CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: MONITORING (CDM-NMM)
Version 01 - in effect as of: 1 July 2004

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SECTION A. Identification of methodology

A.1. Title of the proposed methodology:

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

A.2. List of category(ies) of project activity to which the methodology may apply:

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The methodology can be applied to activities relating to **sector 1** with the **sector scope**: **Energy Industries - supply side energy efficiency improvements**. Since there is no approved methodology, this new monitoring methodology is proposed to cover the following activities.

- Traditional charcoal production based on brick beehive, one-chimney, and other types of kilns, as applicable.
- Charcoal production for industrial use, for example, in pig iron production.
- Charcoal production for commercial use such as for the barbecue market.

A.3. Conditions under which the methodology is applicable to CDM project activities:

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This methodology is applicable to a project entity that seeks to switch from a process of high methane emitting charcoal production to a process that minimizes the methane emissions. The methodology is applicable under the following conditions. Methane emissions from charcoal production would continue to occur in the absence of adoption of improved technology for controlling methane emissions.

- The project entity is capable of ensuring proper monitoring and measurement of carbonization gravimetric yield (mass of charcoal over mass of wood) in the charcoal production process.
- No relevant changes in greenhouse gas emissions other than methane occur as a consequence of the project activity and/or need to be taken into account, e.g. as leakage.
- Emission reductions are achieved through the adoption of technologies and processes that avoid or diminish the production of methane emissions in the carbonization process.
- The project activity is unlikely to result in charcoal production that would significantly exceed the production in the baseline scenario.
- Local regulation does not require controlling methane emissions in charcoal production or is less stringent than the project controls and/or the law enforcement is not strong enough to ensure widespread compliance (defined as a compliance rate above 50 percent of activities that do not take the CDM incentive into account).

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

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Strengths

- The monitoring methodology is based on the latest research into the process and output of wood carbonization and charcoal production.
- The methodology is applicable to a wide range of process and technological modifications that avoid the formation of methane in charcoal kilns.

Weaknesses

- The methodology requires skilled operating personnel and specialized knowledge of the carbonization process and of charcoal production technologies.
- The cost of monitoring can be high considering the large number of kilns in the carbonization units. There needs to be sufficient incentives to motivate the project entity to invest resources in the monitoring process.

SECTION B. Proposed new monitoring methodology

B.1. Brief description of the new methodology:

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This methodology sets out the requirements for monitoring of the baseline and project emissions, and guides the development of the monitoring plan for projects that have charcoal production as one of the components and propose to use this methodology. The carbonization process generates emissions of two GHG gases: CO_2 and CH_4. Since plantations remove CO_2 from the atmosphere, the CO_2 emitted during carbonization is carbon neutral and is not subject to monitoring under this methodology. Therefore, this methodology focuses only on CH_4 emissions.

This monitoring methodology is closely linked to the baseline methodology. In particular, it uses the same parametric relationship outlined in the baseline methodology for the determination of baseline and project emissions, and emission reductions. This relationship was estimated based on the intensive research sponsored by the project entity on the wood carbonization process in charcoal production. This monitoring methodology specifies the methods for monitoring of the carbonization process, collection of data, and the estimation of resulting emissions and emission reductions.

This monitoring methodology enables the monitoring of the carbonization process through measuring the carbonization gravimetric yield (i.e. charcoal output per unit of wood input), a key variable in the estimation of methane emission factors per unit of charcoal output under the baseline and project scenarios. The gravimetric yield for the baseline scenario is determined prior to the start of the project activity, whereas the gravimetric yield of the project activity is continuously monitored throughout the project period. The methodology assumes that the same charcoal output is produced in the baseline and project scenarios. It permits the calculation of the emissions by applying the monitored charcoal output of the project activity to the methane emission factor for the baseline and for the project scenarios, respectively. The emission reductions are then calculated as the difference between baseline and project emissions.

The methodology provides for the confirmation or updating of the baseline at the point of renewal of the crediting period. Since the project entity may no longer be able to provide baseline reference within its own operations after the implementation of the project activity, information on the prevailing charcoal production process, which represents the baseline, is collected through a survey of charcoal making facilities in the relevant region.

This new methodology presents the general guidance on the collection of data on wood sources, quantities of wood used and charcoal produced, in particular the monitoring methods, instrumentation, measurement guidelines, data collection, database management, and estimation of emissions and emission reductions, and the recording and processing of this information as required for the verification of the achieved emission reductions. This guidance must be translated into a monitoring plan for the project activity and must be submitted for registration of the CDM project. The steps and guidelines outlined in the monitoring plan must be implemented in the project's operational manuals and is subject to validation.

B.2. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario:

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Monitoring project emissions

Data monitoring and recording should follow the operational sequence of the charcoal production process. The sources of data, periodicity of data collection, and data archival methods are outlined in **Table B.2.1** below. Relevant changes to the carbonization units must be recorded, in particular the number of kilns and their start date under the project activity. The changes in the number of kilns are reflected in the monthly data on kilns operating during the period and the associated emissions.

The amount of charcoal produced along with its end uses should be monitored and recorded. Any changes to the quantities of charcoal produced due to changes in production process and operational procedures should be recorded in the database and considered in the estimation of emissions. The major variables of charcoal production such as carbonization yield should be carefully monitored and recorded. The instructions that operational staff should follow to measure and calculate the carbonization gravimetric yield can depend on the production technology and may vary between charcoal producers. These instructions shall therefore be provided in the project's Monitoring Plan and are subject to validation. An example is contained in Appendix 1 to the Monitoring Plan for the Plantar carbonization project activity. Considering that the monitoring data forms the basis for estimating the methane emissions, the correct application of the prescribed operational procedures for monitoring and recording of the data should be periodically verified by the supervisory personnel to ensure the integrity of the data.

B.2.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

2.1.a	Location of carbonization unit	Production department / farm maps	Location/ site description	m	Monthly	100%	Electronic/ paper	
2.1.b	Number of new kilns/ operational procedures	Kiln design / work instructions	Plantar Kilns	m	Once, at the start date of project in each carbonization unit	100%	Electronic	Verify the number of new kilns operating under improved carbonization procedures.
2.1.c	Starting date of new procedures for ERs	Production department	Carbonization unit	m	Once	100%	Electronic	
2.1.d	Amount of wood used	Carbonization unit	Tons	m	Monthly	100%	Electronic	Weight the wood before arrival at the carbonization units.
2.1.e	Wood moisture	Wood for carbonization	% water content	m & c	Weekly	Representa tive sample	Electronic or paper	
2.1.f	Charcoal moisture	Charcoal	% water content	m & c	Weekly	Representa tive sample	Electronic or paper	
2.1.g	Amount of charcoal produced (*CP*)	Charcoal production/ carbonization unit	Tons	m	Daily/ Monthly	100%	Electronic	Weight all charcoal at delivery
2.1.h	Carbonization yield (*Yp*)	Charcoal production/ carbonization unit	Charcoal weight (dry-basis) / wood weight (dry-basis)	c	Daily/ Monthly	100%	Electronic	Carbonization yield calculations will be stored in the "CY calcula-tion spreadsheet"

2.1.i	Methane emissions of project scenario (PE)	Carbonization yield (Yp), production (CP)	Tons of CO2e / time period	c	Monthly	100%	Electronic	Emission reductions calculations will be stored in the "ERs calculations spreadsheet"

Where,
Yp = Carbonization yield of the project scenario
CP = Amount of charcoal produced in tons/time period
PE = Project emissions in CO_2 equivalents (tons/time period)

B.2.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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To calculate the total project emissions, the weighted average of the project scenario gravimetric yield (mass of charcoal/mass of wood) for each month shall be estimated based on the data monitored and recorded during the month. The monthly weighted data shall be applied to the regression equation outlined below to estimate the amount of methane emissions per ton of charcoal produced.

$$\mathbf{M_{(p)} = 147.0 - 340.37 * Y_{(p)}}$$

Where,

$M_{(p)}$ = Methane emissions factor of the project scenario (kg of CH_4/ton of charcoal)
$Y_{(p)}$ = Carbonization gravimetric yield (ton of charcoal/ton of wood, dry basis) based on the monthly weighted average.

The total project emissions in tons of CO_2 equivalent can be determined by multiplying the amount of emissions with the CH_4 global warming potential and the total charcoal production on dry weight basis. Data on charcoal production shall be aggregated monthly data and calculations shall be performed on monthly basis and stored in the spreadsheet databases.

$$\mathbf{PE_{CO2e} = M_{(p)} /1000 * GWP\_CH_4 * CP}$$

Where,

PE_{CO2e} = Total project emissions in CO2 equivalent (tons/ period of time)
GWP_ CH_4 = Global warming potential of methane = 21
CP = Amount of charcoal produced (ton) / period of time)

Monitoring baseline emissions

The methods followed to determine the baseline emissions factor have been outlined in the baseline methodology. The procedure followed and the resulting baseline emission factor is subject to validation. Since the weighted average carbonization yield in the baseline scenario and thus the baseline emission factor must be determined before the implementation of project scenarios, this factor serves as the baseline reference during the crediting period.

Since this methodology uses the same parametric relationship outlined in the baseline methodology for determination of baseline and project emissions, the only variable that is required to be monitored to determine the absolute emissions of the baseline scenario is the amount of charcoal produced in the project scenario (i.e. the activity level). The methodology assumes that the amount of charcoal produced is the same under baseline and project scenarios. By applying the amount of charcoal produced to the parametric equation for the baseline scenario, including the baseline emissions factor, it is possible to calculate and monitor the methane emissions in the baseline scenario.

Thus, this methodology encompasses the monitoring of the absolute emissions of the baseline scenario on an *ex-post* basis, based on a pre-determined baseline emissions factor and a parametric equation for methane emissions. Therefore, the only data required for the monitoring of baseline emissions under this methodology is the amount of charcoal produced by kilns under the project activity.

B.2.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

2.3.a	Carbonization yield in the baseline scenario (Y_b)	Charcoal production/ carbonization unit	Charcoal weight (dry-basis) / wood weight (dry-basis)	c	Determined before the project implementation	Pre-determined emission factor based on statistical sample	Electronic	Baseline carbonisation yield is used to calculate absolute emissions in the baseline. The factor is determined in accordance with the baseline methodology and stored in the "CY spreadsheet"
2.3.b	Amount of charcoal produced under the project scenario (C*P*)	Charcoal production / carbonization unit	Tons	m	Monthly	100%	Electronic	Charcoal is weighed at delivery
2.3.c	Methane emissions of the baseline scenario (BE)	Carbonization yield (Yb), production (CP)	Tons of CO2e / time period	c	Monthly	100%	Electronic	Emissions calculations will be stored in the "ERs calculations spreadsheet"

Where
Yb = Carbonization yield of the baseline scenario
CP = Amount of charcoal produced
BE = Baseline emissions in CO_2 equivalents (tons/time period)

B.2.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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To estimate the baseline emissions, the weighted average baseline gravimetric yield estimated prior to the project implementation shall be used, which will serve as the baseline scenario throughout the crediting period.

$$\mathbf{M_{(b)} = 147.0 - 340.37 * Y_{(b)}}$$

Where,

$M_{(b)}$ = Methane emissions factor in the baseline scenario (kg of CH_4/ton of charcoal)
$Y_{(b)}$ = Baseline weighted average carbonization gravimetric yield (ton of charcoal/ton of wood, dry basis) estimated prior to project implementation.

The above equation calculates the amount of methane emissions per ton of charcoal produced under baseline scenario. The total baseline emissions (tons of CO_2 equivalents) can be determined by multiplying the amount of emissions with the CH_4 global warming potential, and the total charcoal production on dry weight basis. Data on charcoal production shall be aggregated on a monthly basis and calculations shall be performed at monthly intervals and stored in the spreadsheet database.

$$\mathbf{BE_{CO2e} = M_{(b)} /1000 * GWP\_CH_4 * CP}$$

Where,

BE_{CO2e} = Total baseline emissions in CO2 equivalent (tons/ time period)
GWP_ CH_4 = Global warming potential of methane = 21
CP = Amount of charcoal produced (ton) / time period)

B.3. Option 2: Direct monitoring of emission reductions from the project activity:

>>Not Applicable

B.3.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

B.3.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>> Not Applicable

B.4. Treatment of leakage in the monitoring plan:

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As per the conditions in Section A.3, this methodology can only be used if the project activity is not subject to leakage. Therefore, the present methodology does not address leakage in the monitoring plan.

Typically, improved carbonization projects that meet the applicability conditions are not likely to result in leakage, since there are no net changes in anthropogenic emissions by GHG sources outside the project boundaries that are attributable to the project scenario. The GHG emissions from transportation of wood occur in both baseline and project scenarios. Therefore, these emissions are not monitored. If there are any technological or process changes in the project scenario that produce leakage, this methodology would have to be amended to address the possibilities of leakage before it can be applied to the project activity in question.

B.4.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

B.4.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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Not applicable (see above).

B.5. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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For the emission reduction calculations, the only variable that differs in the project and baseline scenarios is the *carbonization gravimetric yield*. In the baseline, this variable represents the weighted average carbonization gravimetric yield just before the implementation of project activity. In the project

scenario this variable is actually monitored after the project implementation. The difference between the baseline emissions and project emissions represents the emission reductions as outlined below.

Baseline emissions:

$$BE_{CO2e} = M_{(b)} /1000 * GWP\_CH_4 * CP$$

Project Emissions:

$$PE_{CO2e} = M_{(p)} /1000 * GWP\_ CH_4 * CP$$

Emission Reductions (ER's):

$$ER's_{CO2e} = BE_{CO2e} - PE_{CO2e}$$

B.6. Assumptions used in elaborating the new methodology:

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- The research underlying this methodology, and in particular the regression equation used to determine the methane emissions as a function of carbonization gravimetric yield, reflects the most up-to-date, relevant and correct knowledge on the relationship between methane emissions and carbonisation yield.
- The changes in the number of kilns within a carbonization unit may occur due to non-functioning, maintenance requirements, and addition of new kilns. The methodology assumes that changes in the number of kilns are monitored, recorded, and taken into account while estimating the emissions and emissions reductions.

B.7. Please indicate whether quality control (QC) and quality assurance (QA) procedures are being undertaken for the items monitored:

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
2.1.a	Low	Location of kilns are physically verifiable and registered in production registries already subjected to monitoring provisions under this methodology
2.1.b	Low	The impact of operational practices and project emissions is reflected in the carbonization gravimetric yield. A quality management system shall be implemented that is capable of indicating that the new carbonization procedures, including kiln designs and operational practices, are in place.
2.1.c	Low	Production records must include the date of implementation of the new carbonization procedures.

2.1.d	Low	Scales used must be accurately monitored and calibrated. Records must be kept in line with production registries.
2.1.e	Low	Design work instruction based on proper and verifiable methods.
2.1.f	Low	Design work instruction based on proper and verifiable methods
2.1.g and 2.3.b	Low	Scales used must be accurately monitored and regulated. Check production and delivery records at the carbonization units.
2.1.h and 2.3.a	Low	Follow guidelines in Annex 1 to the Baseline Methodology and design work instructions with a step by step guide for calculations.
2.1.i and 2.3.c	Low	Calculations must be performed within a verifiable spreadsheet database in accordance with the formulae herein presented”

B.8. Has the methodology been applied successfully elsewhere and, if so, in which circumstances?

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The monitoring methodology is new and has not been applied elsewhere.

The recently C-rated new methodology NM0067 (Gerdau Carbonization Improvement Projects) is not comparable with this methodology, as the “Gerdau methodology” deals with the destruction of methane using end-of-pipe technology. However, the “Gerdau methodology” and the related recommendations were reviewed in the course of preparing the present methodology.

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