



DISTRIBUTION OF IMPROVED COOK STOVE - PHASE VI



Document Prepared by EKI Energy Services Limited

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project activity is to facilitate clean cooking practices and reduce health risk due to indoor air pollution¹ along with household drudgery amongst the tribal households (Schedule Tribe) and families living below the poverty level (BPL category²) in villages of Maharashtra through dissemination of improved cook stoves. The improved cook stoves through replacement of inefficient traditional cook stove contributes towards reduction of greenhouse gas emission and by-products of incomplete combustion like black carbon, conservation of fuel wood and thereby preventing forest degradation. Successful operation of the project activity encourages rural residents to shift from traditional cook stoves usage to the project improved and modern cook stove usage.

The higher efficiency portable, single pot cook stoves distributed and conceived under the project activity has replaced prevailing practice of using traditional cook stoves in rural areas across the state. Independent research³ reveals that, out of 120 million of the total potential of biomass cook stove in India total number of household using cook stoves is around 14.904 million (WHO, UNDP 2009)⁴ only. Study by ESMAP⁵ (Energy Sector Management Assistance Program) revealed that, improved cook stoves accounted for less than 7 percent of the total biomass stoves used in rural areas. The report also refers to the latest national survey in India highlighting the fact that, only 5 percent of rural households possess an improved cook stove (Zhang et al. 2006). The study portrays Maharashtra amongst one of those few states where, improved cook stoves were distributed under the National Programme of Improved Chulha (NPIC) since 1983-84 and continued thereafter.⁶ The distribution was facilitated through Rural Development and Water Conservation Department, Maharashtra Energy Development Agency and Khadi and Village Industries Commission.

¹ Household Cook stoves, Environment, Health and Climate Change – World Bank (Executive summary, page 9-11)

² As per the article in The Hindu (<http://www.thehindu.com/news/national/article3013870.ece>) dated March 20, 2012 anyone with daily consumption expenditure below Rs. 22.42 is categorised under BPL. The article depicts of 24.5% of the total population in Maharashtra under BPL in 2009-10.

³ Independent research has been done by Indian Institute of Science (Center for Ecological Sciences)

⁴ Household Cook stoves, Environment, Health and Climate Change – The World Bank

⁵ http://www-wds.worldbank.org/external/default/WDSPContentServer/WDSP/IB/2012/04/30/000386194_20120430023655/Rendored/PDF/682790PUBOESMA0terOHomes0Book0Small.pdf (pg 13-14)

⁶ <https://documents1.worldbank.org/curated/en/757091468268510429/pdf/682790PUBOESMA0terOHomes0Book0Small.pdf>

It is worthwhile to note that firewood and wood chips contributes as major cooking fuel amongst rural households in India. According to the NSSO⁷ (National Sample Survey Office) 61st round survey, a considerable percentage of rural population of Maharashtra relies upon fire wood for cooking and the percentage is substantially much higher amongst the lower MPCE (Monthly Per Capita Expenditure) group. Since, the beneficiary selected under the project belongs to BPL and ST category of population in terms of capacity of expenditure therefore; improved cook stove use results in substantial fuel wood saving as this section is the major consumer of fuel wood.

MPCE Groups	Percentage of Population using firewood ⁸
Rs. 0 – 235/-	79.2%
Rs. 235 – 270/-	93.8%
Rs. 270 – 320/-	90.0%
Rs. 320 – 365/-	87.2%
Rs. 365 – 410/-	86.2%
Rs. 410 – 455/-	84.2%
Rs. 455 - 510/-	82.8%

The improved cook stoves distributed are more efficient with thermal efficiency of 29.88%⁹ as compared to traditional stoves with thermal efficiency of around 10%¹⁰. Use of efficient cook stove results in fuel consumption reduction i.e. non-renewable biomass (since the demand of fire wood is considerably higher than the sustainable potential of fire wood extraction and the wood available through unsustainable extraction is conceived as non-renewable biomass) through minimizing thermal energy losses by facilitating complete combustion and thereby resulting in GHG emission reduction.

Technology Employed

The cook stove deployed under the project activity is single pot, portable, metallic, improved biomass cook stoves¹¹ made of cast iron for combustion of solid biomass. The improved cook stoves are manufactured in accordance to IS 13152, Part-1: 1991, CPRI Design Type I¹²

⁷National Sample Survey Office

(http://mospi.nic.in/sites/default/files/national_data_bank/pdf/NSS%2061st%20Round-511.pdf)

⁸ Redefining poverty lines and survey of BPL families

(http://mospi.nic.in/sites/default/files/publication_reports/Report_no558_rou68_30june14.pdf) the annual income of Rural BPL is considered to be Rs. 30,000.

⁹ Thermal Efficiency Test Report of Improved Cook stove tested at Biomass Cook stove Testing Centre, Dept. of Renewable Energy Sources, Udaipur

¹⁰ Paragraph 6 (Option 2) of approved applicable methodology AMS –II.G., Version 03

¹¹ MNRE accredited system - <http://164.100.94.214/national-biomass-cookstoves-programme>

¹² The design of the cook stove is certified by Bureau of Indian Standards relating to its appropriateness to, IS 13152 (Part1). The standard was adopted by Bureau of Indian Standard after the draft finalized by the oil burning Appliances Sectional Committee had been approved by Heavy Mechanical Engineering Division Council.

standard. The design ensures complete combustion of biomass. The cook stove is tested for thermal efficiency of 29.88% as per water boiling test protocol specified in IS 13152, Part 1: 1991.

Measures undertaken

The Rural Development and Water Conservation (RDWC) Department, Government of Maharashtra is involved in promoting betterment of living standard for the tribal household (ST) and families living Below Poverty Line (BPL) in villages of Maharashtra. The department as a part of its aforesaid programme selects households from amongst the ST and BPL category depending upon level of vulnerability (assessed on basis of 13 parameters: Category and size of usable land, Type of house, Availability of regular usable clothes, Protection of food or food security, Cleanliness, Ownership of required goods, Heights /Level of literacy, Family working capacity, Source of livelihood goods, Number of children in age group (5 to 14), Type of bankruptcy, reason for staying away from family of Earning member, Choice of help /Yojana)¹³ and provide financial assistance to facilitate better and hygienic living standard. The household selected for financial assistance under the programme is provided with an improved cook stove system. The household considered as end users of cook stoves under the project activity are poor enough to afford procurement of cook stoves and are also least interested towards investment as wood is available for free. So, in absence of the cook stove the household would have continued with traditional cooking practice. Since, the project activity is conceived under the program of Govt. of Maharashtra which provides cook stove only to BPL and ST category household so; there is no chance of cook stove to be distributed to non-baseline household. The identification of beneficiaries and distribution of cook stoves comes under the preview of the Rural Development and Water Conservation Department.

The project activity plans to disseminate improved cook stoves over period of time¹⁴ amongst Below Poverty Line (BPL) and Scheduled Tribes (ST) households in rural areas of Satara and Solapur districts of Pune Division in Maharashtra. The project is to consider beneficiaries comprising of 14,450 Nos. of household to which improved cook stoves are to be disseminated under the programme and has signed the end user Tripartite Agreement¹⁵. The project through conservation of non-renewable biomass results in greenhouse gas emission reduction of 12,990 tCO₂e annually¹⁶.

Vikram Stoves and Fabricators (hereafter referred to as Vikram Stoves) is a MNRE (Ministry of New and Renewable Energy) approved manufacturer and distributor¹⁷ of

¹³ Criteria issued by Department of rural Development, Government of Maharashtra
<https://pbplanning.gov.in/pdf/bplproposal.pdf>

¹⁴ Each of the cook stoves is included for the purpose of emission reduction calculation from the day on which it is distributed to the beneficiary and the end user agreement is signed. Thus, in the first monitoring period all the cook stoves may not claim the full credits but for ex-ante determination it is estimated the same operation period for all the cook stoves.

¹⁵ Tripartite Agreement is for transfer the CER right to the Project Participant by each beneficiaries/end users and is signed amongst end user, GKEMPL and Vikram Stoves.

¹⁶ The ex-ante estimation of emission reduction is conceived considering that 90% of the cook stove is in operation and also at desired efficiency. Therefore the number of cook stove conceived for determining the ex-ante estimation of emission reduction is 13,005 instead of 14,450. However, the number of cook stove to be considered for ex post estimation of emission reduction is determined on the basis of survey result and considering the actual number of cook stove disseminated i.e. 14,450.

¹⁷ <http://www.vikramstoves.com/index.html>

improved cook stoves having operation network in Maharashtra. The agency is selected by the RDWC Department, Government of Maharashtra for distribution of improved cook stoves amongst identified beneficiaries. The revenue was conceived in deciding upon the capital cost as well as to meet up the cost towards imparting awareness and training, periodic maintenance¹⁸ and post lifetime replacement within the crediting period.

M/s G K Energy Marketers Pvt. Ltd (hereafter referred to as GKEMPL) is authorised as Project Participant by Vikram Stoves and the end users for development of project activity for cook stove dissemination. As a part of the project activity GKEMPL (Project Participant) along with Vikram Stoves enter into contractual agreement with the beneficiaries by virtue of which, the end user confirms use of cook stove as well as transfer the CER right to the Project Participant.

1.2 Sectoral Scope and Project Type

- Sectoral Scope: 3- Energy demand
- Project Type: Type II.G.

The project activity fulfills the applicability criteria of small- scale project activity, Type II – Energy Efficiency Improvement Projects, Category G –‘Energy efficiency measures in thermal applications of non-renewable biomass - Version 03, Sectoral Scope 03, EB 60’ of the ‘Indicative Simplified Baseline and Monitoring Methodologies for Selected Small-scale Project Activity Categories’.

This is non-AFLOU type of project

1.3 Project Proponent

Organization name	M/s G K Energy Marketers Pvt. Ltd
Contact person	Mr. Gopal Kabra
Title	Authorized Signatory
Address	Lokmanya Nagar, LBS Road, Flat No.- 350, Building No.- 25,Ground Floor, Pune, Maharashtra – 411030 India
Telephone	+91-997045
Email	gopal@energymarketers.in

1.4 Other Entities Involved in the Project

Organization name	EKI Energy Services Limited
Role in the Project	Project Consultant
Contact person	Mr. Pankaj Rajpoot

¹⁸ “The Indian stove programme: an insider’s view – the role of society, politics, economics and education” by Bhaskar Sinha, National Institute of Science, Technology & Development Studies (NISTADS), CSIR, New Delhi outlines that the woman are least interested for maintenance as they do not perceive the usefulness of the stove and revert back to traditional practice when the cook stove becomes non-functional therefore timely operation and maintenance are vital.

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1.5 Project Start Date

12-October-2012

The first date of actual handover of ICS to beneficiary was on 12 October 2012 as mentioned in the Emission Reduction (ER) sheet and same date is considered as first cookstove operation date of the project as per project start date definition of section 3.7 of the VCS Standard V.4.1.

1.6 Project Crediting Period

The crediting period of the project activity is for 10 years (Fixed).

The length of the first crediting period is 15-12-2012 to 14-12-2022 (both dates inclusive).

1.7 Project Location

The project is located in state Maharashtra, India.

Pune Division, Satara and Solapur Districts

District	Satara	Solapur
Latitude	17.50 - 18.11 °N	17.10 - 18.32 °N
Longitude	73.33 - 74.54 °E	74.42 - 76.15 °E

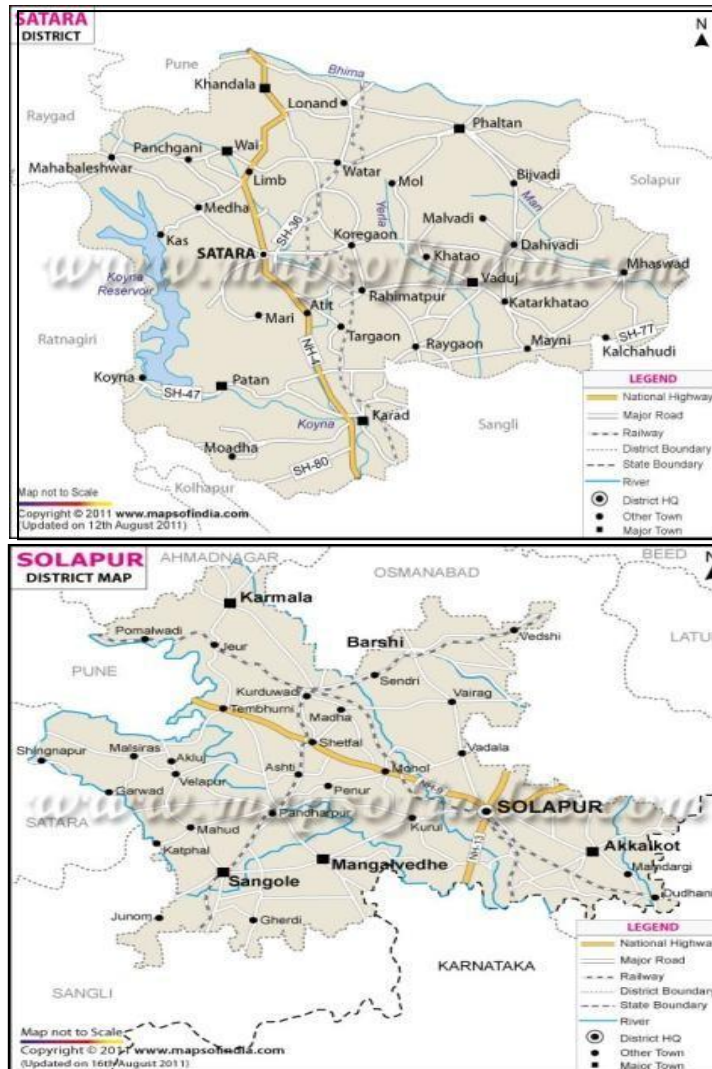
Map of India



Map of Maharashtra



Map of Satara and Solapur



1.8 Title and Reference of Methodology

Consolidated baseline methodology for “Energy efficiency measures in thermal applications of non-renewable biomass”; AMS II-G, Version 04.0.0 Sectoral Scope: 03, EB 68.

1.9 Participation under other GHG Programs

Project has been registration with UNFCCC under Clean Development Mechanism program, Registration reference number is 8732.

No CERs have been issued in CDM mechanism.

The Project is not rejected by any other GHG programs.

1.10 Other Forms of Credit

India is Non-annex1 country and there is no compliance with an emission trading program or to meet binding limits on GHG emissions for this project activity. The project is registered under CDM with registration ID 8732. Project Proponent has submitted undertaking that they will not claim same GHG emission reductions of the project from CDM and VCS. PP would not use net GHG emission reductions by the projects for compliance with emission trading program to meet binding limits on GHG emissions. PP has also submitted an undertaking stating that they will not take REC benefits for the same Emission Reductions.

Project has been registered with UNFCCC under Clean Development Mechanism program. Registration reference number is 8732. Project Proponent has submitted undertaking for not availing other forms of environmental credit for the same crediting period under consideration. Project Participant is not taking REC benefits for the same emission reductions.

1.11 Sustainable Development

The project contribution towards sustainable development is established in line with the sustainable development indicator framed by the host country DNA:

Social benefits:

Reduces drudgery of women and children of rural areas (due to reduced fuel wood use) by reducing time spent and distance travelled for fuel wood collection. Reduction in firewood requirement helps in spending more time in productive activities such as education, employment etc.

Improves overall health (particularly diseases related to respiratory system) of women and children by reducing smoke in the kitchen.

Environmental benefits:

Improves the local environment by reducing rate of forest degradation /deforestation in the project area. Conservation of forest will not only reduce non-renewable biomass demand and also reduce soil erosion and loss of biodiversity as a consequence of deforestation.

Reduces emission of black carbon to the atmosphere.

Reduces Green-house gas emissions.

Economic benefits:

Employment opportunities for local communities involved in monitoring, training of users, undertaking periodic maintenance and post life time replacement.

Reduces the expenditure involved in the pre project scenario for purchase of fuel wood.

Technological benefits:

Introduction of new technology to the rural communities.

Knowledge transfer to trainers including technicians for pertaining training to users, maintenance of system.

Demonstration of a successful project at household level creates replication potential in other states and countries.

In view of the above, the project proponent considers that, the project activity profoundly contribute towards sustainable development of the region as well as of the nation.

2 SAFEGUARDS

2.1 No Net Harm

According to the Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India, under the Environment Impact Assessment Notification vide S.O.1533(E), dated 14/09/2006; the project activity of utilization of Improved Cook stove for cooking in rural households does not require environmental impact assessment study to be carried out.

2.2 Local Stakeholder Consultation

The project proponent has opted to develop VCS project for distribution of cook stoves in and across the different location in the state across different time frame. Based on the number of cook stoves aimed to be distributed under the planned program 30 phases are planned. Since the household to be covered in each phases are homogeneous owing to the household being identified by the Rural Development Department, Government of Maharashtra based on the level of poverty judged on the basis of the thirteen point criteria figured out by the Ministry and the total budgetary provision across the year. Because of the limited budgetary provision across a financial year a fixed number of populations can only be covered amongst the group leaving the others to be covered in subsequent time frame. Because of the similar category of population the project proponent decided to carry out the stakeholder's consultation for all the planned phases in a single go, so that the people from different geographical locations could able to respond to such meeting.

The location for the consultation program is so selected that the particular location of the consultation represents the particular division or region of Maharashtra under whose jurisdiction several districts comes into. As such the locations for the consultation program are selected and newspaper advertisements are published both in English and regional daily about the program so that the peoples from the particular region can attend the consultation program which they feel nearby.

Local stakeholders meetings were conducted to take public comments. Six stakeholder meetings were conducted at Nasik, Pune, Nagpur, Latur, Sangli and Washim districts of Maharashtra. The details of meetings are –

Date of Meeting	District	Meeting Venue
2 nd February 2012	Nasik	Siaram Indrayani Housing Society, Takli Rd, Nasik– 06
2 nd February 2012	Pune	G K Energy Marketers Pvt Ltd, Lokmanya Nagar, LBS Rd, Pune
2 nd February 2012	Nagpur	246 Kumbhar Pura, Jagnath Rd Gandhi Bag, Nagpur
2 nd February 2012	Latur	Sut Mil Rd, Pushkar Residency, Latur

Date of Meeting	District	Meeting Venue
3 rd February 2012	Sangli	Khan Bag, Jai Bhavani Chowk, Sangli
3 rd February 2012	Washim	Dr. Jirvankar Bhar Jahangir Resod, Washim

Along with public notices published in newspapers namely - The Free Press Journal, Mumbai and Navshakti, Mumbai on 26th January 2012, notification of the meetings was sent through invitations, letters and personally to various categories of stakeholders to attend the stakeholder meeting. The meeting was conducted in regional language –Marathi and English. The discussion points of the meeting included purpose of the consultation, background and role of bundling agency and manufacturer under this project, description of the project, demonstration of improved cook stove, about climate change, impact of climate change, global environment scenario, contribution of the project towards sustainable development of the country by the representative from bundling agency and Improved Cook stove manufacturer. After a detailed elaborative discussion on the project, the stakeholders were asked to provide their comments /feedbacks /suggestions on the project. The cook stoves in this project activity (Sixth phase) are distributed in Satara and Solapur districts of Maharashtra which lies in Pune division jurisdiction and therefore, it can be concluded that, the stakeholders consultation conducted on 2nd February 2012 at Pune district of Pune Division covered this project activity and the consultation was also conducted before the webhosting of the PDD.

The meeting was attended by members from various backgrounds as listed below –

Sl. No.	Name of Participants	Designation
1	Baviskar Chandrakant Namdeo	Sr. Operator
2	Jitesh M Gavade	Executive
3	Phatak Revati Vishwajit	Office Assistant
4	Vishwajit V Phatak	Sr. Engineer
5	Amit Namdev Davre	Farmer
6	Sachin Aadagle	Executive
7	Vijay Budwale	Executive
8	Akash Rajpurohit	Sales Executive

9	Sunny Chandane	Worker
10	Abhijit Londhe	Farmer
11	Sagar Londhe	Business
12	Sandeep Randive	S/w Technique
13	Avinash Subash Jadav	Sales Executive
14	Dhavre Suhas Shivaji	Worker
15	Gautam Dhani Binge	Plumber
16	Dilip Shah	HR Manager
17	Gunaji Adagale	Farmer
18	Roshan Patel	Business
19	Jadhav Avinash Subhash	Student
20	B Rupesh Dalvi	Farmer
21	Shankar Patil	Worker
22	Pankaj Baviskar	CTO, GKEMPL

The overall response from the local stakeholders on the project was encouraging and positive. No adverse or negative comments or response received in the meeting. The participants of the meeting had not raised any significant concerns nor seek any clarification related to potential impacts of the project activity or any other issue. The project as a whole gives positive impression towards the issue of sustainable development of the country.

The stakeholder's comments sought during the meeting in following manners –

- The stakeholders were invited to ask any clarification or information on the project activity during the meeting.
- Evaluation form / questionnaire were asked to fill in by the stakeholders interested to give their inputs on the project activity.

The evaluation forms were analyzed for the comments and no negative comments is being found.

The summary of stakeholders comment received during stakeholders meeting of Pune are summarised as below –

Queries	Reply
How the project is contributing in pollution reduction?	The representative from GKEMPL explained that, project is reducing fire-wood consumption through improved combustion technology and thereby reducing green-house gases emission and also reducing smoke generation.
What is the tentative timeline for project development?	Responding to the query, Mr. Baviskar mentioned that, time line for project development and registration is around one year but, the revenue inflow takes at least another one year.
What is the process of estimation of Green-house gas emission reduction?	In response to this, Mr. Baviskar explained the procedure of Green- house gas emission reduction calculation in brief.

Comment	Mr. Phatak, Engineer emphasized that, it is a very good initiative taken by GKEMPL and Vikram Stoves and this helps to achieve the objective of the Govt. of Maharashtra and Govt. of India. Hence, everyone should encourage and implement such type of projects to keep the environment good.
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Grievances:

Name of beneficiary	Grievance	Location	Redressal
Salve Babu	Unable to dispose ash from grate.	Satara	Complained addressed and resolved

There has been no grievances received from Solapur district.

2.3 AFOLU-Specific Safeguards

Not applicable to this as this is not an AFOLU project activity.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The improved cook stove conceived under the project activity is MNRE and BIS (Bureau of Indian Standard) approved state of art and environmentally sound technology. The improved cook stove is manufactured in accordance to IS13152 (Part 1): 1991 (Solid Biomass – Chulha Part 1(Metallic))¹⁹. This Indian Standard was adopted by the Bureau of Indian Standard after the draft specification was finalized by the Oil Burning Appliances Sectional Committee had been approved by Heavy Mechanical Engineering Division Council. There has been no transfer of technology for the project activity. The standard has been prepared in line with the national approach towards fuel conservation, better environment, mitigating health hazards and loss of forest cover caused by burning of wood as cooking fuel and therefore, can be conceived as an environmentally sound technology for combustion of solid biomass for the purpose of cooking. Moreover, the materials used in manufacturing of the cook stove are of iron and steel which is recyclable after end use and hence, considered to be environmentally safe after lifetime also.

¹⁹ The Standard has been prepared by Indian Standard body in line with the national approach towards fuel conservation and better environment, mitigating Health hazards and drudgery and loss of forest cover caused by burning of wood as cooking fuel (Forward: Indian Standard Solid Bio-Mass, Chulha – Specification Part 1 Portable (Metallic))

The cook stove distributed under the project activity is a portable, single-pot stove without chimney, natural draft and metal made stove specifically suitable for combustion of solid biomass. The cook stove broadly comprises of a combustion chamber, top plate for holding the utensils, grate for holding fuel during combustion and bottom plate that facilitates ventilation of air. The combustion chamber is cylindrical shaped and made up of mild steel. One side of the chamber of improved cook stove is opened for feeding of fuel. The chamber top plate is die cast and made up of cast iron.

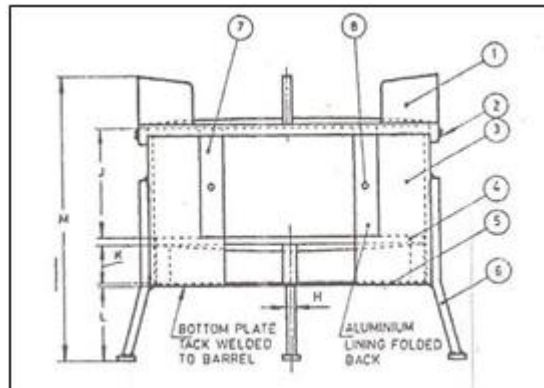
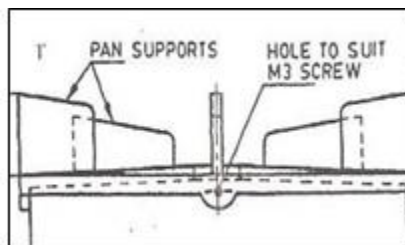
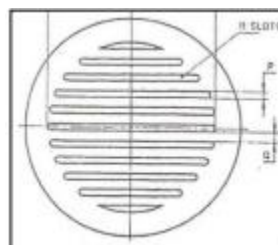


Diagram of Improved Cook Stove

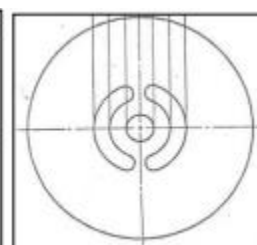
1. Top plate,
2. Screw,
3. Barrel,
4. Grate,
5. Bottom Plate,
6. Legs,
7. Aluminium Lining and
8. Rivet



Top Plate



Grate



Bottom Plate



Material used for manufacturing of each component of the cook stoves are:

Component	Material
Top plate	Cast iron
Grate	Cast iron
Barrel	Mild steel
Bottom Plate	Mild steel
Lining	Aluminum
Perforated Sleeve	Mild steel
Handle	Mild steel
Pan Support	Mild steel sheet-flat-rod
Legs	Mild steel sheet and rod

During the reporting period there has been no instances of change of improved cook stoves, therefore no such impact on emission reduction calculation due to increase of cook stoves efficiency.

Decline in the cook stove efficiency as assessed through periodic efficiency testing is being reported and considered as part of emission reduction calculation.

As the operational lifetime of the cook stove is 5 years 00 months therefore the cook stove will be replaced as and when 5 years 00 months is over. However, if any of the components of cook stove or the cook stoves are damaged and cannot be repaired the damaged cook stove will be replaced with immediate effect.

In the current monitoring period of 5 years none of the improved cookstoves have been replaced.

The beneficiaries not considered as part of the emission reduction calculation are not totally discontinued users but comprises of both (a) discontinued user and (b) beneficiary using improved cook stoves partially during the annual monitoring period. Partial users are beneficiaries /household, those who have not discontinued using of ICS but have been using ICS for a limited period (lesser number of days in compared to users using cook stoves for entire days under an annual crediting period) and also using traditional cookstoves for the

purpose of cooking along with ICS. The user's ratio not considered for estimations of emission reduction, mostly belongs to the partial user category.

Since the number of days of operation of partial ICS usage during a particular crediting period is hard to ascertain (avoid uncertainty of estimation), therefore as a conservative approach the beneficiaries /household using ICS partially are considered as discontinued users.

The district coordinator of the Project Proponent during the annual (periodic) maintenance, motivates and persuades the beneficiaries for continuation of ICS usages for the entire period and cooking of all meals towards reducing the health impact of the family especially the women and children from usage of traditional cook stoves and thereby ensuring the restoration of operation of ICS in case of partial users. Even the survey and monitoring team undertakes similar motivational exercise to ensure total usage of ICS in case of partial/discontinued users are observed during annualized monitoring exercise.

3.2 Deviations

2.3.1 Methodology Deviations

Not Applicable

2.3.2 Project Description Deviations

Not Applicable

3.3 Grouped Projects

Not Applicable

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	B_{old}
Data unit	tonnes/ household/year
Description	Quantity of woody biomass used in absence of the project activity
Source of data	Teri Energy Data Directory Yearbook for 2010
Value applied	1.469
Justification of choice of data or description of	The study as per Wood Fuel Trade in India – Food and Agricultural Organisation of the United Nation, July 2001, per capita per day biomass consumption of 1.52 kg and 5.6 kg of

measurement methods and procedures applied	fuel wood consumption per household per day. Annual consumption per household per day is therefore estimated at 2.044 tonnes. Further, the publication of TERI Energy Data Directory and Yearbook2010 outlines that, the per capita per month consumption of fire wood in Maharashtra at 25.51 kg/month/capita. With average population size of 4.8 persons/household/the annual consumption of firewood is estimated at 1.469 tonnes/year/household. Being the annual household fuel consumption data estimated on the basis of the TERI Energy Data Directory is most conservative amongst the available fuel wood consumption figure available secondarily the value of 1.469 tonnes/household/year is considered for estimation of By, savings.
Purpose of Data	Quantity of biomass utilization is used to estimate the quantum of biomass that will be saved in the project scenario after factoring into the improvement of efficiency.
Comments	The maximum value of B_{old} is fixed at ex-ante. Factors calculated based on the number of days of traditional cook stove usage and number of days of improved cook stoves usage is multiplied with B_{old} to estimate the B_{old} to be used for emission reduction calculation.

Data / Parameter	η_{new}
Data unit	%
Description	Efficiency of the cook stove being deployed as a part of the project activity
Source of data	Test report issued by Biomass Cook stove Testing Centre, Dept. of Renewable Energy Sources, Udaipur
Value applied	29.88%
Justification of choice of data or description of measurement methods and procedures applied	Thermal efficiency test carried out as per water Boiling Test Protocol specified as per IS13152 protocol.
Purpose of Data	Efficiency of the improved cookstoves is used to estimate the saving in fuel wood. (The factor is not fixed ex-post and estimated based on monitored efficiency of sample number of cookstoves)

Comments	The value of Efficiency is monitored on an annual basis and vintage wise.
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Data / Parameter	B_{y,savings}
Data unit	tonne/household/year
Description	Quantity of woody biomass saved due to implementation of the project activity
Source of data	Calculated
Value applied	0.9774
Justification of choice of data or description of measurement methods and procedures applied	B_{y, savings} is calculated using equation $B_{y, savings} = B_{old} * (1 - \eta_{old} / \eta_{new})$ $= 1.469 * (1 - 0.1 / 0.2988)$ $= 0.9774 \text{ tonne /household/year}$
Purpose of Data	Fuel wood saving is calculated for estimation of emission reduction.
Comments	The efficiency of the improved cook stoves is monitored on an annual basis based on the sample survey and if appliances are found to be operational with lower efficiency then, the actual efficiency determined during monitoring is considered to calculate emission reduction.

Data / Parameter	Energy Saving per cook stove or household
Data unit	GWh _{th} /household/year
Description	Energy saving per cook stove due to improved efficiency of the distributed cook stove
Source of data	Calculated
Value applied	0.00407
Justification of choice of data or description of measurement methods and procedures applied	Energy Saving = B_{y, saving} * NCV_{biomass} $= B_{old} * (1 - \eta_{old} / \eta_{new}) * NCV_{biomass}$ $= 1.469 * (1 - 0.1 / 0.2988) * 0.0150$ $= 0.01466 \text{ TJ /household /year}$ $= 0.00407 \text{ GWhth/household/year}$ $= 4.073 \text{ MWhth/ household/year}$ $= 1.358 \text{ MWhe / household/year}$ Note: Value of NCV_{biomass} is considered as per Paragraph 5 of the applicable methodology AMS -II. G. Version 03; IPCC default value for fuel wood i.e. 0.015 TJ/tonne is chosen.

Purpose of Data	The data is used to assess the applicability condition of the project under micro small scale guidelines and also de-bundling.
Comments	-

Data / Parameter	$F_{NRB,y}$
Data unit	-
Description	The factors relates to the fraction of non-renewable biomass
Source of data	Calculated using secondary sources
Value applied	87.9%
Justification of choice of data or description of measurement methods and procedures applied	The fraction of non-renewable biomass is calculated based on the fuel wood demand and supply of biomass across the state of Maharashtra.
Purpose of Data	Data is used for estimation of emission reduction.
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	η_{new}
Data unit	%
Description	Efficiency of the system being deployed in project activity
Source of data	Third party efficiency test report from an accredited test centre or by the verifying DoE.
Description of measurement methods and procedures to be applied	The sample systems tested as per Water Boiling Test Protocol indicated in IS 13152 (Part 1): 1991 for solid biomass cook stove. The testing is carried out on annual basis of representative sample. The minimum value of tested efficiency or 29.88%, whichever is lower is used to calculate emission reduction of the systems for particular year of operation.
Frequency of monitoring/recording	Efficiency of the improved cookstoves under operation is monitored across sample system on an annual basis
Value monitored	15 December 2012 – 14 December 2013 – 27.06% 15 December 2013 – 14 December 2014 – 26.20% 15 December 2014 – 14 December 2015 – 25.13% 15 December 2015 – 14 December 2016 – 24.01% 15 December 2016 – 14 December 2017 – 23.78%

Monitoring equipment	-
QA/QC procedures to be applied	Efficiency of the system is tested by third party agency on principle of the Water Boiling Test Protocol indicated in IS 13152 (Part 1): 1991. The number of sample system to be inspected is estimated in accordance to "Guidelines for Sampling and Surveys for Project Activities and Programme of Activities" Version 02, EB 69 Annex 5 and procedure for sample size calculation is specified in Section B.7.2 of the PDD.
Purpose of the data	For emission reduction calculation
Calculation method	-
Comments	In case of the efficiency tested for the sample system is found to be lower than 29.88% then, the minimum value of efficiency as tested is considered as a threshold for the subsequent years in place of 29.88% till the point further lower value of efficiency is tested. The value of the efficiency is used to calculate the By, savings used for expost estimation of emission reduction. The data estimated is archived both in paper and electronic spread sheet whereby the paper and the electronic form of the documents is maintained by the Project Participant for period of two year and electronic data is maintained till 2 years after the last issuance.

Data / Parameter	No. cook stoves in use
Data unit	Number
Description	The number of improved cook stoves distributed to households under the project activity.
Source of data	Third party agency survey report and database managed by the Project Participant (the end user agreement)
Description of measurement methods and procedures to be applied	The monitoring consists of third party agency survey of representative sample on annual basis to evaluate the number of systems in operation. The percentage of cook stove in usage as estimated from the survey result is multiplied with the total number of cook stove (14, 450) to determine number of cook stove in operation and to be considered for the purpose of emission reduction calculation.
Frequency of monitoring/recording	Number of improved cookstoves under operation is monitored annually based on sample survey

Value monitored	Percentage of cook stoves operational in the monitored period: 15 December 2012 – 14 December 2013 – 87.50% 15 December 2013 – 14 December 2014 – 86.25% 15 December 2014 – 14 December 2015 – 83.13% 15 December 2015 – 14 December 2016 – 81.25% 15 December 2016 – 14 December 2017 – 82.50% Number of Improved Cook stoves distributed – 14,450
Monitoring equipment	-Survey
QA/QC procedures to be applied	The project proponent obtains an authorization from each /group of the household in form of end user agreement for processing of CER. The agreement contains the date in which cook stove is physically handed over to beneficiaries. The database containing all information of the end user agreement is maintained in a central server located with project participant and accessible to the project team at different locations. During the time of verification, the DoE can verify the list of beneficiaries who has signed the end user agreement (for which the emission reductions are claimed) with the final distribution list provided by the government and against the list of beneficiaries identified by the government based on the 13 point formula. Thus, the project cook stoves is there in all the three lists. Since, the Government list is used for verification it is ensured without ambiguity that the cook stoves are distributed only to the selected baseline (BPL/ST category) beneficiaries.
Purpose of the data	Emission Reduction Calculation
Calculation method	-
Comments	The percentage of the representative sample using the improved cook stove determined from the sample survey is used to calculate the total number of cook stoves in operation. The survey report is kept and maintained by the project proponent for the period of two years after the last issuance.

Data / Parameter	Days of Operation
Data unit	Number
Description	The parameter relates to the number of days for which the cook stove in operation during the particular year

Source of data	Monitoring Database
Description of measurement methods and procedures to be applied	The emission reduction as against the cook stove is calculated when the system is being delivered to the end user, the end user initiated its operation and the end user agreement is being signed. Since, the emission reduction is based on the days of operation therefore, it is important to monitor the number of days of non-functioning. The days of non-functioning is estimated based on the number of days between the date of complaint as against damage or non- functioning received and date of repair or replacement. The information is maintained in form of database and archived. Number of days of operation = 365–Average number of days the cook stove was non-functional. The number of non-functional days is based on the number of days the cook stoves were under repair/replacement.
Frequency of monitoring/recording	Days of operation of improved cookstoves under operation is monitored annually based on sample survey
Value monitored	15 December 2012 – 14 December 2013 – 365 15 December 2013 – 14 December 2014 – 365 15 December 2014 – 14 December 2015 – 365 15 December 2015 – 14 December 2016 – 365 15 December 2016 – 14 December 2017 – 365
Monitoring equipment	-Survey
QA/QC procedures to be applied	The database for the date of dissemination of cook stoves, date of receipt of complaint for repair/ replacement and the date of repair/replacement is recorded by the village coordinator. The related information is maintained by the village co-ordinator and passed on to the VCS team on a monthly basis. In case of the cook stove being replaced, a new end user agreement is signed with the end user and attached to the original agreement. Monitoring database and the end user agreement is maintained both in soft as well as hard copy.
Purpose of the data	Emission Reduction Calculation
Calculation method	-Survey
Comments	The number of days for which the improved cook stoves were non-functional is considered for estimation of emission reduction. The record of database and copy of end user agreement is kept and maintained by the project participant for the period of two years after the last issuance.

	For ex-post, the total number of days of non-operation of the improved cook stoves due to repair, maintenance is retrieved from the maintenance log books is averaged as against the total number of cook stoves in actual operation (as per survey) and is considered. Say, if n is the total no of non- operational days as per the maintenance records of all of the cook stoves, the average days of non-operation for each cook stove is estimated as = n/x where x is the number of cook stoves in actual operation as per the sample survey.
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Data / Parameter	Number of days of functioning of traditional cook stoves
Data unit	Number
Description	The parameters refer to the number of days for which the traditional cook stove is being used by the household.
Source of data	Annual third party agency survey of representative sample household
Description of measurement methods and procedures to be applied	Survey is carried out to estimate the number of days for which the household has operated the traditional cook stove during a particular monitoring period.
Frequency of monitoring/recording	Number of days of functioning of traditional cook stoves is monitored annually based on sample survey
Value monitored	15 December 2012 – 14 December 2013 – 0 15 December 2013 – 14 December 2014 – 0 15 December 2014 – 14 December 2015 – 0 15 December 2015 – 14 December 2016 – 0 15 December 2016 – 14 December 2017 – 0
Monitoring equipment	Survey
QA/QC procedures to be applied	The survey is carried out by third party agency and is co-ordinated by the co-ordinator.
Purpose of the data	Emission Reduction Calculation
Calculation method	Survey
Comments	Number of days of operation of the traditional cook stove is obtained from the result of sample survey. The number of days of traditional cook stove as per the survey is used to obtain the average days of usage of the traditional cook stoves for all the

	households who still use the improved cook stoves of this project activity. This average days is used to arrive at a factor - $= (365 - \text{Average number of days of traditional cook stove usage in all households}) / 365$ This factor is considered as leakage and is multiplied with baseline emission to obtain the leakage emission for the usage of traditional cook stoves as per Paragraph 20 (b) of the methodology. Thus, the adjustment for Bold for the usage of traditional cook stove is taken into account.
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Data / Parameter	Number of Cook stove replaced
Data unit	Number
Description	The parameters refer to the number of cook stove that are replaced (due to end of life time or damage) by the new cook stove with efficiency greater than or equal to 29.88%.
Source of data	Monitoring database, new end user agreement and test certificate of the new system supplied.
Description of measurement methods and procedures to be applied	In case complain of the damaged cook stove is received where maintenance is not possible or lifetime of the system distributed under the project is over then, in such case the old cook stove is replaced by a new cook stove with similar or higher efficiency of existing cook stove (29.88%). On replacement a new end user agreement is signed with the existing end user and the information relating to the replacement along with necessary details is updated in the database.
Frequency of monitoring/recording	Recorded as and when replaced
Value monitored	15 December 2012 – 14 December 2013 – 0 15 December 2013 – 14 December 2014 – 0 15 December 2014 – 14 December 2015 – 0 15 December 2015 – 14 December 2016 – 0 15 December 2016 – 14 December 2017 – 0-
Monitoring equipment	Survey
QA/QC procedures to be applied	The copy of the new end user agreement for the replaced cook stove along with the efficiency certificate of the new system is archived along with the existing agreement. The database is updated as and when the system is replaced.

Purpose of the data	Emission Reduction Calculation
Calculation method	Survey
Comments	The record of database and copy of end user agreements (both new and old one) is maintained by the project participant for the period of two years after the last issuance.

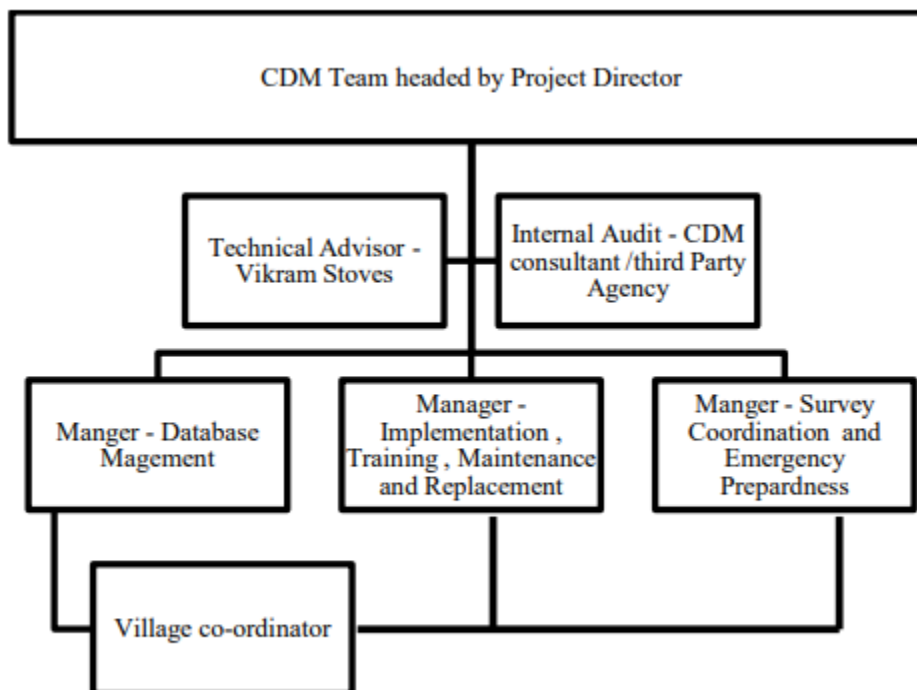
Data / Parameter	B_{y, savings}
Data unit	Tonnes/year/household
Description	Quantity of woody biomass that is saved through the project activity.
Source of data	Calculated
Description of measurement methods and procedures to be applied	The quantity of woody biomass saved is calculated following the equation $B_{y, \text{savings}} = B_{\text{old}} * (1 - \eta_{\text{old}}/\eta_{\text{new}})$ Where, B_{old} is calculated based on number of days cook stove is operational as calculated above and per capita biomass consumption of 25.51 kg/person/month multiplied by 4.8 members per rural household also factoring into the number of days for which the traditional cook stoves were in operation and the number of days of non-functioning of the improved cook stoves. The efficiency of the project system is tested on a representative sample basis.
Frequency of monitoring/recording	Calculated on an annual basis
Value monitored	15 December 2012 – 14 December 2013 – 0.9261 15 December 2013 – 14 December 2014 – 0.9082 15 December 2014 – 14 December 2015 – 0.8843 15 December 2015 – 14 December 2016 – 0.8573 15 December 2016 – 14 December 2017 – 0.8512
Monitoring equipment	-Survey
QA/QC procedures to be applied	The minimum of the minimum tested efficiency of the representative samples or 29.88% is used for η_{new} .
Purpose of the data	Emission Reduction Calculation
Calculation method	Survey

Comments	The data estimated and the survey related documents is archived by the project participant for the period of 2 years after the last issuance.
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4.3 Monitoring Plan

The monitoring of the Project activity is executed by the team of the Project Participant, Village level coordinator appointed by the Project Participant, Technical Advisor from Vikram Stoves and consultant whose specific role and responsibilities are explained as follows. The following section also explicitly indicates the monitoring plan, implementation and record archiving procedure, management of monitoring, facilitating survey, training, maintenance plan and emergency preparedness.

The detailed team structure for executing the monitoring is as follows:



Roles and Responsibilities

The roles and responsibilities of the team include:

- Undertaking awareness amongst the beneficiaries relating to usefulness of the cook stoves.
- Providing training to each entity on the operating methods and regular maintenance practice of improved cook stoves.
- Undertaking maintenance of the cook stoves on a periodic basis.

- Replacing supplied improved cook stoves with new one at the end of technical life time of the distributed system within the crediting period.
- Development and monitoring of project.
- Undertaking spot check, annual survey to access the usage, functional efficiency, maintain database and facilitate monitoring as described in section B.7.as well as the following section of the registered CDM PDD.

The end users or beneficiaries is responsible for -

- Continual usage of cook stoves
- Undertaking regular maintenance
- Supporting the village co-ordinator and the project participant in undertaking monitoring
- Inform the village co-ordinator in case the cook stove malfunctions.
- Dismantle or refrain from use of traditional cook stove
- In case the family decides to shift to the same is intimated to the village co-ordinator.

The purpose of monitoring is to achieve actual and credible emission reduction estimation pertaining to the project activity. The project participant therefore, needs to monitor and archive data required for estimation of emission reduction.

According to the approved methodology AMS -II. G.; the monitoring comprises of –

1. Efficiency check of the representative sample on annual basis to ensure that, the cook stoves are still operating at the specified efficiency (η_{new}). If appliances are found to be operational with efficiency lower than 29.88%, the efficiency determined during monitoring is used to calculate emission reduction. (In accordance to Paragraph 15 of the approved methodology)
- Thermal efficiency test is carried out in accordance to the Water Boiling Test Protocol as specified in IS 13152 (Part 1): 1991 standard.
- The sample size is selected in accordance to "Guidelines for Sampling and Surveys for Project Activities and Programme of Activities" Version 2, EB 69.
2. Monitoring also consists of checking of representative sample on annual basis to determine if the improved cook stoves are still operating or are replaced by an equivalent in service appliance. In case of replacement it is ensured that, efficiency of new equipment is similar to the equipment being replaced.

If the cook stove is replaced with higher efficiency appliances then, the efficiency of 29.88% is considered as conservative approach. (In accordance to Paragraph 16 of the methodology)

3. Monitoring ensures that:
 - a. Either the replaced low efficiency appliances are disposed of and not used within the boundary or within the region; or

- b. If baseline stoves continue to be used, monitoring ensures that the fuel-wood consumption of those stoves is excluded from B_{old}.

Therefore, the project proponent has developed a plan for monitoring under the following heads –

Implementation Arrangements and Record archiving-

On selection of beneficiaries, the rural development department places purchase order to Vikram Stoves for supply of cook stove at Block Development Office or Panchayat samity office and the supply is acknowledged by the respective authority. After the inventory receipt the concerned government office (District Rural Development Authority/ Block Development office /Panchayat samity) along with the representatives of the Vikram Stoves distributes the cook stoves to each beneficiary.

All the household post to the distribution of the cook stoves is oriented to its usage and regular maintenance. With registration of the project under the UNFCCC; the project participant imparts an awareness session unlike as in the stakeholder's consultation making the beneficiaries aware of the registration of the project.

As a part of the implementation program the project participant ensures:

1. Signing of the end user agreement with the beneficiaries (the project participant completes signing of end user agreement with all the beneficiaries who are being provided with the cook stoves before registration of the project). For beneficiaries with cook stove supplied later than the date of registration the project participant ensures to enter into end user agreement immediately after dissemination. As a part of the contractual agreement with each of the beneficiaries for the titled project a unique identification number is issued as against to each project cook stoves. Moreover, as a part of the agreement each of the end user ascertains that they won't be entering into agreement with other agencies to obtain revenue. The above two steps nullifies the chances of double counting.
2. Forming a village level committee comprising of representatives of Panchayat Samity, Project Participant (GKEMPL), Vikram Stoves and village level coordinators (employed by the project participant to support monitoring). The coordinators are employed under the project activity and is responsible for monitoring, archiving of the records and undertaking maintenance.
3. Creating database to archive relevant information about the end user, cook stoves and related information of the end user agreement. The database is created based on the end user agreement and is managed by the team. The database contains all the relevant information about the beneficiary in regard to the end user agreement. Each of the beneficiaries in the database is identified by the unique identification number. The database manager ensures that there has been no double counting/ repetition of the beneficiary information, location and unique identification number of the cook stoves. The database is updated on a regular basis to include:

- a. Replacement of the cook stoves after schedule life time
- b. Scheduled maintenance
- c. Unscheduled maintenance or fault rectification measures undertaken
- d. Temporary or permanent drop out

The village coordinator is trained on the database input parameters. The coordinator is providing input to the database manager from time to time to include and modify details as against the beneficiary if any.

Finalising the number of cook stoves for emission reduction estimation

As described in the section above in regard to the implementation arrangement and record archiving the dissemination of the cook stove to the household and its usage thereafter includes the following steps:

1. Selection of beneficiary by the Rural Development Department
2. Issue of Work /supply order to Vikram Stoves
3. Supply of cook stoves by the village panchayat /Block Development Office
4. Facilitation of dissemination of cook stoves to each end user by the village panchayat or the Block Development Office in association with village panchayat.

In accordance to the guidance of the methodology, emission reduction as against each cook stoves can only be estimated from the point of cook stove usage. Therefore, the date of dissemination of cook stoves and signing of the end user agreement with each beneficiary after dissemination is considered as the date from where the emission reduction calculation is initiated for each cook stove for the first monitoring period. From the next monitoring period, the end date of the first monitoring period is considered as the date from which emission reduction is calculated for all other cook stoves under the project activity.

Management of monitoring activities

The monitoring of the project activity is reviewed and coordinated by the top management of the Project Participant (GKEMPL) through Monitoring Coordinator (Coordinator at the village level), team of Project Participant (GKEMPL) headed by Project Director Representative of village Panchayat and technical team from Vikram Stoves.

The persons and staffs involved in monitoring is trained over the procedure in accordance to the manual and works out under the supervision of the Project Director. The major task to be undertaken and the responsibility are as follows:

1. Co-ordinator: Each coordinator acts as coordinating point between the project household and the Team (respective manager). The village coordinator is responsible to facilitate and oversee continual operation of cook stoves, maintain database related to number of cook stoves distributed and replaced thereafter, filing complain relating to non-functioning and undertaking on-call maintenance, recording of the complaint and maintenance time line and periodic submission of

information to the team.

2. Team: Creating and maintaining database and end user agreement, up-gradation of beneficiary level information in the central database. The team monitors related information pertaining to the replacement of the cook stoves²⁰. In case household considered under the project activity fails to meet the condition of the end user agreement or household drops out (because of the shift to location outside project boundary for employment purpose/migration for a temporary period or even the beneficiary decided to discontinue usage of improved cook stoves) then, such dropout household is conservatively deducted on temporary or permanent basis from the emission reduction calculation for the particular monitoring period. The VCS team is responsible for estimating the emission reduction.
3. Maintenance team – Vikram Stoves is responsible for imparting training relating to the cook stove scheduled maintenance and undertaking periodic maintenance and on-call maintenance.
4. Daily usage- Household uses cook stove and intimate from time to time relating to non- functioning or temporary transfer/migration. The coordinator on basis of the usage report intimates the team.
5. Replacement of Existing improved cook stoves: In case complain of the damaged cook stove is received where maintenance is not possible or lifetime of the cook stove distributed under the project is over then, in such case the old cook stove is replaced by a new cook stove with similar or higher efficiency of existing cook stove (29.88%). On replacement a new end user agreement is signed with the existing end user the same information relating to the replacement along with necessary details is updated in the database. The copy of the new end user agreement for the replaced cook stove along with the efficiency certificate of the new system is archived along with the existing agreement. The database is updated as and when the system is replaced. The replaced cook stoves is dismantled and sold out to the cast iron and steel units respectively in order to recycle the system components. Such initiatives nullifies the chances of the replaced cook stove to be re-used.

Monitoring of Traditional cook stove usage

The traditional cook stove is considered as an auspicious with religious value and household consider it as a linkage to their tradition so, the households has kept the traditional stoves only for their religious values . However, each household has assured and confirmed through signing of end user agreement with the project participant to continue using of improved cook stoves at household.

However, as a conservative approach to monitor fuel wood consumption in the project household from use of existing mud cook stove, third party survey is carried out of representative sample household on annual basis to evaluate the number of days for

²⁰ The replaced cook stoves is dismantled and sold out to the cast iron and steel units respectively in order to recycle the system components. Such initiatives nullifies the chances of the replaced cook stove to be re-used.

which the traditional stoves has been operated across the year. The number of days for which the traditional stoves were in operation is used to derive the factor to be adjusted with B_{old} . The factor is calculated as follows:

$$= (365 - \text{Average No. of days of traditional cook stoves usage in all households}) / 365$$

The factor calculated using above approach is multiplied with B_{old} to calculate the value of B_{old} to be used for ex-post calculation of emission reduction.

Sampling design

Objective: The objective of the sample design is to determine –

- Efficiency of Improved cook stove in operation:** Efficiency of the system is tested by third party agency of a representative sample on principle of the Water Boiling Test Protocol indicated in IS 13152 (Part 1): 1991.
- Usage Survey** – This is conducted on annual basis to determine the number of cook stove in operation. The survey is initiated after a year from date of project registration.
- Usage of traditional cook stoves:** The survey is conducted to determine the number of days for which the household is using the traditional cook stoves.

Reliability Requirement: As per paragraph 22 of the approved methodology AMS - II.G; 90% confidence interval and 10% margin of error needs is considered conceiving the fact that survey is carried out on an annual basis.

Target Population: The number of cook stove conceived under the project activity is 14, 450.

Survey Method: Simple Random sampling is chosen, as the population under the project activity are homogeneous owing to the selection of beneficiary from similar socio economic circumstances.

Sample Size:

The sample size is calculated using exact equation for random sampling –

$$n \geq 1.6452N * p * (1-p) / ((N-1) * 0.12 * p^2 + 1.6452 * p*(1-p))$$

Where,

N	=	Sample size
N	=	14,450
P	=	expected proportion (on basis of assumption that, 90% of the cook stove is in operation and at the desired efficiency)
1.645	=	Represents 90% confidence required
0.1	=	Represent 10% relative precision

a) Sample size for Efficiency test

Although the cook stoves are designed to operate at a desired efficiency level throughout its life time subjected to periodic maintenance; efficiency test of the cook stoves is carried out on

annual basis. The sample size for undertaking efficiency test is therefore, decided considering 90% of the cook stoves operates at a specified efficiency of 29.88%.

Following equation (3) above, the number of sample size arrived as below –

Time Period	Percentage of cook stove operational at specified efficiency at any point of time during the entire crediting period (This assumption is only for estimation of sample size) ⁶²	Sample size for survey (No. of systems)	Sample size after conceiving response rate of 80%
Annual	90%	31	40

(Note: the final sample size is rounded up and increased to the next closest integer)

The household for testing the efficiency as stated above is selected on a random sample basis. However while undertaking the sample beneficiary selection it is ensured that the household opted for efficiency testing are not common with the household /beneficiary selected for sample survey for improved cook stove usage and traditional cook stove usage during a particular year. Moreover, it is ensured that the household once selected for efficiency testing during a particular year is opted out from the selection procedure in course of the crediting period for further testing.

Data to be collected -

Field Measurement – Frequency: The efficiency testing of sample system is carried out on an annual basis. The inspection is carried out one year after the date of registration. There after once in every year the survey is conducted.

QA/QC Procedure: Each system is assigned with unique identification details. The systems to be sampled is randomly selected using software or random number tables and screen shots of the same is kept in the data base. The PP gets the services of third party agency or any scope accredited DOE including the verifier for conducting the efficiency test of the samples presented by the PP before the preparation of the monitoring report.

Analysis: In case of the efficiency tested for the sample system is found to be lower than 29.88% then, the minimum value of efficiency tested is considered as a threshold for the subsequent years in place of 29.88% till the point further lower value of efficiency is tested.

b) Sample size determination for no. of improved cook stoves in operation and number of days of traditional cook stove usage

The sample size is estimated for determining the number of cook stoves in operation on basis of assumption that, 90% (This assumption is only for estimation of sample size) of cook stove is operational i.e. proportion of the cook stove in operation during a particular year is 0.9.

Therefore, $n \geq 31$

For covering 100 percent of the sample and expecting a response rate of 80%. Thus, the sample size is estimated as $31/80\% = 39$. However, to cover the wide range of population and have a conservative sample the PP selects 4 times the number of sample estimated i.e., 156 numbers of household every year for the sample.

The household survey is designed to estimate the percentage of cook stove still in operation and number of days for which the traditional cook stoves are used for the purpose of estimation of emission reduction. The survey questionnaire essentially contain the unique identification details of the household, satisfactory level of usage and service, date of signing of the agreement, information regard to the maintenance or replacement if any, number of person in the household, other type of stoves used if any (type of fuel) and number of days of traditional cook stove usage (specific details about the festive season and any other occasion the traditional cook stove is used, if the size of the members are extremely high when it is not possible to use the improved cook stove).

It is to be noted that the household selected for the usage survey for determination of proportion of cook stove in operation is common where the survey for determining the number days for which the traditional cook stoves usage is carried out. The samples once surveyed in a year is not considered for subsequent year.

Data to be collected

Field Measurement – Frequency: The survey is carried out on an annual basis from the date of registration in specified format duly signed by the beneficiary to assess whether the beneficiary has been using the cook stoves distributed till date and to assess the number of days for which the beneficiary has used the traditional cook stoves during that year.

QA/QC Procedure: Each system is assigned with unique identification details. The systems to be sampled is randomly selected using software or random number tables and screen shots of the same is kept in the data base. The PP gets the services of third party agency or any scope accredited DoE including the verifier for taking the survey before the preparation of the monitoring report.

Analysis: Based on the response the percentage of improved cook stoves which are distributed as the part of this project activity that are still operated by the households and the average number of days of operation of the traditional cook stoves by each household would be estimated and the same is considered for ex-post emission reduction calculation.

The sample beneficiaries/household is same where the survey is carried out for estimation of operation of improved cook stoves and traditional cook stoves i.e. a single survey is designed to capture both. Moreover, it is ensured that the household once selected for survey during a particular year is opted out from the selection in course of the subsequent crediting period for further testing.

Sl. No.	Description	Data to be collected	Method of survey	Sampling method	Proposed Sample size	Variance
1	Efficiency of Improved cook stove	Testing of the Efficiency of the improved cook stoves	Household Collection and conducting the test for the selected samples.	Simple Random sampling	40	90% Confidence level
2	Usage survey	No of system in operation	Household survey	Simple Random Sampling	156 household/ annum	90% confidence level
	Traditional cook stove usage	No of days for which the				

		household use traditional cook stoves are used in the project Household				
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Reliability Check

The sample size as indicated in the table above is subjected to the final value of the precision calculated and in case the value of the precision estimated from the survey result is less than $\pm 10\%$ then, the sample size is re-estimated and the additional number of beneficiary/household is interviewed to obtain the desired level of precision. The precision is calculated as follows:

Step1: Estimation of the value of proportion (p)

P = number of success/ number of cook stoves that were observed in the sample

Step 2: Estimating Standard Error of the proportion

The standard error of the proportion is estimated using the following equation Standard error of proportion = $\sqrt{(1-f) pq/n}$

Where,

f = sampling fraction = (number of cook stoves that are observed in the sample)/14,450, i.e., 156/14,450.

p = proportion, 90%

q = (1-p)

n = number of cook stoves that are observed in the sample

Step 3: Estimating of Precision

Proportion = $\pm z$ value * standard error of proportion

z value = for 90% confidence level the value of z is 1.645 Standard error of proportion = estimated in step 2

Step 4: Estimating of Relating Precision Relative Precision = Precision/proportion Where,

Proportion is estimated in step 1 and precision in step 3

In case the value of the relative precision estimated based on the level of success relating to

1. Tested Efficiency of the improved cook stove being equal to greater than 29.88%
2. Number of the beneficiaries using improved cook stove

3. Number of beneficiaries/household using traditional cook stoves is not within the specified limit of $\pm 10\%$ the value of sample size is increased and survey is carried out amongst the additional population to obtain the desired level of precision i.e. within $\pm 10\%$.

Detailed modalities for monitoring each of parameter are explained in Section B.7.1 above.

Training

The training is imparted to the following entities in following way-

Entity	Objective of training	Trained by	Onset	Frequency
Household	Operational procedure Scheduled maintenance Itemised recording and reporting	Vikram Stoves (for item no 1. and 2) team (for item 3)	After distribution	Once
Village Coordinator	Monitoring of the related parameter like Spot check of cook stove usage, situational review Database management and coordination with team System Maintenance	VCS team (for item no. 1 and 2) Vikram Stoves (for item 3)	On appointment	Once in a year
VCS team	Database management Undertaking Monitoring, Recording and archiving Preparation of monitoring report	Consultant and Top Management of the Project participant	On registration	Once in a year

Quality Assurance and Quality Control of monitoring activities–

Top management of the Project participant (GKEMPL) is responsible for QA/QC which includes monitoring of accurate and transparent record keeping, monitoring and evaluation so that all supporting documentation and records for the project is easily accessible for spot checking and cross referencing by a third party agency. Top management of the project participant ensures quality control of the monitoring activities in order to guarantee of records and to confirm absence of double-counting in any form. Project participant ensures that, the detailed beneficiary level database and the project database is up to date and the latter is representative of the most recent definitions of clusters. Internal audit is carried out on six month basis by the consultant or third party agency and includes -

1. The internal review is carried out in every six months for compliance check in accordance to the manual.

2. Non conformity if noted is reported and brought into the notice of the top management and measures is undertaken to ensure that required compliance is met.
3. Training on the monitoring if felt by the auditor is imparted to the team.

Emergency Preparedness

In case the village co-ordinator is reported against malfunction/ non-function of cook stove which the technical team is unable to rectify the fault and unable to co-ordinate with the technical team of Vikram Stoves; the co-ordinator immediately replace the existing cook stove with the new one. The faulty stoves thereafter be transported to the industry for repair.

1. The coordinator is provided with stand-by stove components for repair and/or replacement.
2. Few numbers of cook stoves are stocked with the Panchayat Samity/ Block Development Office to reduce the down time of replacement.
3. In case the coordinator is unable to carry out maintenance, the same is reported to the technical team of Vikram Stoves and the nearby representatives visits the village to support the co-ordinator in rectifying the fault.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

Emission reduction is estimated in following way –

$$ER_y = B_{y, savings} * f_{NRB,y} * NCV_{biomass} * EF_{projectedfossilfuel}$$

Where, In accordance to paragraph 13 of the methodology, leakage related to the non-renewable woody biomass saved by the project activity is assessed based on ex post surveys of users and the areas from which this woody biomass is sourced. Subsequent to the clarification provided in sub paragraph (a) survey is not required for ex-post estimation of leakage in case B_{old} is multiplied by a net to gross adjustment factor of 0.95 to account for leakages.

Parameter	Data	Unit
B_{old}	1.469	Tonne fuel wood /cook stove/ year
$B_{y, savings}$	0.9774	Tonne fuel wood /cook stove/ year
$f_{NRB,y}$	87.90%	
$NCV_{biomass}$	0.015	TJ/tonne
$EF_{projectedfossilfuel}$	81.60	tCO ₂ e/TJ
$ER_{y,WGA,per\ cook\ stove}$	1.0515	tCO ₂ e /cook stove/ year

(Emission reduction/ cook stove /year without gross adjustment factor for B_{old} to account for leakage)		
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The leakage emission for ex-ante estimation of emission reduction is thereby calculated as a difference between the emission reduction estimated considering the actual value of B_{old} i.e. 1.469 Tonne fuel wood /cook stove/ year and emission reduction estimated by considering the value of B_{old} is estimated by multiplying B_{old} with a net to gross adjustment factor of 0.95.

For the purpose of ex-ante estimation of emission reduction it is assumed that, only 90% of the cook stoves are operational in any point of time. Thus, the emission reduction per year ($ER_{y, WGA}$) without gross adjustment factor for B_{old} to account for leakage considering 90% of the cook stove as operational for the entire crediting period is 13,674 tCO₂e /year.

The Baseline Emissions achieved for this monitoring period is 57,944 tCO₂e /year.

5.2 Project Emissions

Project emissions are considered as zero for this project as no fossil fuels are used

5.3 Leakage

The leakage emission per cook stove is estimated as difference between the emission reduction estimated considering the actual value of B_{old} and emission reduction estimated considering the value of B_{old} obtained by multiplying B_{old} with a net to gross adjustment factor of 0.95.

Parameter	Data	Unit
Leakage emission	0.053	tCO ₂ e /cook stove/ year
Leakage emission due to use of traditional cook stove usage (assuming 0 for ex-ante)	0	tCO ₂ e /cook stove/ year
Leakage emission, (LE _y , per cook stove)	0.053	tCO ₂ e /cook stove/ year

Therefore, the total leakage emission (LE_y) for the project activity assuming 90% of 14,450 numbers cook stove distributed is 684 tCO₂e /year.

The leakage emissions achieved for this monitoring period is 2,899 tCO₂e /year.

5.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
15-December-2012 to– 14-December-2013	12,596	0	630	11,966
15- December-2013 -to 14-December-2014	12,177	0	609	11,568
15- December-2014 to- 14-December-2015	11,427	0	572	10,855
15- December-20 15 to - 14-December-2016	10,827	0	542	10,285
15- December-20 16 -to 14-December-2017	10,917	0	546	10,371
Total	57,944	0	2899	55,045

Comparison with estimated emission reductions is given below:

Period	ER _{y,WGA} (tCO ₂ e /yr.)	Project Emission (PE _y)	Leakage (LE _y)	Net emission reduction for the project activity in the year y, ER _y	Comparison with Estimated ER	Percentage Change
15-December-2012 – 14-December-2013	12,596	0	630	11,966	12,990	-8%
15-December-2013 - 14-December-2014	12,177	0	609	11,568	12,990	-11%
15-December-2014 - 14-December-2015	11,427	0	572	10,855	12,990	-16%
15-December-2015 - 14-December-2016	10,827	0	542	10,285	12,990	-21%
15-December-2016 - 14-December-2017	10,917	0	546	10,371	12,990	-20%
Total	57,944	0	2,899	55,045	64,950	-15%

