Draft baseline and monitoring methodology AM00XX

"Mitigation of Methane Emissions in the Wood Carbonization Activity for Charcoal Production"

I. SOURCE AND APPLICABILITY

Source

This methodology is based on the project activity "Mitigation of Methane Emissions in the Charcoal Production of Plantar, Brazil" whose baseline and monitoring methodology and project design document were prepared by RS Consultants, Statistics Department of IPEAD/UFMG - Institute of Economic, Administrative and Accounting Research of the Federal University of Minas Gerais, Plantar S/A and Carbon Finance Unit of the World Bank. For more information regarding the proposal and its consideration by the Executive Board please refer to case NM0110-rev: "Mitigation of Methane Emissions in the Wood Carbonization Activity for Charcoal Production" on http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

This methodology also refers to the latest version of the *"Tool for the demonstration and assessment of additionality"*.[1]

Selected approach from paragraph 48 of the CDM modalities and procedures

"Existing actual or historical emissions, as applicable"

Applicability

The methodology is applicable under the following conditions:

- Emission reductions are achieved through the adoption of technologies and processes that avoid or diminish the production of methane emissions in the carbonization process.
- Local regulation does not require controlling methane emissions in charcoal production or is less stringent than the project controls or laws/regulations exist for mandating the project technology but the laws/regulations enforcement is not strong enough to ensure the widespread compliance. If such laws/regulations exist, the project activity is considered additional and shall receive credit only if it is demonstrated that there is widespread non-compliance with the regulation. The compliance rate shall be monitored on an annual basis. The evidence of non-compliance shall be based on data from the control group, set up as per this methodology, and/or data on legal action and enforcement mechanisms implemented under the prevailing regulation. The relevant laws and regulations are considered enforced if more than 50% of the charcoal production activities comply with the relevant laws and regulations. Other registered CDM projects are to be included in the analysis if the CDM has been used in more than 50% of the cases where the legislation or regulation has been enforced.
- Where it is possible to monitor and measure carbonization gravimetric yield (mass of charcoal over mass of wood) in the charcoal production process and apply the technical and statistical methods outlined under this methodology.

[1] Please refer to: < http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

- No relevant changes in greenhouse gas emissions other than methane occur as a consequence of the project activity and/or need to be accounted, except for the possibilities of leakage.
- The moisture content of the wood and charcoal can be measured and monitored accurately as per the methods and procedures outlined in this methodology.
- The emissions reductions credited are limited to the existing rated capacity of carbonization units, where the project activity is implemented, using pre-project technology.
- The implementation of the project shall not result in any changes in the type and source of inputs (e.g. wood source, adoption of fossil-fuel based inputs, etc.) for the production of charcoal.

Control group is defined as charcoal production companies, excluding the projects implemented under the CDM, in the region where the project is located. The region of the control group is defined as the geographic area around the project activity that has similar legal compliance requirements as for the project activity. The production capacity of the charcoal production companies included in the control group should represent at least 20% of the total production in the region and should include at least 10 charcoal production companies. In case the legal compliance requirements for all provinces in the country is similar, the production capacity of the charcoal production companies included in the control group should represent at least 20% of the total production in the country and should include at least 10 charcoal production companies.

II. BASELINE METHODOLOGY

Project boundary

The spatial extent of the project boundary is the area of the carbonization units that use the improved technologies and processes described in the project activity. A carbonization unit typically comprises a group of several charcoal kilns. The DOE shall verify the number of carbonization units included in the project activity at validation based on record of the project boundary and location of carbonization units in accordance with the monitoring plan.

Only methane (CH_4) emitted directly from charcoal production facilities, in particular the charcoal kilns, is monitored and its emissions calculated for the baseline and project scenarios, except for the provisions on leakage.

Table 1: Summary of gases and sources included in the project boundary, and justification / explanation where gases and sources are not included.

	Source	Gas	Included?	Justification / Explanation
Baseline	Carbonization Activity	CO_2	No	Sources and types of inputs are not changed in the project activity.
		CH_4	Yes	
		N_2O	No	Not applicable to the process
Project Activity	Carbonization Activity	CO_2	No	Sources and types of inputs are not changed in the project activity.
		CH_4	Yes	

		N_2O	No	Not applicable to the process

Procedure for the selection of the most plausible baseline scenario

The methodology applies the following steps to determine the baseline scenario:

Step 1. Identification of alternative scenarios to the proposed CDM project activity that is consistent with current laws and regulations.

Project participants are to identify all realistic and credible alternatives to the project activity that are consistent with current laws and regulations.

The following likely scenarios of charcoal production shall be assessed. Any other scenarios as applicable to the specific regional and project contexts could also be considered.

- Continuation of the existing carbonization practice. Continuation of existing carbonization practice may be taken in the baseline selection even if local laws/regulations exists which mandates the project technology provided that the law enforcement is not strong enough to ensure the widespread compliance. The evidence of non-compliance shall be estimated based on the procedure given in the second bullet under applicability conditions.
- Adoption of minor efficiency upgrades / refurbishments / improvements of carbonization kilns that are readily available.
- Investment in carbonization technologies and equipment that are based on sophisticated industrial processes, such as carbonization retorts.
- Development and adoption of technology or process innovations or improvements that limit methane emissions from kilns.
- Project activity implemented as a non-CDM project.

The alternatives to the project activity shall be in compliance with all applicable legal and regulatory requirements - taking into account EB decisions with respect to national and/or sectoral policies and regulations in determining a baseline scenario[2] - even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution.

Step 2. Barrier analysis to eliminate alternatives to the project activity that face prohibitive barriers

Establish a complete list of barriers that would prevent alternative scenarios to occur in the absence of the CDM, using the guidance in Step 3 of the latest version of the "*Tool for the demonstration and assessment of additionality*".

Since the proposed project activity not being registered as a CDM project activity shall be one of the considered alternatives, any barrier that may prevent the project activity to occur shall be included in that list. Show which alternatives are prevented by at least one of the barriers previously identified and

[2] Annex 3 of the 22nd EB meeting report: "Clarifications on the treatment of national and/or sectoral policies and regulations (paragraph 45(e)) of the CDM Modalities and Procedures) in determining a baseline scenario (version 2)"

eliminate those alternatives from further consideration. All alternatives shall be compared to the same set of barriers.

If there is only one scenario alternative that is not prevented by any barrier, then this scenario alternative is identified as the baseline scenario.

Where more than one credible and plausible alternative remains, project participants shall, as a conservative assumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario, or conduct an investment analysis (Step 3).

Step 3. Investments analysis (optional)

Conduct an investment analysis, consistent with the guidance in Step 2 of the latest version of the "*Tool for the demonstration and assessment of additionality*". The economically most attractive alternative is deemed as the most plausible baseline scenario.

NOTE: The methodology is only applicable if the baseline identified is the historical or the existing charcoal production practices.

Additionality

Additionality shall be demonstrated using the latest version of the *"Tool for the demonstration and assessment of additionality"* that is available on the UNFCCC web site with further guidance on its use as provided below.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

The alternatives to be identified under this step should be the same alternative scenarios that are considered in determining the baseline scenario. The proposed project activity and the baseline scenario must be part of the list of alternatives.

All alternatives must comply with current laws and regulations unless these laws/regulations are not enforced and widespread non-compliance is observed.

If the project activity is mandated by laws or regulation, then the project activity is not additional. Show that, based on an examination of current practice in the country or region in which the law or regulation applies, those applicable legal or regulatory requirements are systematically not enforced and that non-compliance with those requirements is widespread in the country. A compliance threshold of 50% for the relevant laws and regulations is prescribed for the crediting period. Other registered CDM projects are to be included in the analysis if the CDM has been used in more than 50% of the cases where the legislation or regulation has been enforced. Documented evidence pertaining to the data and information on compliance and prevailing charcoal making technologies and production practices in the region or country shall be used to demonstrate enforcement/non-enforcement. If the information on the compliance of laws and regulation is not available, survey of charcoal production units in the region or country where the laws/regulations are applicable shall be conducted to obtain the information.

Step 2: Investment analysis

Investment analysis shall be used in situations where the charcoal production in the region[3] is not dominated by traditional practices and charcoal pricing schemes enable additional revenue from the implementation of project activity (other than the potential CERs income). In case the investment analysis is not chosen, the justification for the same shall be provided in the CDM-PDD.

Step 3: Barrier analysis

The typical barriers that are likely to impede the development, adoption and maintenance of innovative carbonization practices are illustrated below:

i) Investment barriers
- The cost associated with the development and adoption of innovative technology and processes is too high (not considering the CDM incentive).
- Return on investment for the improvements in carbonization efficiency and emission reductions in the charcoal industry is too low in comparison to the investment needs.
- Short and long-term resource commitments to technological improvements are low to non-existent in a traditionally low profit industry such as charcoal production, further limiting the innovation.
- High real or perceived risk involved in the development and adoption of new technology is a constraint for investments in technological or process innovations.

ii) Barriers due to prevailing practice.
- The lack of regulation or best practice to reduce methane emissions from kilns limits the motivation of the project entity to make changes to the prevailing production process.
- Lack of industry-wide emphasis on technological improvements limits the peer pressure to undertake the improvements.

iii) Technical/operational barriers.
- The first-of-a-kind nature of the project highlights the technical and operational concerns, especially if the technology and process modifications have not been implemented elsewhere.
- Information, implementation, and production risks associated with unfamiliar technologies contribute to risk aversion and inhibit its adoption.
- Historically low-skilled human labor makes it difficult to introduce technological and process innovations and transfer of skills, especially where large trained labor may be needed to run large number of charcoal kilns using sophisticated processes.

iv) Other barriers, as applicable.
- Lack of awareness with new technologies makes it a low priority for senior management.
- Legal, regulatory, and other barriers may limit the implementation of the project scenario.

Step 4: Common practice analysis

The common practice analysis shall be undertaken using documented information on the prevailing charcoal making technologies in use in the region or in the country where the project is located. If such information is not readily available, a survey of charcoal production facilities shall be conducted to obtain

[3] As defined in the applicability section.

information on production technologies and processes commonly applied. The common practice threshold shall be applied to the control group selected prior to the start of the project and at each renewal of the crediting period.

If more than 33%[4] of the control group uses an improved carbonization process that is similar to the project activity, then the project is not additional. If less than 33% of the control group uses an improved carbonization process that is similar to the project activity, then proceed to step 5. The designated operational entity shall verify the documented evidence for the purpose of common practice evaluation.

Step 5: Impact of CDM registration

The list provided in the additionality tool of the possible impact of the CDM registration on the project activity shall also include the awareness raising effect of the CDM and the associated incentive to invest in research, development and innovation.

Baseline emissions

The estimation of baseline emissions is done employing the three steps, described below:

Step 1: Adoption of the regression equation expressing statistical relationship between methane emissions and carbonization gravimetric yield:

The estimated relation between methane emissions and carbonization gravimetric yield (CGE) shall be based on experimental measurement and statistical analysis. The relation can be based on either:

(i) data collected as per the implementation of the carbonization research protocol, as described in Appendix 1, and following the statistical requirements presented in Appendix 2; or

(ii) Previously established statistical relationships and the applicable regression equations (e.g. based on the previous application of the same or the similar protocols to other project activities), provided such parameters are applicable to the circumstances of project participants and comply with the applicability conditions of this methodology and the statistical requirements in Appendix 2.

An independent third party statistical expert(s) shall implement the carbonization research and review the statistical procedures followed in the estimation process. The report on the choice of the approach and its justification, including report of implementation of Appendix 1 and Appendix 2 shall be presented and attached to the CDM-PDD. The report shall include all calculations, and the supporting documentation on the carbonization process improvements implemented. All documentation and references used for the determination of the regression equation must be presented to the Designated Operational Entity at the time of validation.

The following steps are used to establish a statistical relationship, which are further elaborated in Appendix 1:

1) Set up the experimental apparatus, including a real size carbonization kiln, an industrial scale, thermometers and gas collectors in order to enable mass balance analysis.

[4] This threshold is referenced from Everett M. Rogers, 2003, Diffusion of Innovations, Fifth Edition, Simon & Schuster Inc. This value is subject to further guidance from the CDM-EB and sets no precedent.

2) Run several charcoal manufacturing processes (carbonization processes) that reflect not only the actual practices undertaken by the project entity but also improved processes that demonstrate lower emissions, including the project activity technology, as per the terms defined in Appendix 1.
3) Document all input and output data, i.e., wood and charcoal weights on dry basis, and collect gas samples throughout the carbonization process. The gas samples shall be analyzed in certified laboratories for chromatographic analyses.
4) Conduct regression analysis and establish a linear or non-linear regression equation that best demonstrates the relationship between the methane emissions and the gravimetric yield, consistent with the statistical procedure presented in Appendix 2, the EB guidance on the use of regression in methodologies[5] and model selection procedure outlined below.
5) Record the technological changes required to improve the carbonization process.

Model selection for estimated relationship

The selection of the model (linear or non-linear) relating the methane emission and gravimetric yield shall be done as per the following criteria:

(i) Percent explained variance (R^2) $\geq$ 70%.

The percent explained variance or coefficient of determination (R^2) of the regression model shall be equal to or higher than 70% in order to establish the statistically significant relationship between methane emissions and carbonization gravimetric yield.

(ii) CV (β_i) $\leq$ 5% ; i = 1, 2, ... κ

Where:

CV is the coefficient of variation
β_i are the coefficients of the regression model

The CV (β_i) is a stability measure of coefficients of the variables included in the model. In order to estimate CV (βi) in the criterion (ii) above, the methodology should use a *Jacknife procedure*[6] on the existing data sample.

The regression equation shall be used to estimate the baseline emissions, as per the steps outlined below.

Mass of charcoal, methane emissions, time interval and location characteristics

The mass of methane emissions per mass of charcoal is a function of carbonization process and is not dependent on the time interval or the location of the production. The physical apparatus used in the carbonization process (e.g. carbonization kilns, gas bottles, scales, pipes and tubes etc.) is not affected by the time interval and location and the baseline and project scenario operate under similar time and location

[5] Annex 7 of the 21st EB meeting report: "Recommendations on multiple regression analysis to estimate baseline emissions or project emissions "

[6] Jacknife is a statistical procedure used to test the robustness of regression coefficients. It facilitates the selection of the model based on the variability in regression coefficients. The procedure involves the iterative estimation of regression models by dropping one pair of values from the sample data points in order to identify the robust regression model that best explains the relationship between dependent and independent variables.

characteristics. Moreover, this methodology is based on the ex-post estimation of the baseline emissions, based on the baseline emissions factor applied to the same amount of charcoal produced under the project. Thus, it maintains the common time intervals for comparing the baseline and the project emissions and thereby avoids differences in the treatment of time under both scenarios.

Step 2: Calculation of the baseline emission factor.

The baseline emission factor shall be calculated as per the regression equation established in step 1. Examples of the generalized linear regression and non-linear regression equations (e.g. exponential, logarithmical) are presented in Appendix 2.

$$\mathbf{EF_{CH4,BL} = f\,(Y_{BL})} \qquad \mathbf{(1)}$$

Where:

$\mathbf{EF_{CH4,BL}}$ = Methane emission factor in the baseline scenario (tCH_4/tCharcoal)
$\mathbf{Y_{BL}}$ = Weighted average carbonization gravimetric yield in the baseline scenario (tCharcoal/tWood, dry basis), estimated as per procedure provided below

Baseline carbonization gravimetric yield

The carbonization gravimetric yield of the baseline represents the scenario that occurs prior to the implementation of the project activity and is fixed for the crediting period. The data to estimate $\mathbf{Y_{BL}}$ shall be collected as per the measurement protocols presented in the Appendix 3 of this methodology.

The value of Y_{BL} used in equation 1 above shall be estimated as follows:

(i) Calculate the coefficient of variation of gravimetric yield in the baseline

$$\mathbf{CV\,(Y_{BL,i}) = \sigma\,(Y_{BL,i}) / \mu(Y_{BL,i})} \qquad \mathbf{(2)}$$

Where:

$\mathbf{CV\,(Y_{BL,i})}$ = Coefficient of Variation in the baseline gravimetric yield of the sample.
$\mathbf{\sigma\,(Y_{BL,i})}$ = Standard Deviation of the baseline gravimetric yield of the sample
$\mathbf{\mu(Y_{BL,i})}$ = Average of the baseline gravimetric yield of the sample
$\mathbf{Y_{BL,i}}$ = Baseline gravimetric yield of the sampled kiln i

(ii) Estimate the Y_{BL}

With the increase in the coefficient of variation, the width of 95% confidence interval around the mean carbonization yield is expected to increase, thus consideration of different quartiles of gravimetric yields of the sampled kilns under the baseline scenario leads to more conservative estimate of the baseline emissions. Based on estimated value of CV ($Y_{BL,i}$), use one the following approaches to determine the gravimetric yield of the baseline (Y_{BL}):

Approach 1 - If CV $\mathbf{(Y_{BL,i})} \leq 10\% \rightarrow$ take weighted average of $\mathbf{Y_{BL,i}}$ for all sample units

Approach 2 - If $10\% < \text{CV } \mathbf{(Y_{BL,i})} \leq 20\% \rightarrow$ take weighted average of $\mathbf{Y_{BL,i}} \geq Q_1$

Where,

Q_1 is first quartile of the distribution of $Y_{BL,i}$. The average is over all the values of $Y_{BL,i}$ that are greater than the first quartile value[7].

Approach 3 - If 20% < CV $(\mathbf{Y_{BL,i}})\leq$ 30% → take weighted average of $\mathbf{Y_{BL,i}} \geq Q_2$

Where,
Q_2 is second quartile of the distribution of $Y_{BL,i}$. The average is for all the values of $Y_{BL,i}$ that are greater than the second quartile value.

Approach 4 - If 30% < CV $(\mathbf{Y_{BL,i}}) \leq 40\%$ → take weighted average of $\mathbf{Y_{BL,i}} \geq Q_3$

Where,
Q_3 is third quartile of the distribution of $Y_{BL,i}$. The average is for all the values of $Y_{BL,i}$ that are greater than the third quartile value.

Approach 5 - If CV $(\mathbf{Y_{BL,i}}) > 40\%$ → reject the sample

Step 3: Calculation of total baseline emissions

Baseline emissions are calculated as follows:

$$BE_y = EF_{CH4,BL} * GWP_{CH4} * P_{char,y} \quad \textbf{(3)}$$

Where:
BEy = Baseline emissions during the year *y* (tCO_2/yr)
$\mathbf{EF_{CH4,BL}}$ = Methane emission factor in the baseline scenario (tCH_4/tCharcoal)
$\boldsymbol{GWP_{CH4}}$ = Global warming potential of methane (tCO_2e/tCH_4)
$\boldsymbol{P_{char,y}}$ = Production of charcoal during the year y (tCharcoal/yr)

All survey data, measurements and calculations collected as part of the baseline assessment shall be recorded in a spreadsheet database and shall be verified by the Designated Operational Entity.

Project Emissions

The project emissions shall be estimated as product of project methane emission factor and project charcoal production. The project methane emission factor shall be estimated using equation 1 with the project weighted average carbonization gravimetric yield (Y_P). With the calculation of Y_P as shown below.

All measurements and calculations must be recorded in a spreadsheet database and shall be validated and subsequently verified by the Designated Operational Entity

(i) estimate the coefficient of variation of gravimetric yield in the project case

$$\boldsymbol{CV}\ (\mathbf{Y_{P,i}}) = \boldsymbol{\sigma}\ (\mathbf{Y_{P,i}}) / \boldsymbol{\mu}(\mathbf{Y_{P,i}}) \quad \textbf{(4)}$$

Where:

[7] Quartile designates any of the values in a series dividing the distribution of the individuals in the series into four groups of equal frequency.

$\mathbf{CV\ (Y_{P,i})}$ = Coefficient of Variation in the project gravimetric yield of the sample.
$\mathbf{\sigma\ (Y_P)}$ = Standard Deviation of the project gravimetric yield of the sample
$\mu\mathbf{(Y_{P,i})}$ = Average of the project gravimetric yield of the sample
$\mathbf{Y_{P,i}}$ Project gravimetric yield of the sampled kiln i

(ii) Estimate the Y_P

With the increase in the coefficient of variation, the width of 95% confidence interval around the mean carbonization yield is expected to increase, thus consideration of different quartiles of gravimetric yields of the sampled kilns under the project scenario leads to more conservative estimate of the project emissions. Based on estimated value of CV (Y_P), use one the following approaches to determine the gravimetric yield of the project (Y_P):

Approach 1 - If CV $\mathbf{(Y_{P,i})} \leq 10\% \rightarrow$ take weighted average of all sample units

Approach 2 - If $10\% < CV\ \mathbf{(Y_{P,i})} \leq 20\% \rightarrow$ take weighted average of $\mathbf{Y_{P,i}} \leq Q_3$

Where,
Q_3 is third quartile of the distribution of $Y_{P,i}$. The average is over all the values of $Y_{P,i}$ that are less than the third quartile value.

Approach 3 - If $20\% < CV\ \mathbf{(Y_{P,i})} \leq 30\% \rightarrow$ take weighted average of $\mathbf{Y_{P,i}} \leq Q_2$

Where,
Q_2 is second quartile of the distribution of $Y_{P,i}$. The average is over all the values of $Y_{P,i}$ that are less than the second quartile value.

Approach 4 - If $30\% < CV\ (\mathbf{Y_{P,i}}) \leq 40\% \rightarrow$ take weighted average of $\mathbf{Y_{P,i}} \leq Q_1$

Where,
Q_1 is first quartile of the distribution of $Y_{P,i}$. The average is over all the values of $Y_{P,i}$ that are less than the first quartile value.

Approach 5 - If $CV\ (\mathbf{Y_{P,i}}) > 40\% \rightarrow$ reject the sample

Calculation of total project emissions

Project emissions are calculated as follows:

$$PE_y = EF_{CH4,P} * GWP_{CH4} * P_{char,y} \quad \textbf{(5)}$$

Where:
PE_y = Project emissions during the year *y* (tCO_2/yr)
$\mathbf{EF_{CH4,P}}$ = Methane emission factor of the project activity ($tCH_4/tCharcoal$)
$\boldsymbol{GWP_{CH4}}$ = Global warming potential of methane (tCO_2e/tCH_4)
$\boldsymbol{P_{charcoal,y}}$ = Production of charcoal during year y(ton)

Leakage

Leakage from the process improvements in the carbonization activity is not likely to be a major factor for the following reasons:

- The improvements in the carbonization process are expected to reduce the methane emissions and improve the conditions of the overall charcoal production to certain extent but do not determine the existence of the charcoal production business activity *per se* as the charcoal production occurs regardless of the process improvements undertaken in the project scenario. Therefore, no net changes in the anthropogenic GHG emissions attributable to the project activity are expected to occur outside of the project boundaries.

- If new kilns are constructed for the project activity, the emissions from disposal of the old kilns shall be accounted for as leakage and, as such, an algorithm shall be included in the CDM-PDD showing how this will be accounted.

In the event of leakage from the project activity, measures should be adopted to mitigate the leakage. The following measures illustrate the ways in which a project entity can account the leakage.

- If the implementation of the project activity occurs in conjunction with other project activities directly related to the inputs and outputs associated with the carbonization process (e.g. wood or charcoal), the overall supply chain relationship of the respective baseline and project emissions of the individual project activities must be taken into account. In such cases, provisions to avoid double counting may be included in the CDM-PDD under this or other relevant methodologies as per the EB guidance on double counting of emission reductions as outlined in the paragraph 38 of the EB26 Meeting Report.
- In cases where additional clarification on the treatment of leakage is required, project participants should request a revision of the methodology.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(6)}$$

Where:
ER_y = Emission reductions during the year *y* (tCO_2/yr)
BE_y = Baseline emissions during the year *y* (tCO_2/yr)
PE_y = Project emissions during the year *y* (tCO_2/yr)
LE_y = Leakage emissions during the year *y* (tCO_2/yr)

Emission reductions shall be recorded in appropriate spreadsheets. As the carbonization gravimetric yield is the major determinant of the emissions, it must be strictly monitored and applied to the emission reductions calculations on an ex-post basis. The data and calculations should be verified by the Designated Operational Entity in order to confirm that the carbonization units are operating using the approved practices.

Changes required for methodology implementation in 2nd and 3rd crediting periods

- Consistent with guidance by the Executive Board, project participants shall assess the continued validity of the baseline and update the baseline. In order to assess the continued validity of the baseline, project participants should apply the procedure to determine the most plausible baseline scenario, as outlined above. The crediting period may only be renewed if the application of the procedure shows that the baseline scenario determined in the registered the draft CDM-PDD still applies.

- It shall be demonstrated that the project activity is not a common practice using the procedure define in the Common Practice step of the Additionality assessment section. The Designated Operational Entity shall evaluate the common practice with the information provided regarding the technology and production process used in the project activity.

- The project entity shall be committed to update or replace the regression equation, if new and more conservative parameters become available during the subsequent crediting periods.

Data and parameters not monitored

Data / Parameter:	**Charcoal production capacity (CPC)**
Data unit:	Tons
Description:	Existing rated capacity of carbonization units.
Source of data:	Charcoal production department of the project entity.
Measurement procedures (if any):	Based on historic data of production for three years previous to the start of the project activity or documentation of rated capacity for the carbonization unit using pre-project technology.
Any comment:	

Data / Parameter:	**Y_{BL}**
Data unit:	tCharcoal/tWood, dry basis.
Description:	Weighted average carbonization gravimetric yield in the baseline scenario.
Source of data:	Charcoal production/ carbonization unit of the project entity.
Measurement procedures (if any):	Estimated as per procedure given in this methodology.
Any comment:	Baseline carbonization yield is used to calculate emissions in the baseline. The DOE shall check if the required conservativeness safeguards are incorporated in the calculation of baseline emissions.

Data / Parameter:	**K**
Data unit:	Number of kilns.
Description:	Improved kilns that are operational at the start of the project.
Source of data:	Charcoal production department of the project entity.
Measurement procedures (if any):	Verification and registration of kilns operating under improved carbonization procedures.
Any comment:	

Data / Parameter:	**Percent explained variance**
Data unit:	%

Description:	The percent explained variance for model selection in the methodology.
Source of data:	Data from the experimental protocol demonstrating the relationship between methane emissions and carbonization gravimetric yield.
Measurement procedures (if any):	
Any comment:	Basis for the model to be selected to estimate the methane emissions in accordance with the regression relationship

Data / Parameter:	**CV (β_i)**
Data unit:	%
Description:	Coefficient of variation of the coefficients of the regression model.
Source of data:	Data from the experimental protocol demonstrating the relationship between methane emissions and carbonization gravimetric yield
Measurement procedures (if any):	In order to estimate it, the methodology should use a *Jacknife procedure* on the existing data sample.
Any comment:	

Data / Parameter:	**β_i**
Data unit:	
Description:	Coefficients of the regression model
Source of data:	Regression procedure for estimating the relationship between methane emission factor and carbon gravimetric yield as per Appendix 1.
Measurement procedures (if any):	As defined in Appendix 1.
Any comment:	

Data / Parameter:	**$EF_{CH4,BL}$**
Data unit:	tCH_4/tCharcoal
Description:	Methane emission factor in the baseline scenario.
Source of data:	Data from the experimental protocol demonstrating the relationship between methane emissions and carbonization gravimetric yield.
Measurement procedures (if any):	Calculation of methane emission factor of the baseline in accordance with the regression relationship.
Any comment:	

Data / parameter:	**CV ($Y_{BL,i}$)**
Data unit:	
Description:	Coefficient of Variation of the baseline gravimetric yield of the sample.
Source of data:	Calculated based on data on $Y_{BL,i}$ collected as outlined in Appendix 3.
Measurement procedures (if any):	
Any comment:	

Data / parameter:	**$\sigma (Y_{BL,i})$**
Data unit:	
Description:	Standard Deviation of the baseline gravimetric yield of the sample.
Source of data:	Calculated based on data on $Y_{BL,i}$ collected as outlined in Appendix 3.
Measurement procedures (if any):	
Any comment:	

Data / parameter:	**$\mu(Y_{BL,i})$**
Data unit:	
Description:	average gravimetric yield of the sampled i kilns for the baseline
Source of data:	Calculated based on data on $Y_{BL,i}$ collected as outlined in Appendix 3.
Measurement procedures (if any):	
Any comment:	

Data / parameter:	**$Y_{BL,i}$**
Data unit:	tCharcoal/tWood, dry basis
Description:	Baseline gravimetric yield of the sampled i kiln
Source of data:	Charcoal production department of the project entity.
Measurement procedures (if any):	Baseline gravimetric yield of sampled i kiln shall be calculated prior to the start of the project activity.
Any comment:	

Data / parameter:	**GWP_{CH4}**
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential for CH_4
Source of data:	IPCC
Measurement procedures (if any):	21 for the first commitment period. Shall be updated according to any future COP/MOP decisions.
Any comment:	

III. MONITORING METHODOLOGY

Monitoring procedures

The monitoring procedures and recording of the monitored data shall follow the operational sequence of the charcoal production process. As part of monitoring, the relevant changes to carbonization units must be recorded, including the number of kilns and their start date under the project activity. The changes in the number of kilns shall be reflected in the monthly data on kiln operations.

The major variables that influence methane emissions should be carefully monitored and recorded. The implementation of the instructions on the measurement and calculation of carbonization gravimetric yield shall be ensured (Appendix 3). The compliance of instructions specified in the project's Monitoring Plan is taken into account at the time of validation. Considering that the monitoring data forms the basis for the estimation of methane emissions, the operational procedures shall be periodically verified by the supervisory personnel to ensure the integrity of the data monitored and collected. The amount of charcoal

produced along with its end uses should be monitored and recorded, including the changes in the quantities of charcoal produced and operational procedures implemented.

The monitoring plan of the project should outline the management and operational structure of the project and the monitoring protocols, standard operating procedures and responsibilities of the personnel involved in the charcoal production process shall be outlined in order to ensure the effective implementation of the monitoring plan.

The only variable that is required to be monitored to determine the baseline emissions is the amount of charcoal produced. Charcoal output shall be monitored in accordance with the protocols for carbonization gravimetric yield and measurement of wood and charcoal weights and moisture contents (Appendix 3). Thus, this methodology encompasses the monitoring of the baseline emissions on an *ex-post* basis.

To calculate the project emissions, the gravimetric yield as per the procedure given in the baseline methodology (mass of charcoal/mass of wood) shall be estimated based on the data monitored and recorded monthly. In order to calculate the gravimetric yield, Y_p the data on wood weight, charcoal weight, on dry basis shall be collected following the measurement protocols presented in the Appendix 3 of the baseline methodology.

Data and parameters monitored

Data / Parameter:	$P_{charcoal,y}$
Data unit:	Tons
Description:	Production of charcoal during year y
Source of data:	Charcoal production / carbonization unit
Measurement procedures (if any):	All charcoal produced must be weighted.
Monitoring frequency:	Monthly
QA/QC procedures:	Scales in use must be accurately monitored and regulated. Check production and delivery records at the carbonization units.
Any comment:	Charcoal must be weighted at delivery

Data / Parameter:	**LCU**
Data unit:	Location/site description
Description:	Location of the carbonization unit that typically comprises a group of several charcoal kilns.
Source of data:	Production department /farm maps.
Measurement procedures (if any):	Monthly data and their correspondent changes on kiln number, including start date under the project activity.
Monitoring frequency:	Monthly.
QA/QC procedures:	Location of kilns are physically verifiable and registered in production registries subjected to monitoring provisions under this methodology.
Any comment:	

Data / Parameter:	**SDNP**
Data unit:	Carbonization unit
Description:	Initial date of the operational procedures to reduce methane emissions on carbonization process
Source of data:	Charcoal production department of the project entity.
Measurement procedures (if any):	Verification of operational records in the carbonization units.
Monitoring frequency:	As applicable
QA/QC procedures:	Production records must include the date of implementation of the new carbonization procedures.
Any comment:	Record the starting date of the adoption of new procedures at each carbonization unit

Data / Parameter:	**W**
Data unit:	Tons
Description:	The wood weight used in the carbonization process
Source of data:	Carbonization unit
Measurement procedures (if any):	Recording the weight of wood used in the carbonization process using measurement scales
Monitoring frequency:	Monthly
QA/QC procedures:	Scales used must be accurately monitored and calibrated. Records must be kept in line with production registries.
Any comment:	Wood must be weighted before its arrival at the carbonization units.

Data / Parameter:	**M_{Wood}**
Data unit:	% water content
Description:	Wood moisture
Source of data:	Record on the wood used in carbonization
Measurement procedures (if any):	Laboratory sampling tests
Monitoring frequency:	Quarterly
QA/QC procedures:	Design work instructions based on proper and verifiable methods.
Any comment:	

Data / Parameter:	**$M_{Charcoal}$**
Data unit:	% water content
Description:	Charcoal moisture
Source of data:	Carbonization unit
Measurement procedures (if any):	Laboratory sampling tests
Monitoring frequency:	Quarterly
QA/QC procedures:	Design work instructions based on proper and verifiable methods
Any comment:	

Data / Parameter:	**Y_P**
Data unit:	tCharcoal/tWood, dry basis.
Description:	Weighted average carbonization gravimetric yield in the project scenario
Source of data:	Charcoal production/carbonization unit
Measurement procedures (if any):	Calculate (on dry-basis) and cross-check the charcoal weight with the wood weight used in the carbonization process.
Monitoring frequency:	Daily/Monthly
QA/QC procedures:	Follow operational guidelines in the applicable research and work instructions with a step by step guide for calculations.
Any comment:	Carbonization yield calculations will be stored in the "CY calculation spreadsheet". The DOE shall check if the conservativeness on the safeguards are incorporated in the calculation of project emissions.

Data / parameter:	**$\sigma (Y_{P,i})$**
Data unit:	
Description:	Standard Deviation of the project gravimetric yield of the sample
Source of data:	Charcoal production/carbonization unit.
Measurement procedures (if any):	Calculated based on data on $Y_{P,i}$ collected as outlined in Appendix 3.
Monitoring frequency:	
QA/QC procedures:	
Any comment:	

Data / parameter:	**$\mu(Y_{P,i})$**
Data unit:	
Description:	Average of the project gravimetric yield of the sample
Source of data:	Charcoal production/carbonization unit.
Measurement procedures (if any):	Calculated based on data on $Y_{P,i}$ collected as outlined in Appendix 3.
Monitoring frequency:	
QA/QC procedures:	
Any comment:	

Data / parameter:	**$Y_{P,i}$**
Data unit:	tCharcoal/tWood, dry basis
Description:	Project gravimetric yield of the sampled i kiln
Source of data:	Charcoal production/carbonization unit.
Measurement procedures (if any):	Calculate (on dry-basis) the charcoal weight with the wood weight used in the carbonization process.
Monitoring frequency:	Daily/Monthly
QA/QC procedures:	Follow operational guidelines in the work instructions with a step by step guide for calculations.
Any comment:	

Data / Parameter:	**CV ($Y_{P,i}$)**
Data unit:	%
Description:	Coefficient of Variation in the baseline gravimetric yield of the sample.
Source of data:	Charcoal production/carbonization unit
Measurement procedures (if any):	Statistical procedures and protocol for the calculation of carbonization gravimetric yield
Monitoring frequency:	Monthly
QA/QC procedures:	Calculations must be performed using a verifiable spreadsheet database in accordance with applicable formulae.
Any comment:	

Data / Parameter:	**$RATE^{Compliance}_{y}$**
Data unit:	%
Description:	Compliance rate for relevant law and regulation
Source of data:	Official and public data on the charcoal production process from government sources, producer unions and associations.
Measurement procedures (if any):	The data on compliance of laws and regulation in the charcoal production sector or the methods used by the charcoal producers meet the legal criteria.
Monitoring frequency:	Annual
QA/QC procedures:	Compare the data collected on compliance with rate of threshold of 50% adopted on the compliance of laws and regulation under this methodology.
Any comment:	

Data / Parameter:	**$EF_{CH4,P}$**
Data unit:	tCH_4/tCharcoal
Description:	Methane emission factor in the project scenario.
Source of data:	Data from the experimental protocol demonstrating the relationship between methane emissions and carbonization gravimetric yield.
Measurement procedures (if any):	Calculation of methane emission factor of the project activity in accordance with the regression relationship.
Monitoring frequency:	
QA/QC procedures:	
Any comment:	

Appendix 1, 2 and 3 to be attached