

“Programme, baseline and monitoring methodology for the introduction of an alternative ignition technique as measure to improve the energy efficiency of domestic coal fires”

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## I. SOURCE, DEFINITIONS AND APPLICABILITY

### Sources

This methodology makes use of elements of latest versions of the following Voluntary Gold Standard and CDM methodologies:

- “Methodology for Improved Cook-stoves and Kitchen Regimes ” (Gold Standard);
- AMS-I.C “Thermal energy production with or without electricity ”(CDM);
- SSC-II. G. “Energy Efficiency Measures in Thermal Applications of Non-Renewable Biomass” (CDM).

This methodology refers to the latest approved versions of the following CDM methodology tools and guidelines.

- Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion;
- Tool for the demonstration and assessment of additionality;
- General guidelines on sampling and surveys

### Selected approach from paragraph 48 of the CDM modalities and procedures

1. “Existing actual or historical emissions, as applicable”

### Definitions

2. For the purpose of this methodology, the following definitions apply:

- **Domestic thermal energy.** Domestic thermal energy is the use of heat for household tasks such as food preparation (cooking and drying), residential space heating, water heating (for body washing and other washing) and ironing;
- **Alternative ignition technique for coal fires.** A learned, habitual, purposeful procedure used to start the coal fire that differs from another procedure that represents conventional practice.

### Applicability conditions

3. This methodology applies to project activities that resort under the category of *End-use Energy Efficiency Improvement*.
4. This methodology applies to programs or activities introducing an alternative ignition technique for domestic coal fires to coal using households within a distinct geographical area. The project does not introduce coal use to any households who do not use coal at the time of the project activity. The project activity is the introduction of an alternative ignition technique that causes households to switch from a less efficient ignition technique with significant greenhouse gas emissions to a technique that results in considerably less emissions. The project coordinator

carries out the project activity by way of formal or informal training and demonstration of the alternative ignition technique for domestic coal fires to coal using households. The project coordinator may undertake this activity by conducting demonstrations of the alternative technique in public places or private houses or any other place suitable for such purposes. The project coordinator may also visit the households who attended such training or demonstrations at their individual residences after the initial training or demonstration to continue support in acquiring the skills needed to correctly use the alternative ignition technique.

5. The project activity is implemented by a project coordinator who acts as a project participant. The households will not act as project participants.

6. The methodology is applicable under the following conditions:

- The methodology applies to households who use coal in an open fire or coal burning device for domestic thermal energy such as cooking and/or space heating and/or water heating and/or ironing. Monitoring must confirm that households forming part of the project boundary are indeed using coal for domestic purposes and that they have been using coal before exposure to the project activity;
- The methodology applies only to alternative *ignition* techniques. Ignition of a domestic coal fire is the procedure used to initialise the fire until such time when the coal is burning in a self-sustaining way. This involves actions such as the stacking of burnable material in a specific configuration which may involve mixing and grading of flammable material and applying heat to specific parts of the fuel stack in order to ignite the tinder which in turn ignites the coal. By implication the methodology does not apply to actions (such as improved or alternative operational or management practises) carried out by the user after the coal is burning in a self-sustained way. Monitoring must confirm that households who use the alternative ignition technique do so because of the project activity. This can be done by showing that the households were exposed to the project activity and that another ignition technique was used prior to exposure to the project activity;
- The alternative ignition technique is used in the same coal burning device, with the same fuel and for the same purposes as the conventional ignition technique. Where equipment change takes place within an individual household during the course of the project, it must not be caused by the use of the alternative ignition technique. By implication this methodology does not apply to activities that bring about changes in the types of fuels used by households either as substitute or compliment to domestic coal;
- The coal using households are not included in another CDM or voluntary market project where greenhouse gas emissions from domestic coal use forms part of the baseline or project emissions. The project proponent must take reasonable steps to ascertain what other projects may be active in the same area and present such results in the PDD;
- The alternative ignition technique is unambiguously discernible from the conventional ignition technique and may be known by a colloquial name. The project proponent shall provide a detailed description of the conventional (baseline) ignition technique and the alternative ignition technique introduced by the project as well as the specific mechanism of introduction employed by the project in the PDD. The project proponent may furthermore present a list of names of ignition techniques in languages used within the Target Area as a means of showing that the local population distinguishes the alternative ignition technique from the conventional one;
- The project activity takes place and the households are located within the defined Target Area. All surveys carried out must include information on location of the households surveyed to ensure that they fall within the Target Area.

7. The methodology is not applicable to projects that promote coal use but only to projects aimed at facilitating a change in ignition technique with existing coal users.

8. The project proponent must present a comparative laboratory test measuring emissions of incomplete combustion products and especially CO under the conventional and alternative ignition technique by a third party, over the entire burning cycle of the coal batch. The project proponent must provide protocols for the conventional and alternative technique to credibly reflect the baseline and project scenario. If more CO is found to be released in the project scenario that could lead to higher human exposure to CO, then appropriate corrective and/or mitigation measures must be implemented and documented in the PDD for the methodology to be applicable.

**II. BASELINE METHODOLOGY PROCEDURE**

**Project boundary**

9. A project or programme will specify regions or towns within a country, or a whole country, as the Target Area in which a target population is identified and which provides a geographic outer limit to the Project Boundary. The project proponent must describe the general typology of the Target Area in terms of domestic energy use in the PDD. If there are important differences in energy use patterns within the Target Area (e.g. urban vs. rural), the project proponent must describe these differences and show how the monitoring procedure employed takes this into account.

10. The Project Boundary is defined by the coal burning devices of the households that use the alternative ignition technique introduced by the project within the Target Area. Only households who have used coal as source of domestic thermal energy before the introduction of the alternative ignition technique may form part of the Project Boundary.

11. The Project Boundary is subject to variation over time. The project activity may be implemented in a phased or programmatic manner with the result that new users of the alternative ignition technique are continually added so that the project boundary grows over time. Careful monitoring of changes in the extent of the Project Boundary must be done annually.

12. The greenhouse gases included in or excluded from the project boundary are shown in Table 1.

Table 1: Emissions sources included in or excluded from the project boundary

	<b>Source</b>	<b>Gas</b>	<b>Included?</b>	<b>Justification / Explanation</b>
<b>Baseline</b>	Cooking, space heating, water heating, ironing with coal	CO <sub>2</sub>	Yes	Significant source
		CH <sub>4</sub>	No	Not a significant source
		N <sub>2</sub> O	No	Not a significant source
	Ignition of coal fire with wood	CO <sub>2</sub>	Yes	Significant in cases where not from a renewable source
		CH <sub>4</sub>	No	Not a significant source
		N <sub>2</sub> O	No	Not a significant source
<b>Proj</b>	Cooking, space	CO <sub>2</sub>	Yes	Significant source

<b>ect activ ity</b>	heating, water heating, ironing with coal	CO <sub>2</sub>	Yes	Significant source
		CH <sub>4</sub>	No	Not a significant source
		N <sub>2</sub> O	No	Not a significant source
	Ignition of coal fire with wood	CO <sub>2</sub>	Yes	Significant in cases where not from a renewable source
		CH <sub>4</sub>	No	Not a significant source
		N <sub>2</sub> O	No	Not a significant source

**Identification of the baseline scenario**

13. The baseline scenario is that domestic coal use within the project boundary that would have occurred in the absence of the project activity. Project participants shall apply the following steps to identify the baseline scenario:

***Step 1: Determine the extent of domestic coal use within the Target Area on a year to year basis***

The project proponent determine the extent of domestic coal use within the Target Area and show that the project does not introduce coal use but only introduces a more efficient ignition technique to households who already use coal.

***Step 2: Determine the extent of use of the alternative ignition technique among domestic coal users within the Target Area a year to year basis;***

The project proponent must determine the extent of use of the alternative ignition technique before the start of the project activity and for each year in which the project is operational.

***Step 3: Identify sources that facilitate the switch to the improved ignition technique apart from the project activity on a year to year basis;***

The project proponent must determine if there are any sources of conversion to the alternative ignition technique apart from the project activity. If such sources are present, the calculation of baseline emissions must be adjusted according to equation 4. If a renewable crediting period is chosen, the project proponent must ensure that households that have been part of the project during first crediting will not be included in the calculation of baseline and project emissions in second crediting period. Only new households that join the project during renewed crediting period should be taken into account in the calculation of baseline and project emissions. The users who converted to the use of alternative ignition technique due to the project activity during the first crediting period who may still be in the Target Area must be included in  $XU_{other,y}$  in equation 4 during the second crediting period. This procedure is to be repeated every time the crediting period is renewed.

Only conversions to the improved ignition technique that would not occur in the baseline scenario and that are thus directly attributable to the project activity may be used in the calculation of greenhouse gas emission reductions. The parameters and procedures used to monitor the baseline scenario will be described further in this document.

**Additionality**

14. The latest version of CDM *Tool for the demonstration and assessment of additionality* shall be applied to demonstrate additionality.

Sub-step 2a of the tool is followed to determine appropriate analysis method for the project. Project proponents should in all cases use simple cost analysis (Option I) because the project activity generates no financial other than income related to the sale of emission reductions.

**Baseline emissions**

15. The project activity introduces a technique that reduces coal used for domestic thermal energy. This energy is used for domestic purposes such as space heating and cooking, water heating and ironing. This project introduces an energy efficiency technique that displaces a technique that uses a fossil fuel (coal) in an inefficient way (e.g. improved top-down ignition vs. conventional bottom-up ignition). The baseline emissions is therefore defined as all significant GHG emissions related to domestic coal burning present within the project boundary in the absence of the project activity. The baseline emission is calculated from the coal consumption that would have taken place in the absence of the project activity multiplied by an emission coefficient using the *CDM Tool to calculate project or leakage CO2 emissions from fossil fuel combustion*. The basic formula applied to domestic coal use is:

$$BE_y = C_{B,y} \times COEF \tag{1}$$

Where:

BE<sub>y</sub> = The baseline CO<sub>2</sub> emission from domestic coal combustion within the project boundary in the absence of the project activity for the year *y* (tCO<sub>2</sub>/yr)

C<sub>B,y</sub> = The mass of coal (in tonnes) that would have been combusted by households within the project boundary in the absence of the project activity for the year *y* (t/yr)

COEF = The CO<sub>2</sub> emission coefficient for domestic coal combustion (tCO<sub>2</sub>/t coal)

The CO<sub>2</sub> emission coefficient COEF can be calculated using one of either of the two options described in the *Tool to calculate project or leakage CO2 emissions from fossil fuel combustion* depending of the availability of data. If data is available, option A must be used. In all cases, the same option (A or B) should be followed in the calculation of both the baseline and project emissions. In case Option A is used, an oxidation factor, derived from relevant local scientific literature or laboratory tests or IPCC default values, should be applied to correct for the fact that not all the carbon in the fuel is oxidised.

16. Domestic coal fires are ignited using small amounts of wood and paper. This may be left out of consideration if the project proponent can show that the mass of these fuels used does not differ between the conventional (baseline) ignition technique and the improved technique or that the wood can be regarded as a renewable source following the definition provided in Annex 18 of the report of the 23rd meeting of the CDM Executive Board. If this can not be shown, emissions from wood used for ignition of the coal must be calculated for the project and baseline scenario.

17. The number of users of the alternative ignition technique as a result of the project activity may change from year to year. This may be the result of continuation and extension of the project activity in a programmatic manner or because coal use is declining or because users start using another ignition technique. For this reason the number of users of the improved ignition technique has to be monitored on a year to year basis and baseline emissions has to be calculated accordingly.

18. The project proponent must keep a database containing detailed information of all interactions between users and the project personnel. This must include information on attendance of demonstrations or other events where the alternative method is introduced to users. In this database the household must be uniquely identifiable. It must furthermore be clearly indicated which households use coal for domestic purposes and what the nature of the interaction between the household and the project coordinator was.

19. The calculation of baseline emissions is not based on the assumption of constant coal consumption over the total project period but on the constancy of the improvement in energy efficiency resulting from the use of the alternative ignition technique. The energy requirements of households change from time to time. For this reason, calculating baseline emissions for the total crediting period based on the fuel use of a household before the project activity is insufficient. The project proponent must estimate the baseline emissions on a year to year basis. This is based on the coal that would have been required in the baseline scenario to meet thermal energy needs similar to the energy requirements of the households for each year of the project duration.

20. The increase in energy efficiency brought about by the improved ignition technique is calculated by comparing the mass of coal used over a specific period (e.g. a month) in the baseline scenario with the coal use in a similar period after conversion to the improved ignition method when similar thermal energy needs are present.

21. An energy efficiency factor for a specific household can be calculated as:

$$eef_j = \frac{C_{ante,t,j}}{C_{post,t,j}} \quad (2)$$

Where:

$eef_j$	=	Energy efficiency factor for the households $j$
$C_{ante,t}$	=	Coal consumption for the time period $t$ directly before conversion to the improved ignition technique for households $j$ (units)
$C_{post,t}$	=	Coal consumption for the time period $t$ directly after conversion to the improved ignition technique for households $j$ (units)

22. Where there is likely to be seasonal variation in coal use, the energy efficiency factor has to be calculated **seasonally**. The project proponent should also identify instances where other factors may lead to a rapid reduction in coal use that can be mistaken for the effect of the switch to the alternative technique and present the results in the PDD together with a description of steps taken to avoid attributing a decrease in coal use due to other reasons to the project activity.

23. The energy efficiency factor thus calculated can be used to calculate the mass of coal that the specific household would have used in the baseline scenario for meeting similar thermal energy needs:

$$C_{B,y,i,j} = eef_j \times C_{t,i,j} \times \frac{t}{y} \quad (3)$$

Where:

$C_{B,y,i,j}$	=	Baseline coal consumption for the year $y$ for households $j$ per format type $i$ (tonnes)
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$eef_j$	=	Energy efficiency factor for the households $j$ per format type $i$
$C_{t,i,j}$	=	Current (at time of survey) coal consumption for households $j$ per time period $t$ and format type $i$ (tonnes)
$t$	=	Time period (in days)
$y$	=	One year of 365 days

24. To ensure a conservative estimate the estimation of Baseline coal consumption for a specific household will never be allowed to exceed the initial coal consumption for that household.

25. In the identification of baseline scenarios, other sources of conversion to the alternative ignition method are identified. The contribution of these sources has to be incorporated in the calculation of baseline emissions.

26. This is calculated as follows:

$$C_{B,y} = C_{B0,y} - (XU_{other,y} \times (C_{B0,y} - P_{All,y})) \quad (4)$$

Where:

$C_{B,y}$	=	Baseline coal use of the project in year $y$ (tonnes)
$C_{B0,y}$	=	Baseline coal use in the zero intervention scenario (no project activity or other activities) in year $y$ calculated using equation 3 (tonnes)
$XU_{other,y}$	=	Fraction of users of the alternative ignition method attributable to other sources in year $y$
$P_{All,y}$	=	Project coal use taking into account all interventions (tonnes)

27. Conversions to the alternative technique that can be attributed to other sources must be monitored in the annual household coal use survey (see Section III) and described in the monitoring report.

28. The GHG emissions from coal consumption are calculated using the latest version of the *CDM Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion*.

**Project emissions**

29. The project emissions are all significant GHG emissions within the project boundary after the implementation of the project activity. Because the project activity leads to the implementation of a more efficient method of ignition, the project emissions are lower than the baseline emissions.

30. Project emissions are calculated from the coal consumption of coal using households within the Project Boundary using the *Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion* similar to the way in which Baseline emissions is calculated (see Equation 1).

**Leakage**

31. No significant leakage aspects are anticipated from project activities using this methodology.



**Emission reductions**

32. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \tag{5}$$

Where:

- ER<sub>y</sub> = Emission reductions in year y (t CO<sub>2</sub>e/yr)
- BE<sub>y</sub> = Baseline emissions in year y (t CO<sub>2</sub>e/yr)
- PE<sub>y</sub> = Project emissions in year y (t CO<sub>2</sub>/yr)
- LE<sub>y</sub> = Leakage emissions in year y (t CO<sub>2</sub>/yr)

**Data and parameters not monitored**

33. In addition to the parameters listed in the tables below, the provisions on data and parameters not monitored in the tools referred to in this methodology apply.

<b>Data / parameter:</b>	X <sub>C<sub>coal</sub></sub>
Data unit:	Fraction
Description:	Carbon content of domestic coal
Source of data:	Relevant scientific literature or laboratory tests or IPCC default values
Measurement procedures (if any):	
Monitoring frequency:	Once per target area per crediting period
QA/QC procedures:	Compare sources
Any comment:	

<b>Data / parameter:</b>	X <sub>O<sub>2</sub></sub>
Data unit:	Fraction
Description:	Fraction of unburnt coal per operating cycle per device type
Source of data:	Relevant local scientific literature or laboratory tests or IPCC default values
Measurement procedures (if any):	
Monitoring frequency:	Once per target area per crediting period
QA/QC procedures:	Compare sources
Any comment:	This parameter in to be used when Option A of the <i>Tool to calculate project or leakage CO2 emissions from fossil fuel combustion</i> is used.

<b>Data / parameter:</b>	$EF_{CO_2,wood}$
Data unit:	tCO <sub>2</sub> /TJ
Description:	CO <sub>2</sub> emissions from domestic wood burning
Source of data:	Relevant scientific literature or laboratory tests or IPCC default values
Measurement procedures (if any):	
Monitoring frequency:	Once per target area per crediting period
QA/QC procedures:	Comparison between sources
Any comment:	

<b>Data / parameter:</b>	$XW_{nr}$
Data unit:	Fraction
Description:	Fraction of non-renewable biomass used for ignition of coal
Source of data:	Relevant local scientific literature or laboratory tests or IPCC default values
Measurement procedures (if any):	
Monitoring frequency:	Once per target area per crediting period
QA/QC procedures:	Comparison between sources
Any comment:	

<b>Data / parameter:</b>	$NCV_{bio}$
Data unit:	TJ/t
Description:	Net calorific value of biomass used for ignition of coal
Source of data:	Relevant local scientific literature or laboratory tests or IPCC default values
Measurement procedures (if any):	
Monitoring frequency:	Once per target area per crediting period
QA/QC procedures:	Comparison between sources
Any comment:	

### III. MONITORING METHODOLOGY

34. The greenhouse gas emissions from within the project boundary are monitored through three processes. The first is the establishment and maintenance of a *project implementation database* which records all interactions between the demonstration teams and household members. The second is an annual *household coal use survey*. Thirdly, a survey of the most important *coal merchants* within the Target Area is conducted to determine the respective weights of different formats in which coal is sold. It is strongly advised the project proponent obtain the services of a person or institution with in-depth statistical expertise to accomplish some or all of the monitoring tasks and the statistical analysis.

***Continuous Monitoring: The project implementation database***

35. The project database is used as quality control against the annual survey. All interactions between the demonstration team and households in the Target Area are recorded. There are three categories of interactions:

(a) Invitation: This is where household members are approached and informed about the alternative ignition method and invited to attend a demonstration of the technique or to host a demonstration in their house.

The minimum data that has to be kept from this type of interaction is:

- An unambiguous means of identifying the household. This can be an address if there is only one household who lives at the address or surname combined with an address or a name and surname where no formal addresses exist;
- The date of the interaction;
- The nature and result of the interaction. e.g. household member invited to demonstration but declined because they do not use coal.

(b) Demonstration: This is where household members are taught the alternative ignition technique by way of practical step-by-step demonstration of the technique. By definition, a fire has to be made for an event to qualify as a demonstration. The minimum data that has to be kept from this type of interaction is:

- An unambiguous means of identifying the household;
- The name of the attendant;
- The date of the demonstration.

(c) Evaluation: This takes place when the project implementer visits household members who have attended demonstrations some time after the demonstrations to evaluate the result of the demonstration or to further support or retrain the members of the household.

The minimum data that has to be kept from this type of interaction is:

- An unambiguous means of identifying the household;
- The date of the interaction;
- The nature and result of the interaction. e.g. evaluation interview, respondent uses the alternative technique successfully.

The way in which the project implementation database will be used will be discussed with the section on quality control.

***Annual Monitoring: Household coal use survey***

36. The project coordinator must conduct an annual household coal use survey where information about coal use is gathered from household members. The project proponent must

design a sample plan in accordance with the latest approved CDM *General guidelines on sampling and surveys*. Where the possibility exists that coal use may vary seasonally (such as in cases where coal is used for space heating), the survey should contain responses collected in different seasons in order to facilitate comparison of end-users' estimation of coal consumption made during different seasons. The project proponent must show in the Monitoring Report that the number of responses collected in the season different from the main survey is sufficient to facilitate a reasonable comparison of results. Only after an initial cross-seasonal analysis of estimations of coal use by end-users that confirms that coal use does not vary seasonally may the project proponent work with the assumption of constant coal use during all seasons. Where it is assumed that no seasonal variation in coal use exists, the project proponent should show that sufficient data has been collected and analysed to justify such a conclusion. This means that monitoring at various times of the year must be conducted at least once during a crediting period and described either in the PDD or subsequently in the Monitoring Report.

37. Structured interviews with appropriate household members (i.e. members who have knowledge of the household's coal use: not children under 16 years) must be conducted to gather at least the following information (more than one question may be asked to determine each item):

- An unambiguous means of identifying the household;
- The date of the interview;
- Whether the household use coal for domestic heating, cooking, water heating or ironing. The project proponent should indicate in the Monitoring Report what steps have been taken to ensure an accurate response to this question. The respondent may, for example, be asked to provide details about the coal burning device used by the household. Information on coal use should be cross-checked to ensure consistent responses;
- Whether coal consumption differs seasonally;
- Whether any member of the household uses the alternative ignition technique. The project proponent should indicate in the Monitoring Report what steps have been taken to ensure an accurate response to this question. The respondent may, for example, be asked to provide a description or demonstration of the way they make fire to ensure that an accurate response is obtained;
- When (month and year) the users of the alternative ignition technique started to use it;
- What led to the household members starting to use the alternative ignition technique. The project proponent should indicate in the Monitoring Report what steps have been taken to ensure an accurate response to this question. The respondent may, for example, be asked to provide details on the event where she/he learnt the technique or the medium through which the technique was introduced. This is to be cross-checked with implementation periods and techniques of the project coordinator as well as other entities who have promoted the alternative ignition technique in the Target Area;
- The format in which coal is purchased;
- The frequency at which coal is purchased;
- The number of units of coal bought per week/month (differentiate seasonally if there is a seasonal difference);

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- The supplier from which coal is bought;
  - The number of units of coal used per week/month (depending of purchase frequency) in the period immediately before switch to the alternative ignition technique;
  - The number of units of coal used per week/month (depending of purchase frequency) in the period immediately after the switch to the alternative ignition technique.

***Annual Monitoring: Coal merchant survey***

38. In addition to the household coal use survey, a survey must be conducted among coal merchants within the Target Area. The major merchants are to be identified from responses in the coal use survey. The project proponent must determine the proportion of the total coal supply within the Target Area represented by each merchant surveyed and report the result in the Monitoring Report. The merchants surveyed must together represent at least 10% of the coal supply to households in the area. The geographic area serviced by each merchant surveyed must also be reported. The project proponent should show that the coal merchant surveyed service the total Target Area with no significant areas that are not represented. The project proponent should furthermore analyse the variation in the price of coal per weight (taking into account factors such as transport and value added services) and use this to show that the results of the coal merchant survey adequately represent the coal market in the Target Area.

The following information must be obtained from the coal merchants sampled:

- The different formats in which coal is sold;
- The price of each format;
- The weight of each format;
- The type and origin of wood, if wood is also sold;
- The different formats in which wood is sold;
- The price of each format in which wood is sold;
- The weight of each format in which wood is sold.

**Data and parameters monitored**

39. The following variables will be monitored:

<b>Data / parameter:</b>	$U_y$
Data unit:	Number
Description:	Number of users who switched to the alternative ignition technique in a specific year
Source of data:	Project implementation database
Measurement procedures (if any):	Record is kept of all interaction between user and the project personnel such as invitations or attendance of demonstrations
Monitoring frequency:	Continuous throughout project, once per new user
QA/QC procedures:	Standard survey QC best practise Statistical comparison of results between implementation teams
Any comment:	

<b>Data / parameter:</b>	$C_{ante,t,i}$
Data unit:	Units of coal consumed over the time period $t$ for the format type $i$
Description:	Units of coal consumed before switch to alternative technique
Source of data:	Household coal use survey
Measurement procedures (if any):	
Monitoring frequency:	Annually, for a sample of new users
QA/QC procedures:	Standard survey QC best practise Statistical comparison of results between periods and populations
Any comment:	

<b>Data / parameter:</b>	$C_{post,t,i}$
Data unit:	Units of coal consumed over the time period $t$ for the format type $i$
Description:	Units of coal consumed after switch to alternative technique
Source of data:	Household coal use survey
Measurement procedures (if any):	
Monitoring frequency:	Annually, for a sample of new users
QA/QC procedures:	Standard survey QC best practise Statistical comparison of results between periods and populations
Any comment:	

<b>Data / parameter:</b>	$FC_i$
Data unit:	Kg
Description:	Weight for each format in which coal is sold
Source of data:	Coal merchant survey
Measurement procedures (if any):	Standard weighing equipment
Monitoring frequency:	Annually
QA/QC procedures:	Compare price per kg of coal between formats.
Any comment:	If price per kilogramme differs significantly between formats (taking into account volume discounts), additional measurements must be conducted

<b>Data / parameter:</b>	$XU_{alt,y}$
Data unit:	Fraction
Description:	Coal users converted to the alternative ignition technique present within the Target Area for the year y
Source of data:	Household coal use survey
Measurement procedures (if any):	Survey of sample from the entire population within target area
Monitoring frequency:	Annually
QA/QC procedures:	Standard survey QC best practise Cross-check with project implementation database
Any comment:	This is calculated the proportion of survey respondents who have indicated during the interview that they use coal and that they use the alternative ignition technique to ignite their coal fire using the lower bound of the 90% confidence interval as described in Annex B.

<b>Data / parameter:</b>	Pop
Data unit:	Number
Description:	Population of Target Area
Source of data:	Official statistics, peer reviewed published data or estimate from survey where sampling method allows for estimation
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	Compare data sources
Any comment:	

<b>Data / parameter:</b>	$C_{i,t}$
Data unit:	Units, i is format (e.g. bag, truckload)
Description:	Coal consumed in period t
Source of data:	Household coal use survey
Measurement procedures (if any):	Survey respondents are asked to report the format in which they purchase coal and the number of units consumed per week or month (e.g. 3 bags).
Monitoring frequency:	Annually
QA/QC procedures:	Statistical analysis of results between populations
Any comment:	

<b>Data / parameter:</b>	$XU_{coal,y}$
Data unit:	Fraction
Description:	Fraction of coal users present within the Target Area for the year y
Source of data:	Household coal use survey
Measurement procedures (if any):	Survey of sample from the entire population within Target Area
Monitoring frequency:	Annually
QA/QC procedures:	Standard survey QC best practise Statistical comparison of results between periods and populations Cross-check with project implementation database Compare with official statistics where available
Any comment:	This is calculated from the proportion of survey respondents who have indicated during the interview that they use coal.

<b>Data / parameter:</b>	$XU_{other,y}$
Data unit:	Fraction
Description:	Fraction of users of the alternative ignition technique that can be attributed to sources other than the project activity for a specific year
Source of data:	Household coal use survey
Measurement procedures (if any):	Survey of sample from the entire population within Target Area
Monitoring frequency:	Annually
QA/QC procedures:	Standard survey QC best practise Statistical comparison of results between periods and populations Cross-check with project implementation database
Any comment:	This is calculated from the proportion of survey respondents who have indicated during the interview that they use coal, use the alternative ignition technique and have provided details about the event (start date, place of demonstration, media used) that has lead to them starting to use the alternative technique that can not be unambiguously connected to the activities of the project coordinator.



<b>Data / parameter:</b>	$W_{y,i}$
Data unit:	Units of wood consumed, i is format (e.g. bag, bundle)
Description:	Units of wood consumed in the year y
Source of data:	Household coal use survey
Measurement procedures (if any):	Survey of sample from the entire population within Target Area
Monitoring frequency:	Annually
QA/QC procedures:	Standard survey QC best practise Statistical comparison of results between periods and populations
Any comment:	The project does not apply to household who use wood alone (without coal) but only to wood used to ignite coal.

<b>Data / parameter:</b>	$FW_i$
Data unit:	Kg
Description:	Weight for each format in which wood is sold
Source of data:	Coal merchant survey
Measurement procedures (if any):	Standard weighing equipment
Monitoring frequency:	Annually
QA/QC procedures:	Compare price per kg of wood between formats.
Any comment:	If price per kilogramme differs significantly between formats (taking into account volume discounts and the level of processing [chopped wood costs more]), additional measurements must be conducted.

**Monitoring report**

40. A monitoring report shall be prepared on an annual basis where the data from the three monitoring processes are consolidated. It must:

- (a) Present a sampling plan that includes a justification of the sample design according to the criteria set out in paragraph 32 and 33 of the CDM *General guidelines on sampling and surveys* (EB 47 Report Annex 27 Page 8-9 or corresponding sections in following editions) including justification of the data collection methods to be employed;
- (b) Demonstrate how the sample design was implemented during the survey;
- (c) Demonstrate that appropriate quality assurance systems were in place to prevent fieldworker fraud or error during the survey;
- (d) Demonstrating that appropriate quality control systems were in place to correct fieldworker fraud or error during the survey where that may have occurred.

41. The data gathered in the *Household coal use survey* and the *Coal merchant survey* must be consolidated to:

- (a) Estimate annually the number of domestic coal users present within the Target Area. This is done as follows:

$$UTA_y = XU_{coal,y} \times Pop_y \quad (6)$$

Where:

$UTA_y$  = Number of coal users present in the Target Area for the year  $y$  (number)

$XU_{coal,y}$  = The fraction of coal users present within the Target Area for the year  $y$  estimated from the sample proportion of the Household coal use survey

$Pop_y$  = Population of Target Area (number)

(b) Estimate the number of households who have switched to the alternative ignition technique as a result of the project activity and continue to use the technique present within the Target Area for the year of monitoring. This is done as follows:

$$U_{alt,y} = XU_{alt,y} \times XU_{coal,y} \times Pop_y \quad (7)$$

Where:

$U_{alt,y}$  = Users of the alternative ignition technique present in the Target Area in year  $y$  (number)

$XU_{alt,y}$  = The fraction of coal users converted to the alternative ignition technique present within the Target Area for the year  $y$  estimated from the sample proportion of the *Household coal use survey*

$XU_{coal,y}$  = The fraction of coal users present within the Target Area for the year  $y$  estimated from the sample proportion of the *Household coal use survey*

$Pop_y$  = Population of Target Area in the year  $y$  (number)

This result is compared with the information in the Project Implementation Database on the number of users who switched to the alternative ignition technique in a specific year ( $U_y$ ). As a conservative measure,  $U_y$  must be used in the cases where  $U_y < XU_{alt,y} \times XU_{coal,y} \times Pop_y$

(c) Estimate annually the number of coal using households within the Target Area who have switched to the alternative ignition technique as a result of other sources. This is done as follows:

$$U_{other,y} = XU_{other,y} \times XU_{coal,y} \times Pop_y \quad (8)$$

Where:

$U_{other,y}$  = The number of users of the alternative ignition technique who have started using the alternative ignition technique through mechanisms other than the project activity present within the Target Area in year  $y$  (number)

$XU_{other,y}$  = The fraction of coal users converted to the alternative ignition technique through sources other than the project activity present within the Target Area for the year  $y$  estimated from the sample proportion of the *Household coal use survey*

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$XU_{coal,y}$  = The fraction of coal users present within the Target Area for the year  $y$  estimated from the sample proportion of the *Household coal use survey*

$Pop_y$  = Population of Target Area (number)

(d) Estimate the average annual baseline coal consumption of coal using households within the project boundary for the year of monitoring. This is done as follows:

$$\bar{C}_{B,y} = \frac{\sum_i \sum_j C_{B,i,j,y} \times FC_i}{XU_{alt} \times n} \quad (9)$$

Where:

$\bar{C}_{B,y}$  = Average baseline mass of coal consumed by households within the Project Boundary in year  $y$  (tonne)

$C_{B,i,j,y}$  = Baseline coal consumption for households  $j$  in units of format  $i$  in year  $y$  (calculated according to Equation 3) (units)

$FC_i$  = Weight for each format in which coal is sold (tonne or kg)

$n$  = The sample size

$XU_{alt,y}$  = The fraction of users of the alternative ignition technique present within the Target Area for the year  $y$  estimated from the sample proportion of the Household coal use survey

Where  $C_{B,i,j,y}$  is calculated as:

$$C_{B,i,j,y} = eef_j \times C_{i,j,t} \times \frac{t}{y} \quad (10)$$

Where:

$eef$  = The energy efficiency factor for households  $j$  derived from Equation 3

$C_{B,i,j,y}$  = Baseline coal consumption for households  $j$  in units of format  $i$  in year  $y$  (calculated according to Equation 3) (units)

$C_{i,j,t}$  = Project coal consumption for households  $j$  and format  $i$  in year  $y$  over time period  $t$  from *Household coal use survey* (tonne)

$t$  = Index of time period expressed in days

$y$  = One year of 365 days

(e) Estimate the average annual coal consumption of coal using households within the project boundary for the year of monitoring. This is done as follows:

$$\bar{C}_{P,y} = \frac{\sum_i \sum_j C_{i,j,y} \times FC_i}{XU_{alt,y} \times n} \quad (11)$$

Where:

- $\bar{C}_{P,y}$  = Average mass of coal consumed by households within the Project Boundary in year  $y$  (tonne)
- $C_{i,j,y}$  = Current units of coal consumed by households  $j$  and format  $i$  within the Project Boundary in year  $y$  (units)
- $FC_i$  = Weight for each format in which coal is sold (tonnes or kg)
- $n$  = The sample size

Where  $C_{i,j,y}$  is calculated as:

$$C_{i,j,y} = C_{P,i,j,t} \times \frac{t}{y} \quad (12)$$

Where:

- $C_{i,j,y}$  = Project coal consumption for households  $j$  units of format  $i$  in year  $y$  (tonne)
- $C_{P,i,j,t}$  = Project coal consumption for households  $j$  and format  $i$  in year  $y$  over time period  $t$  from *Household coal use survey* (units)
- $t$  = Index of time period expressed in days
- $y$  = One year of 365 days

(f) Estimate Project coal consumption as follows:

$$C_{P,y} = ((XU_{alt,y} \times XU_{coal,y} \times Pop_y) - (XU_{other,y} \times XU_{coal,y} \times Pop_y)) \times \bar{C}_{P,y} \quad (13)$$

Where:

- $C_{P,y}$  = Project coal consumption in year  $y$  (tonne)
- $XU_{alt,y}$  = Fraction of coal users converted to the alternative ignition technique present within the Target Area for the year  $y$  estimated from the sample proportion of the Household coal use survey
- $XU_{coal,y}$  = The fraction of coal users present within the Target Area for the year  $y$  estimated from the sample proportion of the *Household coal use survey*

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$Pop_y$	=	Population of Target Area (number)
$XU_{other,y}$	=	Fraction of Coal users converted to the alternative ignition technique through sources other than the project activity present within the Target Area for the year $y$ estimated from the sample proportion of the Household coal use survey
$\bar{C}_{P,y}$	=	Average mass of coal consumed by households within the Project Boundary in year $y$ calculated using Equation 11 (tonne)

(g) Estimate Project Emissions as follows:

$$PE_y = C_{P,y} \times COEF \quad (14)$$

Where:

$PE_y$	=	Project Emissions for year $y$ (tCO <sub>2</sub> /yr)
$C_{P,y}$	=	Project coal consumption in year $y$ from Equation 13 (tonne)
COEF	=	The CO <sub>2</sub> emission coefficient for domestic coal combustion (tCO <sub>2</sub> /tonne coal)

The CO<sub>2</sub> emission coefficient COEF can be calculated using one of either of the two options described in the *Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion* depending of the availability of data. If data is available, option A must be used.

(h) Estimate Baseline coal consumption as follows:

$$C_{B,y} = ((XU_{alt,y} \times XU_{coal,y} \times Pop_y) - (XU_{other,y} \times XU_{coal,y} \times Pop_y)) \times \bar{C}_{B,y} \quad (15)$$

Where:

$C_{B,y}$	=	Project coal consumption in year $y$ (tonne)
$XU_{alt,y}$	=	Fraction of coal users converted to the alternative ignition technique present within the Target Area for the year $y$ estimated from the sample proportion of the <i>Household coal use survey</i>
$XU_{coal,y}$	=	The fraction of coal users present within the Target Area for the year $y$ estimated from the sample proportion of the <i>Household coal use survey</i>
$Pop_y$	=	Population of Target Area (number)
$XU_{other,y}$	=	Fraction of Coal users converted to the alternative ignition technique through sources other than the project activity present within the Target Area for the year $y$ estimated from the sample proportion of the <i>Household coal use survey</i>
$\bar{C}_{B,y}$	=	Average mass of coal consumed in the Baseline scenario by households within the Project Boundary in year $y$ calculated using Equation 9 (tonne)

(i) Estimate Baseline Emissions as follows:

$$BE_y = C_{B,y} \times COEF \quad (16)$$

Where:

$BE_y$  = Baseline Emissions for year  $y$  (tCO<sub>2</sub>/yr)

$C_{B,y}$  = Baseline coal consumption in year  $y$  from Equation 15 (tonne)

COEF = The CO<sub>2</sub> emission coefficient for domestic coal combustion (tCO<sub>2</sub>/tonne coal)

(j) In cases where wood use is also included in the Project Boundary the emissions from wood use must be added to the Baseline and Project Emissions from coal. In order to do this, the fraction of non-renewable wood used to ignite coal fires within the project boundary must be estimated. This must be done in accordance with the requirements in the latest version of Voluntary Gold Standard *Methodology for Improved Cook-stoves and Kitchen Regimes*.

(k) In cases where wood use is also included in the Project Boundary the average annual wood consumption of households within the project boundary for the year of monitoring must be estimated from the survey results as follows:

$$\bar{W}_y = \frac{\sum_i \sum_j W_{y,i,j} \times FW_i}{n \times XU_{alt,y}} \quad (17)$$

Where:

$\bar{W}_y$  = The average mass of wood consumed by households within the project boundary (tonne)

$W_{y,i}$  = Units of wood consumed by households  $j$  per format  $i$  for the year  $y$  (units)

$FW_i$  = Weight for each format in which wood is sold (kg or tonne)

$n$  = The sample size

42. The estimations derived from the parameters monitored in the annual survey must be based on either the upper or lower bounds of the 90% confidence interval at 10% precision in such a way as to ensure conservativeness, i.e. in cases where the use of the lower bound leads to a lower estimation of emission reductions, the lower bound must be used while in cases where the use of the upper bound will lead to a lower estimation of emission reductions, the upper bound must be used.

In case the project is a large scale project the upper or lower bounds of the 95% confidence interval shall be used in the same way.

43. There may be a possibility that when households are interviewed during the coal use survey their inter-seasonal estimation of coal use may be inaccurate (i.e. the estimation of winter use made during summer and *vice versa*). This is to be countered by comparison of the

average results (per area) of estimations of winter coal use ( $C_{i,t}$ ) from users who were interviewed in winter with the same estimation made by users who were interviewed in summer and making conservative adjustments if that may be needed. The same comparison should be made for summer users.

44. All data collected as part of monitoring shall be archived electronically and kept for at least 2 years after the end of each crediting period.

45. Summary of variables calculated

<b>Variable:</b>	$BE_y$
Data unit:	tCO <sub>2</sub> eq
Description:	Baseline Emissions in year $y$
Formula:	
Used in calculation / determination of:	Baseline emissions, Emission reductions
QA/QC procedures:	
Any comment:	

<b>Variable:</b>	$PE_y$
Data unit:	tCO <sub>2</sub> eq
Description:	Project Emissions in year $y$
Formula:	
Used in calculation / determination of:	Project emissions, Emission reductions
QA/QC procedures:	
Any comment:	

<b>Variable:</b>	$UTA_y$
Data unit:	Number
Description:	Number of coal users present in the Target Area for the year $y$
Formula:	
Used in calculation / determination of:	Baseline scenario
QA/QC procedures:	
Any comment:	

<b>Variable:</b>	$U_{alt,y}$
Data unit:	Number
Description:	Number of users of the alternative ignition technique present in the Target Area in year $y$
Formula:	
Used in calculation / determination of:	Baseline emissions, project emissions, emission reductions
QA/QC procedures:	
Any comment:	

<b>Variable:</b>	$U_{\text{other},y}$
Data unit:	Number
Description:	The number of users of the alternative ignition technique who have started using the alternative ignition technique through mechanisms other than the project activity present within the Target Area in year $y$
Formula:	
Used in calculation / determination of:	Baseline emissions
QA/QC procedures:	
Any comment:	

<b>Variable:</b>	$\bar{C}_y$
Data unit:	Kg
Description:	Average mass of coal consumed by households within the Project Boundary in year $y$
Formula:	
Used in calculation / determination of:	Baseline emissions, Project Emissions
QA/QC procedures:	
Any comment:	

<b>Variable:</b>	$\bar{W}_y$
Data unit:	Kg
Description:	Average mass of wood consumed by households within the Project Boundary in year $y$
Formula:	
Used in calculation / determination of:	Baseline emissions, Project Emissions
QA/QC procedures:	
Any comment:	