Project 0121: Bagepalli CDM Biogas Programme

Monitoring Report - Version 1

Dated: 6th January 2010

Monitoring Period
1st September 2007 – 31st July 2009
(Both days included)

Project Participants

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1 Executive Summary

The project activity consists of 5,500 biogas plants (digesters) of 2 m^3 capacity each. Each household uses the dung of cows to feed the digester for the production of biogas for cooking purpose and heating water. The project replaced the commonly used inefficient wood fired mud stoves that were using non-renewable wood for cooking with clean, sustainable and efficient biogas fed devices.

The project was registered on 10th December 2005 and the start date of the project activity / crediting period is 1st September 2006.

This is the second monitoring report that corresponds to the period from 1st September 2007 to 31st July 2009 (inclusive of both days). The monitoring report has been established following the monitoring plan detailed in the PDD.

The summary of the project activity is as follows:

Summary of the Project Activity and CERs Generated for the Monitoring Period	
State date of crediting period	**1-Sep-07**
Carbon Credits claim upto	**31-July-09**
Emission reduction/unit/yr	**3.56**
Total Biogas Units Commissioned till 31st July 2009	**5,481**
Total ERs generated	**36,769**
Emissions due to non-operation of biogas units	**776**
CERs generated for the period 1st Sept 2007 to 31st Aug 2009	**35,993**

2 Context

2.1 Background

The project activity consists of 5,500 biogas plants (digesters) of 2 m^3 capacity each. Each household uses the dung of cows to feed the 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 fed devices.

The biogas plant (Deenbandhu Model) consists of a digester with a fixed, non-movable gas space. Families load raw cow dung through the inlet into the fixed dome made of bricks and cement, located outside the kitchen. Gas is produced through anaerobic digestion of the dung and stored in the upper part of the digester before being piped to the biogas stove in the kitchen. The gas pressure displaces the digested slurry into the compensating tank, ready to be used as manure.

2.2 Start Date of the Project

The project was registered **on 10th December 2005** and the start date of the project activity / crediting period is **1st September 2006**.

2.3

2.4 Emission Reduction/CER Calculation

In the baseline scenario in the project area, 75.6% of the firewood used cannot be considered as renewable source of energy, and by burning this firewood, the users were generating greenhouse gases emissions. In the project scenario, this firewood has been replaced with renewable biogas and thus avoiding greenhouse gas emissions.

Each family was using 2.85 t of wood/year of which 2.15 t was non-renewable. Also, per year, 31.2 liters of kerosene was used as additional cooking fuel. The CO_2 emission reduction from avoidance of non-renewable wood usage and kerosene was estimated at 3.56 tCO_2/family/year. Thus, the number of CERs generated through the project in one year is basically calculated by multiplying the number of unit operating by the ratio of 3.56.

2.5 Information Monitored

As per the monitoring section of the PDD, the following project specific standards were monitored:

i) Number of systems installed
ii) Number of operating systems
iii) Annual operating time of biogas system
iv) Sample survey for non-renewable wood and kerosene usage
v) Sample survey for energy production

ID	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment
1	*Energy produced by a sample of the systems*	*EP*	*MJ/day*	*m*	*Every six (6) months*	*Random sample*	*e & p*	*Crediting period plus 2 years*	*Not used for calculation of the emission reductions*
2	*Number of installed 2 m^3 systems*	*IS*	*Units*	*m*	*Every six (6) months*	*All*	*e & p*	*Crediting period plus 2 years*	*Not used for calculation of the emission reductions*
3	*Number of operating 2 m^3 systems*	*OS*	*Units*	*m*	*Every six (6) months*	*All*	*e & p*	*Crediting period plus 2 years*	
4	*2 m^3 system average annual operating time*	*T*	*Hours*	*e*	*Every six (6) months*	*Random sample*	*e & p*	*Crediting period plus 2 years*	*Not used for calculation of the emission reductions*

3 Monitoring Period

The monitoring period is from 1st September 2007 to 31st July 2009.

4 Statement to What Extent the Project has been Implemented as Planned

The Bagepalli Biogas CDM project is implemented by ADATS, a 29 year old rural development NGO, for small and poor peasant families in over 331 villages from 5 taluks i.e. Bagepalli, Chickballapur, Chintamani, Gudibanda and Siddalaghatta of Chickballapur District[1] (formerly Kolar District), Karnataka, India.

The biogas project involves implementation of the technology, maintenance and monitoring the emission reduction (ER). All the tasks and activities are carried out in 16 designated "Areas[2]" comprising of 331 villages. Each Area Team consists of a Field Worker, Case Worker and Mahila Trainers (The organization chart of ADATS can be seen at http://www.adats.com/misc/Organogram.pdf). Each Area Team is "in-charge" of the processes in their respective villages.

Monitoring of the parameters as mentioned in section 1.4 was conducted jointly by ADATS, Velcan Energy and selected biogas users.

As of 31st July 2009, 5481 biogas units have been commissioned (see *CER calculations and daily monitoring – 2007-09.xls*). Thus of the 5,500 units which were taken up as the CDM project, only 5481 units could be built so far. The status of the project as on 31st July 2009 is as follows:

	Commissioned	
Taluk	**Units Commissioned**	**Number of Villages**
Bagepalli	2,613	125
Chickaballapur	647	48
Chintamani	1,001	78
Siddalaghatta	840	58
Gudibanda	380	27
Total	**5,481**	**336**

The list of beneficiaries, their unique user ID, village, and other details is provided in the enclosed excel file (*CER calculations and daily monitoring - 2007-09.xls*).

This is the second monitoring report for the project activity. The details of the earlier monitoring and verification for the project activity are as follows:

[1] 6 districts of former Kolar district have been separately and named Chickballapur district. Chickballapur district was carved out of Kolar district on 23th August 2007 (http://chikballapur.nic.in/district_profile.html). The 6 taluks includes Gowribidanur, Gudibanda, Bagepalli, Chintamani, Sidlaghatta and Chickballapur taluks. Thus the project site is now in Chickballapur district.

[2] Area comprises of a group of villages being overlooked by the Area Team

Description	Monitoring Period	Biogas Units Commissioned	Net Emission Reductions (tCO_2)	Status
1st Verification	1st Sept 2006 to 31st August 2007	4,399	11,761	Issued

5 Monitoring and Procedures for Emission Reduction Calculations

The Monitoring and Verification procedures described below defines the project specific standards against which the project's performance (i.e. GHG emissions reductions) and compliance with all relevant criteria was monitored and verified.

The monitoring steps involved for emission reduction calculations were as follows:

Step 1: Monitoring the biogas units installed
Step 2: Monitoring the operating biogas systems and the average annual operational time
Step 3: Sample survey for non-renewable wood and kerosene usage by biogas users
Step 4: Sample survey to establish that ex-ante baseline is still applicable
Step 5: Sample survey for energy produced by the system

5.1 Step 1: Monitoring of the Biogas Units Installed

All activity processes, including financial transactions for construction of biogas units, were digitally monitored using an online intranet solution that is integrated into ADATS's intranet based monitoring system that tracks various Coolie Sangha activities. Open and transparent online reports are used by everyone – ADATS Staff, Coolie Sangha functionaries and all other secondary stakeholders to know exactly where they stand in terms of progress and results. Reports are generated at all levels i.e. Project, Taluk, Area, Cluster, Village and individual Family level. The database is updated on a daily basis, as and when Field Staff return from their respective villages.

5.1.1 Monitoring during pre-commission and commission of biogas units

The construction of 5,500 biogas plants is being done in a phased manner. During 2006-07, 4,399 units were commissioned. During the year 2008-09, 1,082 units were commissioned and as on 31st July 2009 5,481 are commissioned and are functional. The various processes involved in the implementation of the technology as shown below was monitored for all the units which were being commissioned.

1. Selection of participating families
2. Defining Masons
3. Defining Material Suppliers
4. Monitoring Construction Progress
    - Marking
    - Excavation
    - Supplying crushed stone Jelly
    - Supplying Sand
    - Supplying Bricks
    - Supplying Cement
    - Supplying Hardware
    - Concreting
    - Brick work
    - Plastering

- Filling Gobar
- Supplying Stove
- Fixing Pipe & Stove
- Fixing Safety Grill

5. Commissioning
6. Generating End User Agreements

These processes were monitored on a day to day basis and database maintained from its initiation to completion dates for each of the biogas unit. Quality Control Supervisors comprising of the Audit team and the case worker of ADATS, the key persons to conduct the overall supervision of installed plants, checked the quality of installed biogas plants to ensure that the required materials were used for the construction of biogas units. All payments for construction of biogas units were made by cheque and suppliers were identified with personal data and digital photographs fed into the computerized databank for verification.

Statutory reports, including Trial Balance, Receipts & Payments statement, Income & Expenditure statement and Balance Sheet, have been generated for the project activity. The books of accounts are audited by a certified Chartered Accountant once every 6 months. This financial accounting system gives proof of the construction of these biogas plants under the CDM project activity. Each of the biogas unit has been marked as "ADATS-VELCAN" and the date of construction on the doom, which makes it distinct. These evidences validate the construction and commission of the 5,481 biogas plants built in the project area, 4,399 during 2006-07 and 1082 during 2008-09.

The list of biogas users are identified by a User ID, the name of the beneficiary, the CSU membership number, the village and taluk, and other details such as family strength, land holding, caste, etc. (see *CER calculations and daily monitoring – 2007-09.xls* for details). Other information includes the start date of construction and the date of commissioning.

As of 31st July, 2009, 5,481 biogas units are installed. Thus the number of biogas units installed is monitored on a day to day basis and is updated in the database of ADATS.

5.2 Step 2: Monitoring the Operating Biogas Systems and the Average Annual Operational Time

As per the PDD, the number of operational biogas units and the average operating hours need to be monitored twice a year. For efficient monitoring, continuous day to day monitoring is being done. A user friendly survey sheet for each of the biogas user is maintained at the village level by the village health worker[3] or the Bal Kendra Teacher. Hence continuous monitoring of the operational units is being done.

[3] A village health worker from the CSU is appointed for each village.

The information on the daily operational time is gathered by the village health worker from its users on a day to day basis or during the weekly Mahila meetings[4] held in every village. The information is updated to the individual biogas user's on-line data base maintained by ADATS by the case worker on monthly basis. The average operational hours for each of the biogas users have been computed based on the daily operational hours (*see CER calculations and daily monitoring – 2007-09.xls*).

All the installed biogas units are operational and the yearly average operational hours are 3 hrs/day. Thus the number of operating biogas units and its average yearly operational hours are being monitored on a day to day basis and is updated in the database of ADATS.

ADATS monitoring system: The additional parameters monitored by ADATS after commission of biogas plants are:
Logging Audit Visits
Logging Repairs
Logging Days not used

If any biogas unit is faulty or not functional, the report on the problems of the biogas plants is passed on by the Audit Team to the Area Team. The Treasurer of the Coolie Sangha has been entrusted with the task of audit. This information is entered into the database for each of the beneficiary. **Thus there is a continuous database maintained of all the biogas units.** The upfront CER amount of approximately Rs. 2,500 per Unit, totalling to Rs 13.75 million has been placed in a long term Fixed Deposit to generate Rs 1.17 million each year. This amount is used to maintain the biogas units and keep them in good condition, which is a vital prerequisite for Coolie women to generate CERs and continue enjoying smoke-free cooking.

5.3 Step 3: Sample Survey for Non-renewable Wood and Kerosene Usage by Third Party (Bangalore University)

As stated in the registered PDD "Bagepalli CDM Biogas Programme", 75.6% of biomass (excluding agro-residues) used for cooking and water heating is non-renewable. Each family uses 2.85 tonnes of firewood and 31.2 liters kerosene per year. Thus of the 2.85 tonnes of firewood used per year, 75.6% is non-renewable. The usage of 2.15 tonnes of firewood and 31.2 liters kerosene per year/family is contributing to greenhouse gas emissions. The replacement of the 2.15 tonnes of firewood use and kerosene by biogas are the emission reductions.

To estimate the extent of replacement of fuelwood and kerosene, the study encompassed a stratified random sampling of 5.7% of biogas units. The survey was conducted in all the 5 taluks, twice during 2007-08 and 2008-09. Representative samples for each of the substratum were taken to capture the heterogeneity of population. If fuelwood and kerosene is still being used, the data that was ascertained was the extent of its usage and nature of firewood used.

[4] These Mahila meetings have been held regularly since many years to discuss all issues of coolie sangha

5.3.1 Detailed stratified study of the project area

A detailed study in the project area was undertaken based on stratified sample survey. The study was conducted by the Department of Environmental Science, Bangalore University, Karnataka, with the following objectives:

- To estimate fuelwood and kerosene usage by non-biogas users
- To estimate the extent of replacement of fuelwood and kerosene by biogas for cooking and hot water bath
- To study the environmental and socio-economic impacts of the CDM project that contributes to sustainable development goals.

5.3.2 Extent of fuelwood and kerosene replacement

The extent of replacement of total fuelwood (non-renewable and renewable component) by biogas is 99%. Only 1.02% fuelwood is being used, which is renewable in nature. The major species used are *Lantana camara,* which is a wide spreading weed and forms dense thickets; and twigs and branches of species such as *Mulberry,* and *Proposis juliflora.* Prunings of *Pongamia pinnata* and *Mangifera indica* from their farm land are also used along with crop residue such as red gram, groundnut shells, coconut waste and mulberry stalks. As per the annex 18 of the EB 23, this wood is considered as renewable.

The non-renewable wood previously used by the users is the costliest in terms of time spent to collect or purchase and preparation of the fuel for usage and storage. Thus, by providing a new energy facility to the user which decreases the need for additional fuel usage, the first wood to be replaced is the non-renewable one. Also, renewable wood is available nearer to their homes and fields with less effort and is the first alternative by the user for additional usage.

Fuelwood Use	Value	Source
Non-renewable wood used before CDM project (t/y)	2.15	Baseline
Renewable wood used before CDM project (t/y)	0.7	Baseline
Renewable wood still used after CDM project (t/y)	**0.03**	**As per survey**
Kerosene used before CDM project (lts/y)	31.2	Baseline
Kerosene used after CDM project (lts/y)	**0**	**As per survey**

Kerosene usage is completely replaced by usage of biogas. After the implementation of biogas unit, kerosene usage is zero by all the households.

Thus 100% of non-renewable wood and kerosene is being completely replaced by biogas under the project activity.

5.4 Step 4: Sample Survey to Establish that *ex-ante* Baseline is Still Applicable

A questionnaire survey was conducted to estimate the fuelwood use of non-biogas users covering all the 5 taluks. The study shows that the current fuelwood consumption for the users is about 4 t/household/yr and the kerosene consumption of

the same household is 42 lts/household/yr. This study shows that the *ex-ante* baseline is still applicable.

Thus the baseline assumption is conservative and still applicable for the project activity.

5.5 Step 5: Sample Survey for Energy Produced by the System

This survey aims at demonstrating that the energy produced by the bio-digester is sufficient to displace the energy previously produced through firewood and kerosene (see PDD p 24). This survey is in a way to substantiate the emission reduction calculated through the ratio of 3.56 CER per unit operating.

The results of the survey do not enter into the calculation of CER to be delivered.

The parameters for energy production by bio-digester that were monitored are as follows:

(i) Dung input and frequency of dung influent into the digester: This survey was done in about 1% of the households for a month.

(ii) Slurry level raise in the displacement chamber: This survey was done twice in the year as per the monitoring plan in 1% of the households.

5.5.1 Dung input into the digester

The quantity of dung fed into the digester was measured in approximately 1% of installed units for a period of 30 days for the year 2007-08 and 2008-09. The Village Health Worker or the Balakendra Teacher of the village in collaboration with the biogas user weighed the dung before feeding into the digester using a spring balance (range 0-50 kg). The information was recorded in the data sheets provided to them.

The potential energy content of the dung fed into the digester on an annual basis was calculated as follows:

$$\mathbf{UE_1 = DS^* VS^* D^* EF^* CV^* E_{ff}} \quad \text{.....Equation 1}$$

Where

UE_1 = Useful energy measured through quantity of dung fed into the bio-digester (MJ/year)
DS = Dung fed into the digester (kg)
VS = Volatile Solids produced/kg of dung (kg)
D = No. of days dung fed into the digester
EF = CH_4 production capacity/VS
CV = Calorific Value of methane
E_{ff} = Efficiency of the stove

As per the PDD, the following values were used to derive the energy produced by the quantity of dung fed.

Activity data	Value	Reference
VS Excretion dry mass (%)	40%	Laboratory Report
CH_4 production capacity / VS dairy	0.13 m^3 / kg	IPCC, 2006
CH_4 production capacity / VS non-dairy	0.10 m^3 / kg	IPCC, 2006
Calorific value CH_4	35 MJ/m^3	IPCC, 2006
Efficiency of the stove	55%	PDD

Based on the survey conducted approximately 20.5 kgs of dung is being fed into the digester every day. The useful energy applying the equation 1 for the year is about 6931 MJ/year.

5.5.2 Biogas production

To obtain the gas production rate of the biogas unit, the displacement of slurry in the displacement chamber was measured. The step-wise procedure was as follows:

Step i: The level of slurry in the morning after preparation of meals was marked.

Step ii: The raise in level of slurry was measured on hourly basis till the next meal preparation in the evening or till the complete raise of slurry in the displacement chamber. The measurements were recorded on a data sheet given to each of the biogas user.

Step iii: The rate of slurry rise (cm/hr) multiplied by the cross-sectional area of the biogas chamber gives hourly gas production rate and thus daily gas production rates can be calculated.

This procedure is simple and cost effective and was done by the Balakendra teachers and other literate women who had biogas units in their homes under the guidance and supervision of Velcan Energy team, CSU cluster secretary, ADATS case workers and the Bangalore University research team.

The bi-yearly monitoring was done in 1% of the biogas units covering all the 5 taluks during 2007-08 and 2008-09. The potential energy content of biogas based on the data was calculated using Microsoft excel.

The potential energy content of biogas production on an annual basis was calculated as follows:

$$\mathbf{UE_2 = BGP * CV*D*E_{ff}} \quad \text{.....Equation 2}$$

Where

UE_2 = Useful energy measured (MJ/year)
BGP = Biogas production (m^3/yr)
D = No. of days (365)
CV = Net Calorific Value of biogas (MJ/m^3)
Eff = Efficiency of the stove (%)

The following values were used to derive the energy produced from the measured biogas production.

Activity data	**Value**	**Reference**
Net Calorific Value of biogas	22.1 MJ/m^3	Nijaguna, B.T. 2002. Biogas Technology, New Age International Publishers. New Delhi
Efficiency of the stove	55%	PDD

Based on the survey, biogas production is approximately 1.46 m^3/day. The useful energy applying equation 2 for the year is about 6477 MJ/year.

5.5.3 Comparison of energy output from biogas digester to baseline scenario

The energy available in the baseline from firewood and kerosene is as follows:

$$UE_t = (FW * CV_f * E_{fw} + K * CV_k * E_k) \quad \text{.....Equation 3}$$

Where

UE_t = useful energy delivered to the cooking pot (MJ/yr)
FW = firewood consumption for cooking at family level (t/yr)
CV_f = calorific value of firewood
E_{fw} = Efficiency of the stove
K = liters of kerosene used (lts/yr)
CV_k = calorific value of kerosene
E_k = Efficiency of the kerosene stove

This baseline calculation is based on the approved PDD

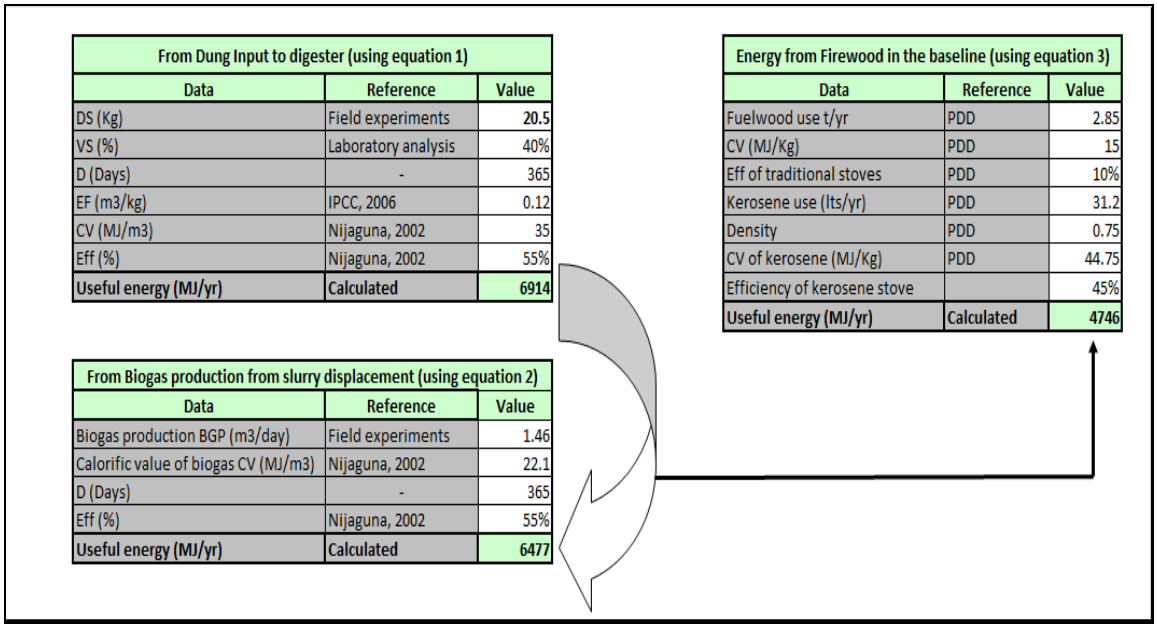
Activity data	**Units**	**Value**
Family wood consumption per year	kg / year	2,850.00
Calorific value wood	MJ / kg wood	15.00
Family kerosene consumption/year	lts/year	31.20
Density of kerosene	kg/l	0.7
Liters of kerosene	Kg/year	23.31
Net calorific value of kerosene	MJ / kg	44.75
Efficiency of traditional stove	Percentage	10%
Efficiency of kerosene stove	Percentage	45%

The energy available in the baseline is

UE_t = (2850*15*10%) + (23.31*44.75*45%)
= 4715 MJ/yr

The UE_1 and UE_2, was compared to UE_t to cross check the replacement of energy from firewood use and kerosene in the baseline by the energy output from biogas plants (Table 1).

Table 1: Energy output from biogas plant compared to that from firewood in the baseline



From Dung Input to digester (using equation 1)		
Data	Reference	Value
DS (Kg)	Field experiments	20.5
VS (%)	Laboratory analysis	40%
D (Days)	-	365
EF (m3/kg)	IPCC, 2006	0.12
CV (MJ/m3)	Nijaguna, 2002	35
Eff (%)	Nijaguna, 2002	55%
Useful energy (MJ/yr)	**Calculated**	**6914**

From Biogas production from slurry displacement (using equation 2)		
Data	Reference	Value
Biogas production BGP (m3/day)	Field experiments	1.46
Calorific value of biogas CV (MJ/m3)	Nijaguna, 2002	22.1
D (Days)	-	365
Eff (%)	Nijaguna, 2002	55%
Useful energy (MJ/yr)	**Calculated**	**6477**

Energy from Firewood in the baseline (using equation 3)		
Data	Reference	Value
Fuelwood use t/yr	PDD	2.85
CV (MJ/Kg)	PDD	15
Eff of traditional stoves	PDD	10%
Kerosene use (lts/yr)	PDD	31.2
Density	PDD	0.75
CV of kerosene (MJ/Kg)	PDD	44.75
Efficiency of kerosene stove		45%
Useful energy (MJ/yr)	**Calculated**	**4746**

As can be seen from Table 1, the energy available from biogas units is approximately 6477 MJ/yr which is able to completely replace the energy obtained from firewood and kerosene in the baseline.

These calculations are not used in emission reduction calculations. But it substantiates the application of the 3.56 ER per unit/year due to the availability of the same energy output from the biogas units.

6 Calculations of Emission Reductions

As described in the PDD, the emission reduction was calculated using a ratio of 3.56 ER/unit operating/year.

The monitoring described in section 3 aids to evaluate the reliability and the consistency of this approximation. As the results obtained by the survey was satisfactory, we have applied the following formula as given in the PDD to estimate the CER to be delivered.

$$CER_y = OS_y \times EM_y$$

Where:

CER_y	yearly certified emission reduction
OS_y	2 cum systems operating in year y
EM_y	3.56 tCO_2 Baseline emissions per household with a 2 cum biogas system

The database of conducted survey and ER calculations is maintained in Excel spreadsheet. The emission reduction calculations are transparent and can be easily verified.

As of 31st July 2009, 5,481 biogas units have been commissioned and are operational during the monitoring period. The unit-wise calculations of emission reduction are as enclosed in the excel sheet – *CER calculations and daily monitoring – 2007-09.xls*.

The total emission reductions for the period 1st September 2007 to 31st July 2009 for the installed and operational 5,481 biogas units are **36,769 tCO_2.**

The non-achievement of emissions reductions due to repairs of biogas units intermittently is **776 tCO_2**.

The total emission reductions for the period 1st September 2007 to 31st July 2009 for the installed 5,481 biogas units are 36,769 – 776 = 35,993 tCO_2.

The emission reductions are lesser than that projected in the PDD as only 5,481 are commissioned. Also, the 1,082 biogas units commissioned during 2008-09 was in a phased manner during the year.

7 Measure to Ensure the Results / Uncertainty Analysis

The main parameters for calculation of emission reductions are the 2 cum systems operating in a year and the baseline emissions per household. The uncertainty is low due to the following:

- After commissioning and satisfactory functioning of the biogas plant for a minimum of 2 weeks, an end user agreement was signed with the beneficiary, which is taken as the day of commissioning of the biogas plant.
- The biogas units operating in a year has to be monitored just twice in a year at 6 months interval according to the PDD. But daily monitoring of the operating systems is being done.
- If the biogas units are not operational due to malfunction, the days not used are not accounted for emission reduction calculations.
- A detailed study was done by a third party to evaluate the biogas project and determine the parameters from the survey.
- Though the baseline emission was fixed *ex-ante*, a survey was done to ensure that the baseline emission is still valid (section 4.4).
- The energy content of biogas has also been verified through field experiments though they are not part of emission reduction calculations by the third party study.

Hence the uncertainty is low and emission reduction calculations are conservative.

8 Leakage Monitoring

There is no leakage due to the project activity. As mentioned in the PDD, leakage is not an issue and need not be monitored for the project activity.

9 Monitoring of Sustainable Development of the Project

The main objective of a CDM project is achieving sustainable development in the host country. The main criteria of sustainable development are social, economic, environmental and technological well being. The impact of the CDM project was determined through household survey and group meetings. The various benefits that the rural communities perceived are as follows.

The communities have perceived many benefits of using biogas.

- There has been a decrease in the quantity of water used for washing vessels after implementation of Biogas CDM Project. The vessels are not covered with soot unlike in the baseline when fuel wood was used for cooking purposes, requiring more water to scrub and clear the vessels.
- It has eliminated indoor air pollution and the indoor air quality has improved.
- Improved indoor air quality has lead to eliminated health problems such as watering of eyes, irritation of throat, long exposure to heat and high levels of smoke, eye problems, respiratory illness.
- The cooking time has reduced drastically due to higher efficiency. All the women are thankful to the project as they are able to prepare timely meals to enable the children to attend school in time.
- Biogas has also reduced drudgery to women by reducing the trek to long distances to collect fuelwood. The benefits in terms of time saved in fuel procurement and cooking, improved kitchens and convenience, and reduction of drudgery of transporting fuelwood, processing them, and storing them for later use is enormous. This time is now being used productively.
- The communities also perceive benefits in terms of increased crop productivity by use of slurry as organic manure.
- At the village level, biogas has reduced the pressure on the already scarce sources of biomass. The technology simultaneously is reducing the need for firewood, reducing forest degradation and deforestation.
- It has also provided employment through construction of the units to local entrepreneurs, turnkey operators, masons and daily-wage labourers.

10 Roles and Responsibilities

A CDM team has been formed for monitoring and verification of all the monitoring parameters as per the guidelines of VELCAN ENERGY and ADATS. Qualified and trained people monitor the parameters and emission reduction calculations. In the complete implementation and monitoring plan, VELCAN ENERGY and ADATS is the sole agency responsible for implementation and monitoring.

10.1 CDM Team Members

1. Dr. Sudha Padmanabha, VELCAN ENERGY, CDM In-Charge
2. Mr. Ram Esteves, Director, ADATS
3. Mr. Mario Esteves, Assistant Director, ADATS
4. Mr. Jean Baptiste Curien, VELCAN ENERGY, Engineer
5. Mr. Abid Pasha, System Administrator, ADATS