tree)
Mean Annual Increment (t/ha)	0.09	Calculated (2.84% of standing biomass)
Sustainable extraction from trees on CNFA (t)	11,417	Area x sustainable rate of extraction
III. Renewable biomass from Plantation		
Plantation area including trees and groves (ha)	1,206	Hand Book of Statistics, 2008 ⁸
Sustainable extraction rate from plantations (t/ha/yr)	2.00	Ravindranath <i>et al.</i> 2001 ⁹
Sustainable extraction from plantations (t)	2,412	calculated
Total Renewable biomass in the project area		
Total Renewable Biomass available (t)¹⁵	17,571	Total of I, II and III

The fuelwood requirement of the mandal and the renewable and non-renewable biomass used is shown below:

FUELWOOD REQUIREMENT FOR THE 5 MANDALS		
Population (Households)	63,899	Hand Book of Statistics, 20088
% of households reliant on biomass for cooking in Andhra Pradesh	80.3%	NSSO 20076
Fuelwood requirement per HH (t/yr)	3.37	Based on household survey
Total fuelwood requirement (t/yr)	172,918	calculated
Availability ratio	10%	calculated
Fraction of non renewable biomass used in the absence of the project activity $f_{NRB,y}$	90%	

¹⁵ Sustainable extraction from all land use - forests, croplands, grasslands and wastelands have been considered.

The fraction of biomass used in the absence of the project activity that is non-renewable is 90%.

Complementary studies for non-renewable biomass

To complement the survey results, other national and local studies have been provided.

- According to the National Forestry Action-Programme India, Ministry of Environment and Forests, Govt. of India,¹⁶ “the per capita availability of forestland in India is one of the lowest in the world, 0.08 hectares, against an average of 0.5 hectares for developing countries and 0.64 hectares for the world. The consumption of fuelwood in India is about five times higher than what can be sustainably removed from forests. The bulk of wood consumed in India is for burning. Fuelwood meets about 40 per cent energy needs of the country. The estimated fuelwood consumption in the country is about 380 million cu.m. About 70 percent of the fuel-wood is accounted for by households. Around 80 percent of the rural people and 48 per cent of urban people use fuel-wood.”
- The Forest Survey of India, Ministry of Environment and Forests, Govt. of India conducted a study on demand and supply of fuelwood, timber and fodder in India¹⁷. Projection of annual fuelwood wood and its sustainable availability has been determined at the state level. According to the study, in Andhra Pradesh State, the total annual consumption of fuelwood during 2006 is 13.7 million tonnes of which only 1.4 million tonnes is sustainably available. Thus at the state level, the renewable fuelwood available accounts to 10%. Thus the non-renewable wood as worked out at the project level is in agreement with the studies conducted by the Govt. of India.
- Further at the district level, the total forest cover of Anantapur district is a mere 2.14% of the total area (Table 5 and Figure 4)¹⁰. The district is the second most drought-affected district of India^{18,19}. Over the years the process of desertification has been taking place in large tracts of the district because of degradation of the forests. The landscape is undulating and has large arid, treeless expanses of poor soils due to large-scale lopping of the trees and shrubs in the patches of green.
- According to the National Remote Sensing Agency (2005), based on remote sensing satellite imagery, the percentage of wastelands (from 16.9% to 18.7%) and the degraded forests in Anantapur increased between 1995 and 2005^{20,21}. Today the remaining forests provide very little wood for fuel while the continuous usage of them further is damaging the vegetation and soil¹⁸. According to the remote sensing satellite imagery, the only forests in the district are very scanty and disperse scrub and open forests (Table 5).

¹⁶ <http://envfor.nic.in/nfap/pressure-forest.html>¹⁶ <http://envfor.nic.in/nfap/pressure-forest.html>

¹⁷ FSI, 1996. Fuelwood, timber and fodder from forests of India: Demand and Supply of Fuelwood, Timber and Fodder in India. Forest Survey of India, MoEF, Govt. of India.

¹⁸ <http://www.timbaktu.org/conditions.html>¹⁸ <http://www.timbaktu.org/conditions.html>

¹⁹ <http://www.anantapur.gov.in/html/agri-dep-profile.htm>¹⁹ <http://www.anantapur.gov.in/html/agri-dep-profile.htm>

²⁰ Wasteland Map of India, 1986 and 2005, National Remote Sensing Agency, Hyderabad.

²¹ Andhra Pradesh Human Development Report, 2007. Govt of Andhra Pradesh

Table 8.1c: District-wise forest cover

Number of Districts: 23

(area in km²)

District	Geographic area	2005 Assessment				Percent of G.A.	Change	Scrub
		Very dense forest	Mod. dense forest	Open forest	Total			
Adilabad ^T	16,128	37	3,640	2,440	6,117	37.93	0	139
Anantapur	19,130	0	73	337	410	2.14	0	945

Table 5: Forest Cover of Anantapur district based on Remote Sensing Satellite Imagery. Source: Forest Survey of India, Ministry of Environment and Forests, Govt. of India.

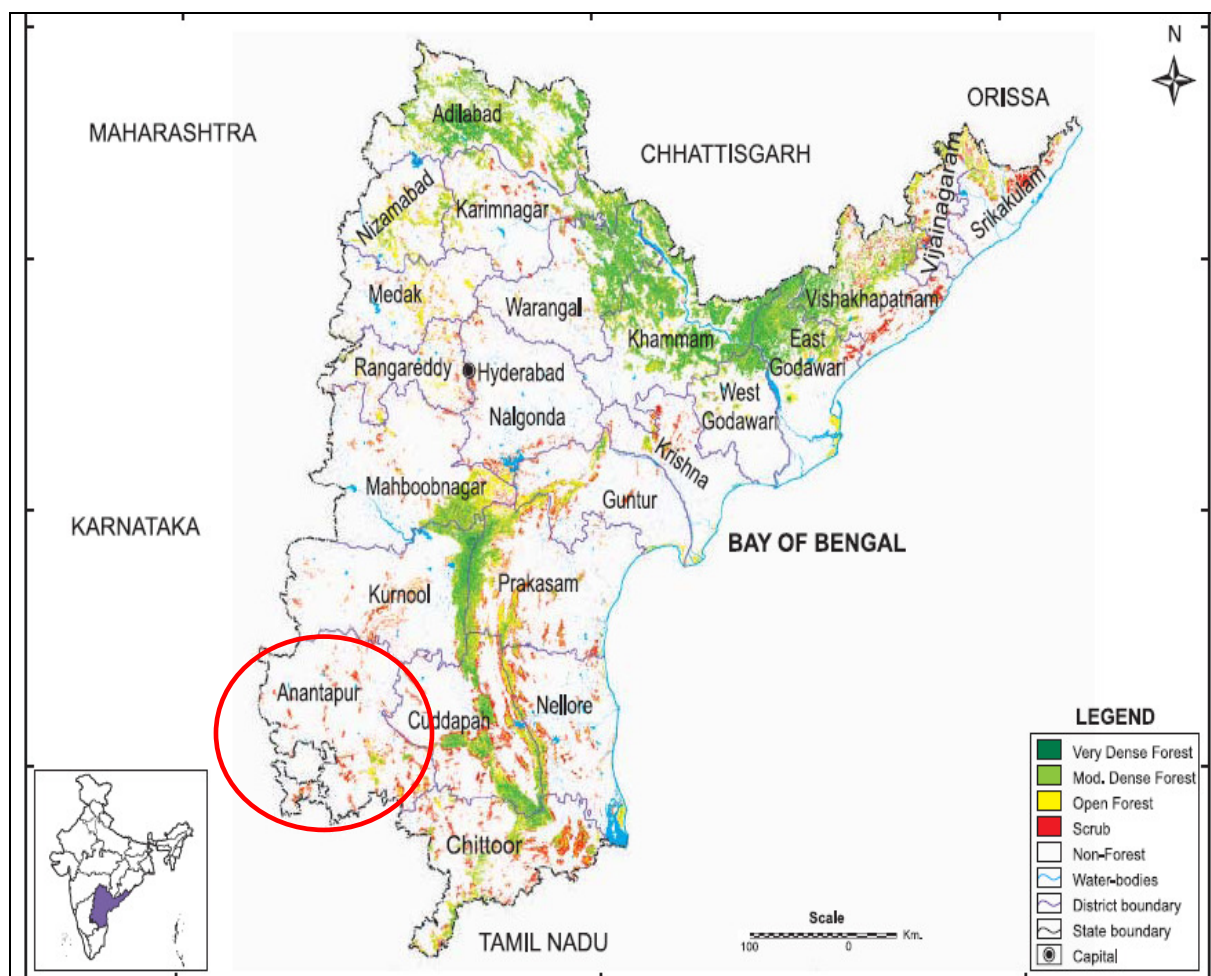


Figure 4: Forest Cover Map based on Remote Sensing of Andhra Pradesh State showing Anantapur district. Source: Forest Survey of India, Government of Environment and Forests, Govt. of India.

A socio-economic survey was conducted by SEDS in the project area to study the trends in time spent, distance traveled and trends in fuel wood prices over the past 20 years. All the respondents in the survey are experiencing greater distances to travel and more time spent to collect fuel wood over the years. The

fuel wood prices over the 20 years period have increased more than 5 times (Figure 5). Of course these trends are not due to any enforcement of national or local regulations.

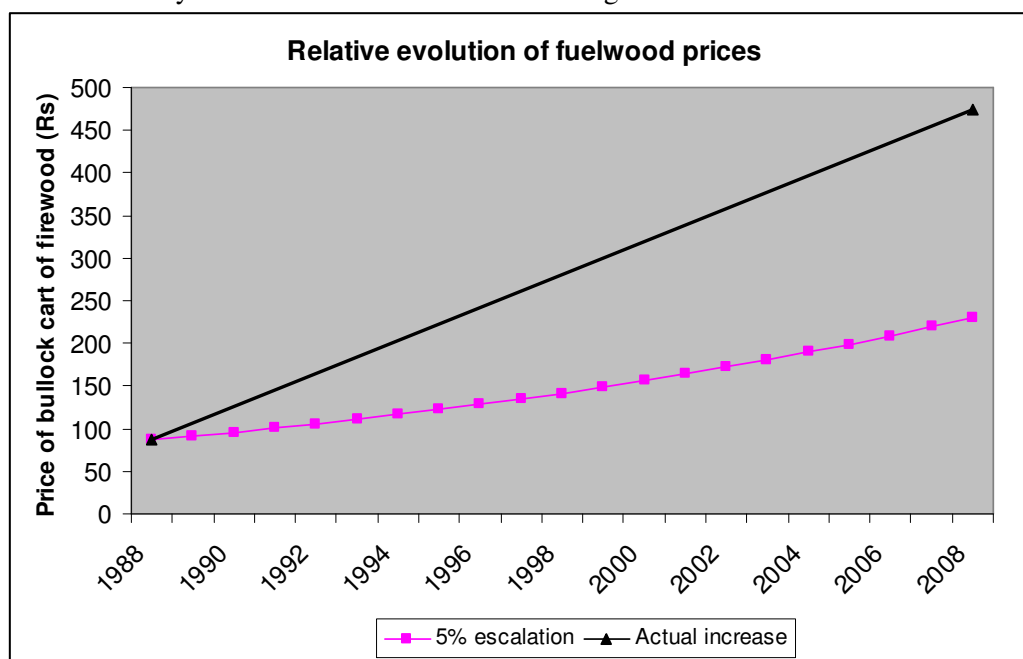


Figure 5: Relative escalation of the fuelwood prices (5% per year corresponds to the average inflation rate in India since 1990)

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

The district is facing fuelwood crisis since many years as the area has scanty vegetation (Figure 6). The use of non-renewable biomass since 1989 is demonstrated below applying the same steps as shown above. As can be seen from Table 6, 87% of the biomass used as fuelwood was non-renewable biomass. The non-renewable use of biomass has increased over the past 20 years though large-scale plantations are being promoted in the district by the Forest Department. This is due to the fact that the population has increased by 20% over the past 20 years.

Table 6: Use of non-renewable use in 1989 in the 5 Mandals of the project area.

Activity Data	Value	Source
RENEWABLE BIOMASS IN THE PROJECT AREA		
Geographical Area of 5 Mandals (ha)	147,575	Hand Book of Statistics 1988-89 ²²
I. Renewable biomass from forests		
Forest Land (ha)	23,678	Hand Book of Statistics 1988-89
% of forest land classified as tropical dry deciduous	100%	Anantapur Forest Department
Sustainable rate of fuelwood extraction from Tropical Dry Deciduous Forests (t/ha/yr)	0.22	Ravindranath <i>et al.</i> 2001 ⁹
Renewable biomass extraction from forests (t/ha)	5,209	Area x sustainable rate of extraction
II. Renewable biomass from Culturable non-forest land		
Total Culturable Non-Forest land (ha)	122,919	Hand Book of Statistics 1988-89

²² Hand Book of Statistics – Anantapur District, Chief Planning Officer, Anantapur, 1990

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No of trees/ha of Culturable Non Forest Area (trees/ha)	11.2	FSI, 2003²³
Mean Annual Increment (as % of standing biomass)	2.84%	Shailaja and Sudha, 1997¹⁴
Average Standing biomass/tree (t)	0.24	
Average Standing biomass/ha (t)	2.67	Calculated (No of trees/ha x standing biomass/tree)
Mean Annual Increment (t/ha)	0.08	Calculated (2.84% of standing biomass)
Sustainable extraction from trees on CNFA (t)	9,384	Area x sustainable rate of extraction
III. Renewable biomass from Plantation		
Plantation area including trees and groves (ha)	977	Hand Book of Statistics 1988-89 ²²
Sustainable extraction rate from plantations (t/ha/yr)	2.00	Ravindranath et al. 2001 ⁹
Sustainable extraction from plantations (t)	1,955	calculated
Total Renewable biomass in the project area		
Total Renewable Biomass available (t)²⁴	16,547	Total of I, II and III
FUELWOOD REQUIREMENT FOR THE 5 MANDALS		
Population (Households)	46,415	Hand Book of Statistics 1988-89 ²³
% of households reliant on biomass for cooking	82.3%	Govt of India, Census of India, 2001
Fuelwood requirement per HH (t/yr)	3.37	Based on household survey
Total fuelwood requirement (t/yr)	128,732	calculated
Availability ratio	13%	calculated
Fraction of non renewable biomass used in the absence of the project activity $f_{NRB,y}$	87%	Calculated

²³ FSI 2003. State of Forest Report 2001, Forest Survey of India, Govt. of Environment and Forests, Govt. of India. 2003. <http://www.fsi.nic.in/sfr2001/Andhra%20Pradesh.pdf>

²⁴ Sustainable extraction from all land use - forests, croplands, grasslands and wastelands have been considered.

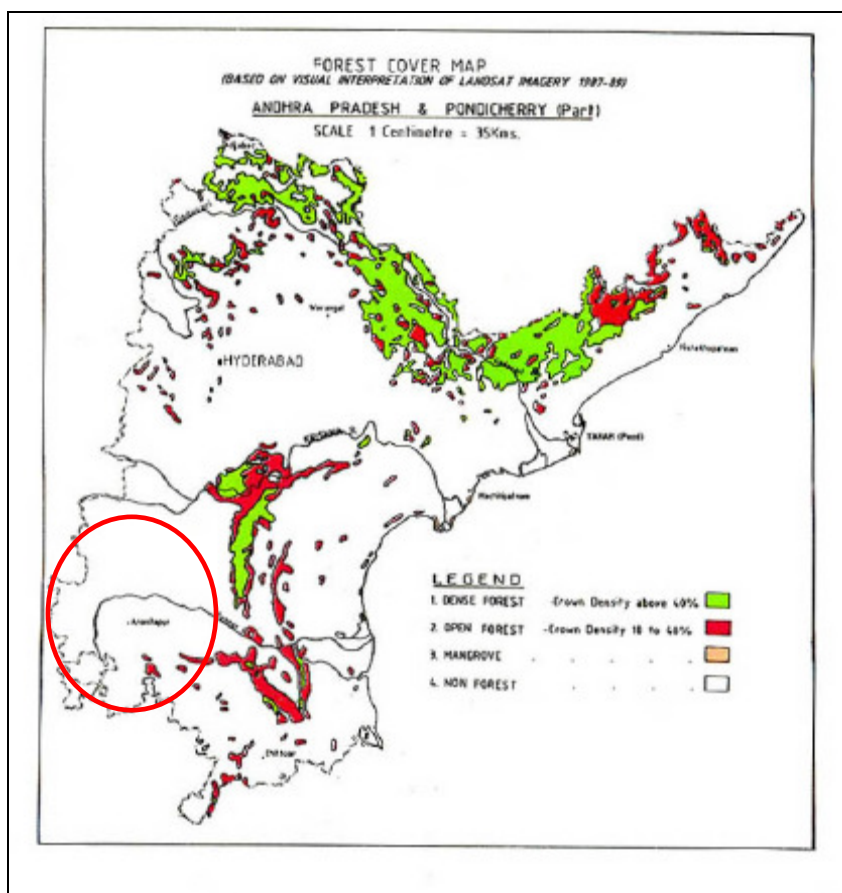


Figure 6: Forest Map of Andhra Pradesh for 1989 showing the project area.

Step 3: Choosing EF_{projected_fossilfuel}

According to Paragraph 6 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 01, this should be *the fossil fuel likely to be used by similar consumers*.

At the district level and in the 5 mandals of the project area, households having LPG connections are far below that procuring kerosene⁸. Kerosene is used to a small extent as a cooking fuel by rural households in the 5 mandals of Chilamanthur, Somandepalli, Gorantla, Penukonda and Roddam. This is also illustrated in the findings of the fuel usage study carried out across 19 villages of these mandals, which also indicates an absence of LPG use:

Type	Fuel wood	Dung	Crop Residue	Coal	Kerosene	LPG
Number of respondents utilising the fuel	500	0	497	0	18	0
% of respondents	100	0	99.4	0	3.6	0

Two litres of kerosene are supplied each month via the public distribution system in Anantapur district at a subsidised rate of Rs. 10 per litre to ration card holders with an annual income of Rs. 14,000 or below. The project beneficiaries fall into this category.

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There are no technological barriers preventing the use of kerosene as a cooking fuel in the local rural area. A 1-litre hand pump kerosene stove costs approx Rs. 300 and is widely available in regional market towns. Similarly there are no prevailing practice barriers preventing the use of kerosene as a cooking fuel. The rural population are aware of its availability and how to utilize a hand pump kerosene stove.

In the case of LPG there are investment barriers, technological barriers and prevailing practice barriers prohibiting it in the rural context. A 12 litre cylinder of LPG costs approximately Rs.400 and will last one month per family to meet all cooking / hot water requirements. This represents a substantial cost to be met by these poor families. A lack of infrastructural support (e.g. lack of facilities for refilling at doorstep) further prohibits the widespread adoption of LPG in the rural context. Based on a survey by NSSO, the penetration of LPG for cooking in rural areas is far below that of kerosene. Taking all of this into account kerosene is the likely fossil fuel to be consumed by the project participants and is taken as the projected fossil fuel.

Step 4: Calculating ER_y

$$ER_y = B_y * f_{NRB,y} * NCV_{Biomass} * EF_{projected_fossilfuel}$$

Calculation for Emissions Reduction		
Activity Data	Value	ID Ref
Quantity of Biomass that is substituted (t/yr)	16,850	B_y
Fraction of biomass established as non-renewable	90%	$f_{NRB,y}$
NCV Biomass (TJ/t)	0.015	$NCV_{biomass}$
Emission factor Kerosene (tCO ₂ /TJ)	71.5	$EF_{projected_fossilfuel}$
Emission Reductions (tCO₂/yr)	16,264	ER_y
Emission reduction (tCO ₂ /year/family)	3.25	

This equates to emissions reduction of 3.25 tCO₂/ household/yr.

Step 5: Ex-ante Leakage

Paragraphs 8 and 10 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 0, states that:

If the project activity includes substitution of non-renewable biomass by renewable biomass, leakage in the production of renewable biomass must be considered using the general guidance on leakage in biomass project activities.

And

If the equipment is transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered.

The project does not involve the substitution of non-renewable biomass with renewable biomass, nor will any equipment be transferred from another activity as all units are to be built new specifically for the project. The project will also not result in the displacement of people or activities. Therefore leakage will not take place.

Leakage relating to the non-renewable biomass shall be assessed from ex-post surveys of users and areas from where biomass is sourced. As per the methodology, the following potential sources of leakage are:

- a. Use/diversion of non-renewable biomass saved under the project activity by non-project households/users who previously used renewable energy sources. If this leakage assessment quantifies an increase in the use of non-renewable biomass used by the non project households/users attributable to the project activity then B_y is adjusted to account for the quantified leakage.
- b. Use of non-renewable biomass saved under the project activity to justify the baseline of other CDM project activities can also be potential source of leakage. If this leakage assessment quantifies a portion of non-renewable biomass saved under the project activity that is used as the baseline of other CDM project activity then B_y is adjusted to account for the quantified leakage.
- c. Increase in the use of non-renewable biomass outside the project boundary to create non-renewable biomass baselines can also be potential source of leakage. If this leakage assessment quantifies an increase in use of non-renewable biomass outside the project boundary then B_y is adjusted to account for the quantified leakage.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

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:

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

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

There is no investment barrier to the continued use of non renewable biomass for cooking. The use of traditional wood stoves represents the baseline situation in the local area with an emission of 3.25tCO₂/family/yr. The traditionally used stoves come in 3 basic categories; traditional mud stove and improved vented mud stove costing about Rs.200 and basic 3 rock stove with no costs. The running cost of all of these stoves is also not considered an investment barrier as biomass is collected free from local wasteland, forest land, and agricultural land²⁵. The rural poor do not have much cash to spend on energy and use the fuels they collect to meet their cooking needs²⁶. Therefore, at the national level 75% of the households⁶ and at the state level in Andhra Pradesh 80% of the households⁶ use firewood as the primary source of energy in rural areas.

For the use of kerosene as the main fuel, two litres of kerosene are supplied each month via the public distribution system in Anantapur district at a subsidised rate of Rs.10 per litre to ration card holders. Additional kerosene can be bought at the market rate of Rs.35 per litre. Approximately 1.25 litres of kerosene are required to meet the cooking requirements of an average rural household per day. Reliance

²⁵ N.C. Saxena. Forest, People and Profit net equations for sustainability. Planning Commission, Govt. of India.

²⁶ 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

on kerosene as the sole cooking fuel would equate to a monthly cost of Rs. 1300 for the average family and is thus not a viable alternative for any of the participating families. The survey revealed an average monthly consumption of only 0.07 litres per household for cooking purposes. 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 level⁶.

A 12 litre cylinder of LPG costs approximately Rs. 400 and will last an average family approximately one month if used to meet all cooking/hot water requirements. An LPG connection (deposit for the pressurised cylinder/canister) and stove constitute a large upfront cost (when compared with the equipment for other fuels), so that some who can afford the fuel cannot make the initial investment²⁷. LPG appears to be the preferred option for those able to afford the initial and refill costs. But it is unaffordable by the rural families. This represents substantial a cost to be met by any of the families participating in this biogas project. There is also a lack of infrastructural support (e.g. lack of facilities for refilling at doorstep) that further prohibits the widespread adoption of LPG in the rural context. Currently, rural areas of the country are located far from distribution centres, so that users have to pay for the extra costs of cylinder supply. Moreover, for small and remote markets, refills often take more than a week. 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.

An individual 2 meter cubed biogas unit costs approximately Rs.12,500²⁸ (inclusive of cook stove and pipe). 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. A socio economic reality that further confirms this fact is that 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. According to NEDCAP, the state nodal agency responsible for the implementation of the NPBD programme, 2.84 lakh family biogas plants have been installed within the state of Andhra Pradesh to date. They estimate the overall potential to be 10.9 lakh units²⁹. Based on 2001 census, only 0.7% of the households were using biogas for cooking at the state level³⁰. In the past 5 years, on an average, 1,000 biogas units/year have been built in the district, where as based on the livestock population the potential in the district is approximately 275,000. Even with subsidies it is beyond the reach of the rural poor communities.

²⁷ 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.

²⁸ <http://www.solutionexchange-un.net.in/environment/cr-public/cr-se-wes-18070601-public.pdf>
<http://www.solutionexchange-un.net.in/environment/cr-public/cr-se-wes-18070601-public.pdf>

²⁹ Non Conventional Energy Development Corporation of Andhra Pradesh (NEDCAP),
<http://www.aponline.gov.in/apportal/departments/departments.asp?dep=05&org=58&category>About>

³⁰ Census of India, 2001. Government of India.

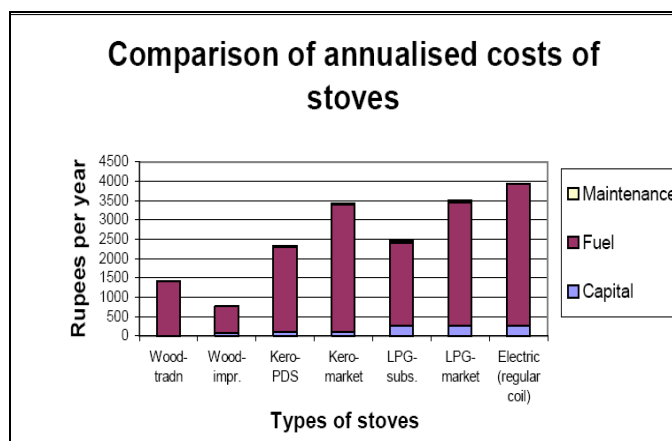


Figure 7: Comparison of annualized costs of stoves for cooking²⁷

Thus the continued combustion of non-renewable biomass fuel for cooking and water heating is the cheapest option (Figure 7), leading to higher GHG emissions. Thus even now all the households use traditional fuel wood stoves for cooking and water heating in the mandals.

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. SEDS 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.

(b) 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 so that it is suited to the local conditions at each plot of land where it is to be constructed³¹. 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.

³¹ Shaik 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.

(c) *Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;*

The prevailing practice by the public sector in A.P and also in India today is to make kerosene as cooking fuel available to families below the poverty line through the public distribution system at subsidized prices. The public distribution system for subsidised fossil fuel in the cooking fuel sector (including LPG) is working well. However, in many cases the kerosene is still too expensive for families to buy in the open market and only 2 litres per month is given through the Public Distribution System. 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 areas³². An important reason for this is that subsidized fuel is not always available to the poor³². In rural India, biomass is more easily available and access to LPG more difficult than in urban areas. This explains the lower use of kerosene and LPG among all expenditure class of the rural areas.

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 wood³³. It is a central sector scheme covered under 20-point programme. According to NEDCAP, the state nodal agency responsible for the implementation of the NPBD programme, 2.84 lakh family biogas plants have been installed within the state of Andhra Pradesh to date. They estimate the overall potential to be 10.9 lakh units²⁹. 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. The household biogas plants that already exist have been built by individuals benefiting from a central subsidy (ranging between Rs.3500 – 2100 depending on beneficiaries economic status³⁴). Even with subsidies, it is beyond the reach of the poor rural communities. To date this programme has resulted in very less penetration of biogas units being built inside the project boundary. 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. Thus a fossil-fuel based approach has come to dominate National and State level cooking fuel policy. The Central and State Government through subsidies has just supported about 5000 biogas units, on an average of 1000 biogas plants annually in Anantapur District in the past 5 years²⁹, while the potential is 275,000 in the district. These were largely implemented by rich farmers and the poor have not been able to afford them even with subsidies³⁵. 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. The findings of the PEO study tend to suggest that realization of the potential will remain a distant dream³⁵.

³² 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.

³³ Ministry of New and Renewable Energy. <http://mnes.nic.in/> <http://mnes.nic.in/>

³⁴ Ministry of Non Conventional Energy, National biogas and manure management programme, <http://mnes.nic.in/prog-ftbp.htm>

³⁵ Evaluation Study On National Project on Biogas Development, Programme Evaluation Organization Planning Commission, Government of India, New Delhi, 2002.

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.

(d) 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 works. To come to a successfully constructed biogas plant, the mason should not only respect the dimensions as indicated on the drawing but also follow the correct construction method. It takes organizational and management skills and coordination to organize construction and continued use of the biogas units³⁶. 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 technology³⁷. 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 services³⁵. These services are required for continuous operation of the biogas units.

Thus, proper extension and support services will be provided by SEDS at the village level. In this way, plants will not be allowed to fall into disrepair, when their functioning may 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 in the communities it is designed to serve. Coordinated management information systems will be developed as part of biogas development, in order for problems to be identified and remedial measures undertaken. A portion of the CER revenues received as forward funding by the project will be set aside for such repair and maintenance for the biogas units.

SEDS 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.

³⁶ N.H. Ravindranath and D.O. Hal. M 1995. Biomass, Energy and Environment: A developing Country Perspective from India, Oxford University Press.

³⁷ Ramachandra, T.V. 2008. Geographical Information System approach for regional biogas potential assessment. Research Journal of Environmental Sciences 2 (3): 170-184.

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Conclusion

The project will be implemented among the women self help groups formed at the village level in 121 villages across 5 mandals. 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. In spite of the fact that this technology is well known in India, the proposed project has to overcome various barriers like prevailing practice and economically viable options. Barriers make it unlikely that biogas plants are 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 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 hope 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 revenue for construction of the biogas units and continuous support for 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 the carbon credits. Thus it is clear that, in the absence of CDM project, which will provide the upfront investment for the establishment of 5,000 biogas plants for the rural poor, this project will not happen.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

TYPE I - RENEWABLE ENERGY PROJECTS, I.E. Thermal energy for the user, Version 1, EB 37. According to the methodology, the baseline emission reductions and leakage emissions will be calculated step-wise as described in section B.4.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	Rating Biogas
Data unit:	kW/digester
Description:	Capacity of a digester
Source of data used:	Calculated as shown in Section B.2
Value applied:	1.78
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as shown in Section B.2
Any comment:	Qualifies as a small-scale project

Data / Parameter:	By
Data unit:	Tonnes / year
Description:	Quantity of biomass that is substituted or displaced in tonnes

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Source of data used:	Survey
Value applied:	3.37 tonnes/year/family
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on sample survey. Details of the survey is given in Annex – 3
Any comment:	

Data / Parameter:	$f_{NRB, y}$
Data unit:	-
Description:	Fraction of Non Renewable Biomass
Source of data used:	Assessment of Non Renewable Biomass
Value applied:	90% for 2008 and 87% for 1989
Justification of the choice of data or description of measurement methods and procedures actually applied :	- utilized government data and method followed by the Forest Survey of India, Ministry of Environment and Forests, Government of India.
Any comment:	

Data / Parameter:	$NCV_{biomass}$
Data unit:	TJ/tonne
Description:	Net Calorific Value of Biomass
Source of data used:	IPCC
Value applied:	0.015
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	

Data / Parameter:	$EF_{projected_fossilfuel}$
Data unit:	tCO ₂ /TJ
Description:	Emission Factor Kerosene
Source of data used:	IPCC
Value applied:	71.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	

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B.6.3 Ex-ante calculation of emission reductions:

Emissions from the use of fossil fuels for meeting similar thermal energy needs		
Activity Data	Value	ID Ref
Quantity of Biomass that is substituted (t/yr)	16,850	<i>By</i>
Fraction of NRB	90%	<i>fNRB, y</i>
NCV Biomass (TJ/t)	0.015	<i>NCVbiomass</i>
Emission factor Kerosene (tCO ₂ /TJ)	71.5	<i>EFprojected_fossilfuel</i>
Emission Reductions (tCO₂/yr)	16,264	<i>ERy</i>
Emission Reductions (tCO ₂ /yr)/family	3.25	

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity Emissions (tCO ₂)	Estimation of Baseline Emissions (tCO ₂)	Estimation of leakage (tCO ₂)	Estimation of overall emission reductions (tCO ₂)
2011	0	8,132	0	8,132
2012	0	16,264	0	16,264
2013	0	16,264	0	16,264
2014	0	16,264	0	16,264
2015	0	16,264	0	16,264
2016	0	16,264	0	16,264
2017	0	16,264	0	16,264
Total estimated reductions (tonnes of CO _{2e})	0	105,716	0	105,716
Total number of crediting years	7			
Annual average over the crediting period of estimated reductions (tonnes of CO _{2e})	0	15,102	0	15,102

B.7 Application of a monitoring methodology and description of the monitoring plan:
B.7.1 Data and parameters monitored:

Data / Parameter:	Biogas Units constructed
Data unit:	Number
Description:	Number of biogas units constructed
Source of data to be used:	Monitoring of construction of biogas units and its start date of operation
Value of data	2,500 units/year for 2 years totalling to 5,000
Description of	The timeline of construction of the units will be monitored and database

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measurement methods and procedures to be applied:	maintained
QA/QC procedures to be applied:	100% of the units will be monitored from the procurement of material till construction and commissioning of the biogas units
Any comment:	

Data / Parameter:	Number of biogas plants operating
Data unit:	Number
Description:	Number of plants operating in year (t)
Source of data to be used:	Log books maintained and entered in the digitized monitoring database for Daily monitoring of the biogas units operating
Value of data	2,500 in Yr 1; 5,000 in Yr 2, and 5,000 every following year.
Description of measurement methods and procedures to be applied:	In every village, the Village Level Volunteers (VLV) will monitor the biogas units that are operating for every single day.
QA/QC procedures to be applied:	Log books and digitized database will be checked regularly by project staff and CDM coordinator.
Any comment:	-

Data / Parameter:	By
Data unit:	Tonnes / yr
Description:	Confirmation that non-renewable biomass has been substituted
Source of data to be used:	Sample survey
Value of data	90% of 3.37 t/family/year i.e. 3.03 t/family/year is substituted
Description of measurement methods and procedures to be applied:	Sample survey
QA/QC procedures to be applied:	Annual stratified sampling will be conducted.
Any comment:	-

Data / Parameter:	Non-usage of biogas plants
Data unit:	Days
Description:	Usage of non-renewable biomass in case of non-performance of biogas units
Source of data to be used:	The days not used from the daily monitoring report for each of the unit done at the village level and data maintained on the digitized monitoring database.
Value of data	Dependent on the number of days the biogas units are under repair
Description of measurement methods and procedures to be applied:	As and when the biogas units are not functional, the beneficiaries will report to the village level volunteer, who in turn will report to the Biogas Field Worker of the project for the repair of the unit. A log book will be maintained for the reason of non-function and days under repair.
QA/QC procedures to be applied:	CERs will be reduced for the non-functional days of the units.
Any comment:	

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Data / Parameter:	Diversion of non-renewable biomass saved under the project activity by non-project households
Data unit:	tonnes / year
Description:	Diversion of non-renewable biomass saved under the project activity by non-project households
Source of data to be used:	Leakage data
Value of data	0
Description of measurement methods and procedures to be applied:	Annual Sample Survey
QA/QC procedures to be applied:	Annual stratified sampling will be conducted.
Any comment:	-

B.7.2 Description of the monitoring plan:
--

Project Management/Team structure

This biogas CDM project will be implemented and monitored by the Social Education and Development Society, a grass root peoples organisation that has been operating in the project boundary for the last 28 years.

This biogas CDM project will be implemented for 5000 members of the SEDS village organisational network made up of 121 individual village organisations.

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

The project implementation and monitoring team will comprise of the following:

- CDM coordinator: To be appointed by the SEDS board of trustees, and who will then manage the project on a full time basis.
- Project Staff: 1 database manager, 10 biogas field workers. These will be appointed by the CDM coordinator.
- Masons: 50 individuals will be selected through the village organisations to partake in an apprenticeship programme through which they will be fully trained as biogas masons. Each will then be contracted, on a piece-rate basis, for the construction of these 5,000 units.
- Village level volunteers (VLV): Each village organisation selects a village level volunteer on an annual basis. This volunteer will maintain a daily usage register for each unit built in their village and enter them into the digitized monitoring system on a monthly basis.
- A maintenance team will be appointed post implementation to ensure that all units are fully operational for the lifetime of the project.

Monitoring database

An online digitized system, custom built for monitoring this Biogas CDM Project, will be used to enter data on an everyday basis and generate real-time online Progress Reports. Inputting data into this intranet solution will be permission driven – i. e. each Biogas Field Worker can record construction progress of only those villages entrusted to her/him; Volunteers can record daily usage only for their respective village; etc. Progress and Analytical Reports will be totally transparent, open for one and all. These reports will be perused by:

- Village organisation functionaries who will meet regularly to discuss the progress made in their respective villages. All of these meetings will also be attended by the respective biogas field worker of the area. Any problems identified will be discussed and solutions found.
- Project staff who will meet every week to ensure the smooth supply of material and timely construction of the biogas units.
- After the construction and satisfactory functioning of each biogas plant for a minimum of 2 weeks, an end user agreement on legal paper will be signed with the respective beneficiary, and this date will be taken as the day of commissioning of that particular biogas unit. Thus from day 1 of the commissioning of the biogas plant, full account of emission reduction can be considered.
- All data will be archived and stored throughout the crediting period and an additional two years.

Maintenance/Service of the biogas units

The post-construction daily usage monitoring will immediately identify dysfunctional units and specific problems faced by the end user.

Repairs and maintenance will be undertaken by the maintenance team appointed post implementation and all problems will be fixed within 7 days. A portion of the CER revenues received as forward funding by the project will be set aside for such repair and maintenance during the ERPA period. During these initial years major breakdowns are not foreseen. After fulfilling the ERPA contract, 80% of CER revenues will be paid out to the each of the women running the biogas unit. The remaining 20% will be set aside in a long term fixed deposit account and be used to pay the salaries of the maintenance staff, to cover all costs of repair and to provide grants to end users facing a shortage of substrate. This could happen due to loss or death of cattle, temporary shortage of fodder faced by a particular family, etc.

At the end of the project's lifetime any funds remaining in the account will be distributed to the end users accordingly.

The village level volunteer through undertaking daily usage monitoring will discover if any unit has become dysfunctional. They will inform the biogas field worker who will visit the unit and assess requirements. If necessary, a member from the maintenance team will be called out to fix the problem. All costs will be covered as described above.

Training

The 50 masons selected for the apprenticeship programme will spend 2 weeks working under a fully trained biogas mason of the Bagepalli CDM Project in Kolar district of Karnataka state. The programme already has 127 fully trained masons. Further training sessions will be held between the field staff member of the Bagepalli CDM Project and those of SEDS in order that the skills required for

implementing and monitoring such a project can be imparted. In turn all end users will be taught proper usage and maintenance techniques.

Monitoring

In accordance with Paragraphs 11 and 13 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 1:

11. Monitoring shall consist of an annual check of all appliances or a representative sample thereof to ensure that they are still operating or are replaced by an equivalent in service appliance.

12. In order to assess the leakages specified under paragraph 9, monitoring shall include data on the amount of biomass saved under the project activity that is used by non-project households/users (who previously used renewable energy sources). Other data on non-renewable biomass use required for leakage assessment shall also be collected.

13. Monitoring should confirm the displacement or substitution of the non-renewable biomass at each location. In the case of appliances switching to renewable biomass the quantity of renewable biomass used shall be monitored.

Monitoring Plan:

- The single relevant project aspect deemed necessary to monitor and report reliable emission reductions is the continued use of the biogas plant. The number of systems operating annually will be recorded through evidence of continuous daily monitoring at the village level by the village level volunteer.
- The annual hours of operation of an average system will be monitored using survey method annually.
- Provided all plants are in continuous use throughout the project period, and emergency preparedness arrangements are recorded as having been used, it is expected that the ex-ante emission reductions will be achieved.
- To monitor this single most important project aspect, the CDM Coordinator will depend on the continued servicing and maintenance management done by the project and documented in the database.
- All monitored data required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occur later both on paper and electronically.

Frequency of Monitoring:

- 100% of plants will be monitored every day for operation of the biogas units and monitoring report prepared for verification.
- For estimating the annual hours of operation, stratified sample survey will be conducted, annually.
- For monitoring leakage as specified in the methodology, an annual stratified sample survey will be conducted

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Leakage:

Paragraph 10 of the chosen methodology, I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 1, stipulates:

If the equipment is transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered.

In this project no equipment will be transferred and so this does not need to be monitored.

In accordance with Paragraph 9:

Leakage relating to the use of non-renewable biomass shall be assessed from ex-post surveys of users and areas from where biomass is sourced.

A stratified sample survey at household level will be carried out with a representative sample of the population living inside the project area and who are not biogas end users on an annual basis. The quantity, source and method of fuelwood collection will be assessed to derive at the quantity of non renewable biomass being used that can be attributable to the project activity. The findings of this survey will be provided in the annual monitoring report and any deviation in the quantity of non renewable biomass being used by non project households/users attributable to the project activity will be accounted to adjust B_y when calculating the overall emission reductions.

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

July 30th 2008.

Responsible entity: Social Education and Development Society

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

01/07/2010 – Likely Start Date for Construction of Bio-digesters

C.1.2. Expected operational lifetime of the project activity:

25y-0m

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C.2 Choice of the crediting period and related information:**C.2.1. Renewable crediting period****C.2.1.1. Starting date of the first crediting period:**

01/01/2011 or date of registration with UNFCCC, whichever is later.

C.2.1.2. Length of the first crediting period:

7y-0m

C.2.2. Fixed crediting period:**C.2.2.1. Starting date:**

NA

C.2.2.2. Length:

NA

SECTION D. Environmental impacts**D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:**

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. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

Not applicable

SECTION E. Stakeholders' comments**E.1. Brief description how comments by local stakeholders have been invited and compiled:**

The local stakeholders identified for this project were:

- Village communities (Self Help Group members, Village level volunteers)
- Elected members of the Village organisations
- Gram Panchayat members

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- SEDS staff
- Members of the district forestry division
- Members of the district NEDCAP division
- Local NGO's
- NGO's affiliated with the Gold Standard (REDS)

The stakeholders meeting was held on the 16th July 2008 at the SEDS vocational training centre situated in Penukonda, Anantapur district, Andhra Pradesh. A personal invitation along with a copy of the non technical PDD was sent in an appropriate language (Telugu, English) to the stakeholders identified above. The SEDS field staff also spread word of the meeting to all village members they encountered in the weeks preceding the meeting. An open invitation to the meeting was posted on the SEDS web-blog and was also published in a local newspaper daily on Sunday the 13th July 2008.

The meeting comprised of village members, village level volunteers, VO members, SEDS staff, Panchayat members, members of district NEDCAP division and members of Local NGO's. All the stakeholders were supportive of the SEDS initiative to undertake such a pro poor CDM project and promised to support the project in anyway possible. No adverse comments were received by any of the local stakeholders.

Photos of the meeting are included below:



**E.2. Summary of the comments received:**

Village people (SHG members, VLV's, VO members): The village people were very happy about the introduction of the project.

Local Panchayats: The local Panchayat members offered their support for the project. They asked whether any similar CDM initiative could be taken up to benefit the people residing in the town areas.

NEDCAP: The district level NEDCAP officer Mr. Kondanda Ramaiah, Executive Engineer, 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.

Local NGO's: The local NGO's said it was an excellent initiative to help the most vulnerable sector-the rural women and wished SEDS all the best in implementing the program. They see no negative environment or social impact.

No adverse comments were received for the project.

E.3. Report on how due account was taken of any comments received:

No comments were received.

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Annex 1**CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	SOCIAL EDUCATION AND DEVELOPMENT SOCIETY (SEDS)
Street/P.O.Box:	Anandapuram, Peddamanthur SO,
Building:	
City:	Penakonda, Anantapur District
State/Region:	Andhra Pradesh
Postfix/ZIP:	515124
Country:	INDIA
Telephone:	+91 8555 245424
FAX:	+91 8555 245436
E-Mail:	sedsngo@gmail.com
URL:	www.sedsngo.org
Represented by:	
Title:	CEO
Salutation:	Mrs.
Last Name:	Joshua
Middle Name:	Jayasena
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Department:	
Mobile:	+91 94405 79566
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Direct tel:	+91 8555 245424
Personal E-Mail:	maniljayasena@gmail.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No ODA will be diverted for this project.

Annex 3

BASELINE INFORMATION

Baseline fuelwood and kerosene used by the households in Anantapur district of Andhra Pradesh

I. Project Description

The project is installation of 5,000 biogas plants (digesters) of 2 m³ capacity each for single households in 5 Mandals of Anantapur District, Karnataka, India. Each household will install a 2 m³ biogas plant and feed cattle dung and other organic waste into the anaerobic digester for the production of biogas for cooking purpose and heating of hot water. 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 hot water heating. The project would be implemented upon registration of the project as a CDM project activity, as the project will be financed completely from carbon revenues. The project contributes to social, environmental, economic and technological benefits which contribute to sustainable development of the local environment.

II. Target Population/Beneficiaries

The target population for the project and the field data collection for the project are the beneficiary households from rural areas, who are using traditional cookstove and kerosene stoves for cooking and hot water bath. They are using fuelwood collected from forests, wastelands and other common property resources which is to a large extent non-renewable. The target population will be from the 5,000 households from 5 Mandals who will be the beneficiaries of the SEDS biogas Project. These communities are from the Self Help Groups formed by women in the villages and are below poverty line with a per capita income of less than 1\$/day/person.

III. Objectives

A baseline survey was carried out in order to establish the prevailing practices of the local communities with regard to fuel use for everyday cooking and water heating purposes. The objective of the baseline survey was to establish the quantity of fuelwood and kerosene used by the rural communities for cooking and hot water bath. This is based on the FAO report: “**A guide for woodfuel surveys**”, EC-FAO Partnership Programme (2000-2002). Sustainable Forest Management Programme, Forest Products Division, Forestry Department, FAO and “**Biomass Studies; Field Methods for Monitoring Biomass**” (1997) by Shailaja Ravindranath and Sudha (1997). Oxford & IBH Publishing Co.Pvt. Ltd. New Delhi.

IV. Method

The methodology used for the study was based on manual “Biomass studies” (1997) by Shailaja Ravindranath and Sudha (1997). The measurements involved were as follows:

- The amount of fuelwood and kerosene used for cooking and hot water bath by a family. This was based on actual measurements taken for a week in each household.
- The value obtained from the study was compared to other scientific studies conducted for similar ecological region.

V. Sample Frame

The NGO SEDS is working in Anantapur District for the past 30 years on rural development issues, and especially with the women. Self Help Groups have been formed at every village level for the women. The sample frame for the baseline survey was developed from the existing records of the beneficiaries with SEDS. The frame consists of currently active accounts with details of Mandal, village code, SHG group ID and SHG membership ID, income, father's name, etc.

The sample unit, which is the minimum unit or the clearly defined unit for constructing the sample frame is the traditional wood stove and the kerosene stoves used in each household for cooking and hot water bath.

VI. Sample Method³⁸

The baseline survey was performed in 2008 on a sample of local communities in 40 villages across 5 Mandals of Gorantla, Chilamanthur, Penukonda, Roddam and Somandepalli. A **Random sampling** was adopted for the study in all the 5 Mandals of Anantapur district of Andhra Pradesh. The beneficiaries were drawn at random from the sample from which each case having an equal probability of selection. For each chosen sample that participated, they were involved in conducting the required survey along with the field staff of SEDS. The details of sampling parameters are given in section VIII.

VII. Sample Size

The sample size was determined on three parameters: The variability, the level of confidence required and the acceptable level of error using the following formula:

$$n_o = \frac{(cv^2 \cdot t_{\alpha,v}^2)}{e^2}$$

Where:

- n_o = size of sample
- $t_{\alpha,v}^2$ = critical value of student's t test with significance level α and v degree of freedom
- e = acceptable error
- cv = coefficient of variation
- v = degree of freedom = n-1

- The desired precision for the baseline fuelwood estimation is $\pm 10\%$
- The confidence level is at 95% which has a critical t value of 1.96.
- The coefficient of variation is assumed at 1.

$$\text{Thus } n_o = \frac{(1^2 \times 1.96^2)}{(10\%)^2} = 384$$

³⁸ Based on FAO report: A guide for woodfuel surveys; EC-FAO Partnership Programme (2000-2002). Chapter 3; <http://www.fao.org/docrep/005/Y3779E/y3779e00.htm>

Thus the sample size required to estimate the fuelwood usage within a target range of 95% confidence level is 384. To be conservative and more precise, **500 samples or 10% of the target population** have been chosen. This also compensates for any sampling error due to sampling approach.

VIII. Survey Design

Structured interview and field studies were involved to obtain data on use of fuelwood and kerosene by the rural households. A questionnaire was designed, field tested and implemented at household level by the SEDS staff who were trained in field data collection. The measurement of fuel consumption from sample households was based on the manual Biomass studies by Shailaja Ravindranath and Sudha (1997).

- All the households are below the poverty line with an income of less than 1\$/day/person.
- Survey of 500 households across the 5 mandals in 40 villages situated inside the project boundary was conducted i.e. 10% of the households.
- The type of cooking device used in the sample household was recorded.
- The person who cooks for the household was requested to set aside an approximate quantity of cooking fuel required for a week prior to cooking in the morning.
- The house was visited in the morning before the start of cooking activity.
- The type and weight of the fuel set aside was recorded.
- The fuel from weighed bundle was used for cooking every day.
- After 7 days in the evening after cooking, the remaining fuel was weighed and value recorded.
- The average fuel wood use/day was estimated.
- The timeline use of fuel wood over the 20 years period was also conducted based on PRA.
- The data from the survey was compiled using Microsoft Excel and analysed.

IX. Survey Findings

a) Fuel Type:

Type of fuel used	Fuel wood	Dung	Crop residue	Coal	Kerosene	LPG
Number of HH reporting to use the fuel type	500	0	497	0	18	0
% of HH reporting to use the fuel type	100	0	99.4	0	3.6	0

- All households reported dependence on fuel wood and crop residue (red gram, mulberry etc.) to meet some if not all of their cooking / water heating fuel requirements.
- No household reported using dung cakes or coal as a source of fuel.
- 3.6% of households reported to be using kerosene supplied through the public distribution system as a cooking fuel. It transpired that although this cooking fuel was available to everyone, most used the fuel for lighting purposes burning the fuel in “whiskey bottle” lamps.
- No household was found to be using LPG. Reasons preventing its use were reported to be; too high a cost, the perception that it was unsafe and prone to explosion, and logistical problems associated with refilling empty gas bottles in rural areas.

b) Source of fuel wood collection:

- 86.2% of the households surveyed responded that they collect fuel wood from forest areas. (Kalligera forest, Penukonda forest, Errakonda forest, Somandepalli forest and riverside forest areas)
- Almost half the households (47.4%) collected some firewood from trees growing on the bunds of agricultural land.
- 41.66% of households sourced some of their firewood from wasteland areas. This also included areas of former agricultural land that had remained fallow for several years.
- 22.9% reported collection of firewood from plantation areas. This included watershed development areas.
- 10% reported collection from “other areas”, this included village tank areas.

c) Time taken to collect firewood:

- Respondents were asked if it takes more time to collect fuel wood today than it had taken to collect the equivalent amount 20 years ago. All replied that it takes more time today due to a greater scarcity of available fire wood.

d) Cost of fire wood:

- Respondents were asked to recall what they remembered one bullock cart of firewood to cost in 1988 and what the same costs today. The answers show that the cost of firewood today is 5 times the cost was in 1988. The cost of one bullock cart of firewood now is about Rs. 464, while it was Rs. 92.20 years back.
- This price rise is far greater than what can be attributed to inflation alone and supports the idea that the price has risen due to the increasing scarcity of available firewood to local communities.

e) Volume of kerosene used as a fuel for cooking / water heating:

- Only 18 out of the 500 respondents reported to use kerosene for the purpose of cooking / water heating.
- These 18 respondents reported that kerosene was used as a supplementary cooking fuel and was generally used for the quick preparation of items such as tea.

f) Volume of fire wood used as a fuel for cooking / water heating:

The results from the survey indicate that on average the fuelwood usage is 1.85 ± 0.04 kg/capita/day at 95% confidence level. At a household level, 3.37 tonnes per HH per year is being used.

g) Time spent cooking/heating water per day:

- Respondents reported spending an average of 4.14 hours cooking / heating water per day.
- This is alarming because such prolonged time periods spent using traditional wood stoves in what are typically unventilated kitchens often results in negative health impacts such as eye inflammation, lung infection and skin diseases.

Annex 4

MONITORING INFORMATION

The monitoring report provided to the verification agency will contain:

- Evidence that each is running, evidence that any found not to be running was recorded as being “under repair” on the central database for no longer than 7 days and had been visited by a member of the maintenance team within 24 hours of being reported dysfunctional.
- Leakage information as outlined in the monitoring plan above.
- ER calculations based on the data collected on the above and applying ex-ante methodology

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Appendix –I: List of Villages and beneficiaries.

Mandal	No. of Villages	No. of Families
Chilamathur	6	146
Gorantla	25	810
Penukonda	25	982
Roddam	38	2329
Somandepalli	27	1070
Total	121	5337

SI No.	District	Mandal	Village	No. of Beneficiaries
1	Anantapur	Chilamanthur	Anji Thanda	7
2	Anantapur	Chilamanthur	Koduru	8
3	Anantapur	Chilamanthur	Muddapalli	16
4	Anantapur	Chilamanthur	Diguvapalli Thanda	27
5	Anantapur	Chilamanthur	D. Thummalakunta	30
6	Anantapur	Chilamanthur	Kanisetty Palli	58
7	Anantapur	Gorantla	Gorantla	2
8	Anantapur	Gorantla	Thonepalli	6
9	Anantapur	Gorantla	Vadigepalli	8
10	Anantapur	Gorantla	Devulacheruvu	9
11	Anantapur	Gorantla	Narasimpalli	10
12	Anantapur	Gorantla	Karavulapalli	12
13	Anantapur	Gorantla	Gaddamthanda	16
14	Anantapur	Gorantla	Samulapalli	18
15	Anantapur	Gorantla	Bellalacheruvu	21
16	Anantapur	Gorantla	Boyalapalli	27
17	Anantapur	Gorantla	Kaligera	29
18	Anantapur	Gorantla	Y.T. Reddipalli	30
19	Anantapur	Gorantla	Buddapalli	33
20	Anantapur	Gorantla	Kajapuram	35
21	Anantapur	Gorantla	Mandlapalli	36
22	Anantapur	Gorantla	Motrapalli	39
23	Anantapur	Gorantla	Gollapalli	42
24	Anantapur	Gorantla	Palasamudram	43
25	Anantapur	Gorantla	Gummaiahgaripalli	48
26	Anantapur	Gorantla	Guntapalli	49
27	Anantapur	Gorantla	B. Kothapalli	52
28	Anantapur	Gorantla	Karavulapalli Thanda	52
29	Anantapur	Gorantla	Buchepalli	54

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30	Anantapur	Gorantla	Puttagundlapalli	62
31	Anantapur	Gorantla	Mallapalli	77
32	Anantapur	Penukonda	P. Maruvapalli	3
33	Anantapur	Penukonda	Penukonda	4
34	Anantapur	Penukonda	Ramapuram	8
35	Anantapur	Penukonda	Mahadevapalli	10
36	Anantapur	Penukonda	Hanumapalli	11
37	Anantapur	Penukonda	Motubaripalli	13
38	Anantapur	Penukonda	Setty Palli	16
39	Anantapur	Penukonda	Mangapuram	17
40	Anantapur	Penukonda	Ammavarupalli	23
41	Anantapur	Penukonda	Kondampalli	26
42	Anantapur	Penukonda	Bojjireddypalli	33
43	Anantapur	Penukonda	C.R. Palli	35
44	Anantapur	Penukonda	VR Palli	40
45	Anantapur	Penukonda	Gonipeta	44
46	Anantapur	Penukonda	Konapuram	44
47	Anantapur	Penukonda	Suddabatlappalli	46
48	Anantapur	Penukonda	Thimmapuram	47
49	Anantapur	Penukonda	Islapuram	51
50	Anantapur	Penukonda	Munimadugu	55
51	Anantapur	Penukonda	V. G. Palyam	63
52	Anantapur	Penukonda	Mavatur	66
53	Anantapur	Penukonda	Guttur	69
54	Anantapur	Penukonda	Bandapalli	80
55	Anantapur	Penukonda	Addadakulapalli	84
56	Anantapur	Penukonda	Nagalur	94
57	Anantapur	Roddam	D.R. Kottala	22
58	Anantapur	Roddam	M. Kothapalli	26
59	Anantapur	Roddam	Patharlapalli	26
60	Anantapur	Roddam	R. Maravapalli	28
61	Anantapur	Roddam	Budipalli	30
62	Anantapur	Roddam	Gonimekalapalli	32
63	Anantapur	Roddam	Nagireddy Palli	32
64	Anantapur	Roddam	Dandepalli	33
65	Anantapur	Roddam	Boxampalli	37
66	Anantapur	Roddam	Kandukurlapalli	37
67	Anantapur	Roddam	Bommireddy Palli	39
68	Anantapur	Roddam	Roddam	42
69	Anantapur	Roddam	Ragimekalapalli	43

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70	Anantapur	Roddam	Kanchi Samudram	45
71	Anantapur	Roddam	Laksanipalli	45
72	Anantapur	Roddam	Kallukunta	47
73	Anantapur	Roddam	Reddypalli	47
74	Anantapur	Roddam	L. Thimmapuram	48
75	Anantapur	Roddam	Peddamanthur	48
76	Anantapur	Roddam	R. Locherla	48
77	Anantapur	Roddam	Chinnakodipalli	54
78	Anantapur	Roddam	Peddi Palli	58
79	Anantapur	Roddam	Sanipalli	59
80	Anantapur	Roddam	K. Maruvapalli	63
81	Anantapur	Roddam	Peddakodipalli	66
82	Anantapur	Roddam	Bucherla	67
83	Anantapur	Roddam	Gowrajapalli	72
84	Anantapur	Roddam	P. Roppala	74
85	Anantapur	Roddam	Gobbarampalli	75
86	Anantapur	Roddam	P.G. Palli	77
87	Anantapur	Roddam	P. Kothapalli	88
88	Anantapur	Roddam	Kalipi	101
89	Anantapur	Roddam	Thurakalapatnam	109
90	Anantapur	Roddam	Chinna Manthur	110
91	Anantapur	Roddam	Cholemarri	123
92	Anantapur	Roddam	Cherukuru	124
93	Anantapur	Roddam	Nallur	124
94	Anantapur	Roddam	Seshapuram	130
95	Anantapur	Somandepalli	Somandepalli	9
96	Anantapur	Somandepalli	Renukanagar	13
97	Anantapur	Somandepalli	S. Kothapalli	17
98	Anantapur	Somandepalli	Chakarlappalli	22
99	Anantapur	Somandepalli	Obuladevarapalli	23
100	Anantapur	Somandepalli	Edulabalapuram	24
101	Anantapur	Somandepalli	Pandiparthi	24
102	Anantapur	Somandepalli	Chennapuram	25
103	Anantapur	Somandepalli	Kugatimanipalli	28
104	Anantapur	Somandepalli	Peddireddypalli	30
105	Anantapur	Somandepalli	Velidadakala	30
106	Anantapur	Somandepalli	Kolimipalli	31
107	Anantapur	Somandepalli	Anandapuram	32
108	Anantapur	Somandepalli	Bushaiahgaripalli	33
109	Anantapur	Somandepalli	C. B. Palli	37

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110	Anantapur	Somandepalli	N. G. Palli	37
111	Anantapur	Somandepalli	Pathikuntapalli	38
112	Anantapur	Somandepalli	Thungodu	39
113	Anantapur	Somandepalli	NNC Thanda	42
114	Anantapur	Somandepalli	Naginayunicheruvu	43
115	Anantapur	Somandepalli	Velugumekalapalli	47
116	Anantapur	Somandepalli	Bramhasamudram	55
117	Anantapur	Somandepalli	Gudipalli	60
118	Anantapur	Somandepalli	Kavatinagepalli	65
119	Anantapur	Somandepalli	Konathattupalli	67
120	Anantapur	Somandepalli	Magecheruvu	71
121	Anantapur	Somandepalli	Challapalli	128
