CLEAN DEVELOPMENT MECHANISM

AM0082

Large-scale Methodology

Use of charcoal from planted renewable biomass in a new iron ore reduction system

Version 02.0

Sectoral scope(s): 09

United Nations
Framework Convention on
Climate Change

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1. Introduction

1.1. Background

1. The following table describes the key elements of the methodology:

Table 1. Methodology key elements

Typical project(s)	Use renewable reducing agents such as charcoal produced from dedicated plantations instead of fossil fuel based reducing agents, in the iron ore reduction process using blast furnace technology. The project should include one or combination of the following new investment types: investment in dedicated plantations for the supply of reducing agents; or establishment of specific long-term binding contracts for the supply of reducing agents; or refurbishment/replacement of blast furnace; or establishment/acquisition of blast furnace; or adaptation of existing blast furnace to the use of charcoal
Type of GHG emissions mitigation action	Renewable energy: Switch to a renewable source of carbon for the reduction of iron in blast furnaces

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology is applicable to project activities that use renewable reducing agents, such as charcoal produced from dedicated biomass plantations, instead of fossil fuel based reducing agents in the production of iron and steel.

2.2. Applicability

3. This methodology is applicable to project activities that reduce emissions in the production of iron and steel by using charcoal produced from dedicated biomass plantations as reducing agents instead of fossil fuels.

4. The methodology is applicable to project activities that establish new iron ore reduction systems (types 1 or 2 below) using blast furnace technology, combined within the same project boundary with at least one of the following investment types 3, 4 or 5:

   (a) Type 1: Production of renewable reducing agents to be used in the production of iron and steel by investing in dedicated plantations;

   (b) Type 2: Establishment of specific long-term binding contracts for the supply of renewable reducing agents to be used in the production of iron and steel, i.e. renewable charcoal from dedicated biomass plantations corresponding to a new investment in the dedicated plantation; this eligibility requirement can be fulfilled whether the long-term contractor being listed as a project participant or not;

   (c) Type 3: Refurbishment/replacement of blast furnace;

(d) Type 4: Establishment/acquisition of blast furnace;

(e) Type 5: Adaptation of an existing blast furnace to the use of charcoal.

5. The applicability conditions of "TOOL16: Project and leakage emissions from biomass" shall apply.

6. As dedicated plantations are in the project boundary, all the corresponding land shall be geographically identified and delineated using maps or GIS or similar systems.

7. If the renewable biomass is sourced from a plantation registered as an A/R CDM project activity, the first verification of this A/R CDM project activity should take place before the first harvesting of the wood takes place.[1] The DOE shall verify that the plantation registered as an A/R CDM project activity from which the renewable biomass is sourced has generated cumulated net tCERs or lCERs at the time of verification of the CDM project activity under this methodology (i.e. the switch of reductant in an iron ore reduction system.) If this condition is not met the corresponding biomass shall not be eligible for the generation of CERs in the context of this methodology.

8. In case blast furnace gas is recovered and used outside of the project boundary for electricity and/or heat generation in the baseline situation, the project activity shall provide similar and/or equivalent energy outputs as the ones identified in the baseline scenario aiming to avoid impacts outside the project boundary due to the project implementation.[2]

9. In cases the project scenario involves partial consumption of the mineral coke in the project's new iron ore reduction system this methodology is only applicable if the production of the mineral coke is undertaken within the host country(ies). Thus, the methodology is not applicable to project activities that rely on the use of imported mineral coke in the project scenario.[3]

10. This methodology is not applicable to cases in which the baseline scenario is the non-renewable charcoal iron ore reduction system or is an iron ore reduction system partially using non-renewable charcoal. In order to ensure a conservative assessment of this applicability condition, the use of non-renewable charcoal shall be assessed in the baseline scenario identification procedure, as per the procedures presented in the corresponding section of this methodology.

11. This methodology is only applicable if the identified baseline scenario is the production of iron and/or steel based on an iron ore reduction system that relies completely or partially on the use of fossil fuels.

[1] This condition ensures that before the first harvest for the purpose of supply of biomass to the steel plant, the plantation has already generated tCERs and lCERs.

[2] In case there is electricity and/or heat generation in the baseline, a parameter for measuring the amount of electricity generated from the blast furnace recovered gas shall be applied and monitored as per the provisions of the Monitoring Data and Parameters Section.

[3] The use of imported mineral coke in the project is not allowed within this methodology, for the sake of simplicity and conservativeness, avoiding the complexities related with emissions that may occur outside the host country's national boundaries.

2.3. Entry into force

12. The date of entry into force is the date of the publication of the EB 101 meeting report on 29 November 2018.

2.4. Applicability of sectoral scopes

13. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology, application of sectoral scope 09 is mandatory.

3. Normative references

14. This baseline and monitoring methodology is based on the proposed new methodology NM0278 “Use of Charcoal from Renewable Biomass Plantations as Reducing Agent in Pig Iron Mill in Brazil” prepared by Plantar Carbon Team and World Bank Carbon Finance Unit.

15. This methodology derives elements from the following approved methodologies:

    (a) “ACM0003: Partial substitution of fossil fuels in cement or quicklime manufacture”;

    (b) “ACM0021: Reduction of emissions from charcoal production by improved kiln design and/or abatement of methane”;

    (c) “AMS-III.K.: Avoidance of methane release from charcoal production”.

16. This methodology also refers to the latest approved version of the following methodological tools:

    (a) “TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality”;

    (b) “TOOL16: Project and leakage emissions from biomass”;

    (c) “TOOL12: Project and leakage emissions from transportation of freight”;

    (d) “TOOL15: Upstream leakage emissions associated with fossil fuel use”

17. For more information regarding the proposed new methodologies and the tools, as well as their consideration by the Executive Board, please refer to:

    <http://cdm.unfccc.int/goto/MPappmeth>.

3.1. Selected approach from paragraph 48 of CDM modalities and procedures

18. “Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment”.

4. Definitions

19. The definitions contained in the Glossary of CDM terms shall apply.

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

(a) **Biomass** - non-fossilized and biodegradable organic material originating from plants, animals and micro-organisms including:

(i) Biomass residue;

(ii) The non-fossilized and biodegradable organic fractions of industrial and municipal wastes; and

(iii) The gases and liquids recovered from the decomposition of non-fossilized and biodegradable organic material;

(b) Renewable biomass - biomass which, in accordance with the A/R CDM modalities and procedures, meets one of the following conditions**:**

(i) The biomass originates from land areas that are forests where:

a. The land area remains a forest;

b. Sustainable management practices are undertaken on these land areas to ensure, in particular, that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and

c. Any national or regional forestry and nature conservation regulations are complied with;

(ii) The biomass is woody biomass and originates from croplands and/or grasslands where:

a. The land area remains cropland and/or grasslands or is reverted to forest;

b. Sustainable management practices are undertaken on these land areas to ensure, in particular, that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and

c. Any national or regional forestry, agriculture and nature conservation regulations are complied with;

(iii) The biomass is non-woody biomass and originates from croplands and/or grasslands where:

a. The land area remains cropland and/or grasslands or is reverted to forest;

b. Sustainable management practices are undertaken on these land areas to ensure, in particular, that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and

c. Any national or regional forestry, agriculture and nature conservation regulations are complied with;

(iv) The biomass is a biomass residue and the use of that biomass residue in an A/R CDM project activity does not involve a decrease of carbon pools, in particular dead wood, litter or soil organic carbon, on the land areas from which the biomass residues originate;

(v) The biomass is the non-fossil fraction of industrial or municipal waste;

(c) **Charcoal and Renewable charcoal** - Charcoal is solid biofuel obtained from biomass by means of a chemical process known as "pyrolysis" or simply as "carbonization process", which consists of the thermal decomposition of biomass in the absence of oxygen.[4] Renewable charcoal is charcoal produced using renewable biomass resources as per the definition of renewable biomass approved in Annex 18 of the twenty-third meeting of the Board criteria;

(d) **Iron Ore Reduction System** - Primary Iron productive arrangement that integrates the production of reducing agents and the iron ore reduction facility;

(e) **Dedicated plantation** - A plantation implemented in the context of this project activity in order to supply an iron ore reduction system with renewable biomass. A dedicated plantation must be *newly* established as part of the project activity.

5. Baseline methodology

5.1. Project boundary

21. The spatial extent of the project boundary encompasses:

(a) The geographic boundaries of the dedicated plantations;

(b) All units that convert raw material[5] into reducing agents (coke oven facilities that distil coal into coke; and carbonization units that convert wood into charcoal);

(c) The means of transportation of the raw materials to the carbonization units and of the reducing agents to the iron ore reduction facility;

(d) The iron ore reduction facility (blast furnace).

22. The sources and gases of emissions covered under this methodology are presented in the Table 2 below.

Table 2. Emission sources included in or excluded from the project boundary[(a) (b)]

Source		Gas	Included	Justification/Explanation
Baseline	Iron ore reduction process	CO_2	Yes	Main source of baseline emissions
		CH_4	No	Negligible and excluded for simplification

[4] Brazil, 2007 *apud.* Vianna et alli. 2006.

[5] The term "raw material" shall be understood as the primary carbon source that is further converted into reducing agents, i.e. coal or planted biomass. Henceforth, the terms "raw materials" and "primary carbon sources" are used interchangeably.

Source		Gas	Included	Justification/Explanation
		N_2O	No	Negligible and excluded for simplification
	Reducing agent production	CO_2	Yes	Coal coke production
		CH_4	Yes	Coal coke production
		N_2O	No	Negligible and excluded for simplification
	Primary carbon source	CO_2	Yes	Emissions of the mining process
		CH_4	Yes	Fugitive methane emissions in coal mining
		N_2O	Yes	Emissions of the mining process
Project activity	Iron ore reduction process	CO_2	Yes	Main source of project emissions
		CH_4	No	Negligible and excluded because differences in the baseline and project activity are not substantial
		N_2O	No	Negligible and excluded because differences in the baseline and project activity are not substantial
	Reducing agent production	CO_2	Yes	Major source of emissions in the production of reducing agents, e.g. coal coke, carbonization biomass
		CH_4	Yes	Coal coke production process and biomass carbonization
		N_2O	No	Negligible and excluded because differences in the baseline and project activity are not substantial
	Primary carbon source	CO_2	Yes	Emissions of the mining process
		CH_4	Yes	Fugitive methane emissions in coal mining
		N_2O	Yes	Emissions of the mining process
	Cultivation of biomass in a dedicated plantation	CO_2	Yes	May be a significant emissions source
		CH_4	Yes	May be a significant emissions source
		N_2O	Yes	May be a significant emissions source

[(a)] The emissions from onsite electricity consumption are considered to be the same under the baseline and project scenario, therefore, these are neglected under this methodology..

[(b)] The emissions from the transportation of reducing agents to the project site are considered to be of the same magnitude under the baseline and project scenario, therefore, these are neglected under this methodology.

5.2. Selection of the baseline scenario and demonstration of additionality

23. The selection of the baseline scenario and demonstration of additionality should be conducted by applying the "TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality".

5.2.1. Identification of alternative scenarios

24. The identification of alternative baseline scenarios (step 1 of the TOOL02) should include all possible realistic and credible alternative uses of reducing agents in the iron ore reduction process in blast furnaces, comparable with the proposed CDM project activity (pig iron or hot metal). The project proponents shall identify alternative scenarios, taking into account specific circumstances of the iron ore reduction system. The scenarios relevant under this new methodology may include *inter alia*;

    (a) Coal coke iron ore reduction system;

    (b) Renewable charcoal from planted biomass from existing plantations for iron ore reduction system;

    (c) Renewable charcoal from planted biomass from new plantations for iron ore reduction system;

    (d) Non-renewable charcoal based iron ore reduction system;

    (e) Iron ore reduction system based on the use of a mix of reducing agents.

25. In light of applicable laws of regulations, the legal permissions to use a mix of reducing agents in the iron ore reduction process, e.g. fossil and biogenic shall be assessed in accordance with the "TOOL02: Combined tool to identify the baseline scenario and to demonstrate additionality". It is good practice to apply the legal constraint as a potential alternative regarding the use of mix of reducing agents in the assessment of baseline scenarios and additionality, preventing infinite possibilities of scenarios involving such use.

5.3. Baseline Emissions

26. Baseline emissions are calculated as follows:

$$BE_y = BE_{IR,y} + BUE_{RA,y} \quad \text{Equation (1)}$$

Where:

BE_y	=	Baseline emissions in year *y* (tCO_2e)
$BE_{IR,y}$	=	Baseline process emissions within the iron ore reduction facility (tCO_2e) in year *y*
$BUE_{RA,y}$	=	Baseline upstream emissions from the production and supply of reducing agents in year *y* (tCO_2e)

5.3.1. Baseline emissions within the iron ore reduction facility

$$BE_{IR,y} = \left(P_{PJ,y} \times EF_{Ind,BL}\right) - \left(P_{PJ,y} \times Cc_{HM,BL,y} \times \frac{44}{12}\right) \quad \text{Equation (2)}$$

Where:

$BE_{IR,y}$	=	Baseline emissions within the iron ore reduction facility (tCO_2e) in year *y*
$P_{PJ,y}$	=	Hot metal production in year *y* (expected hot metal production of the new iron ore reduction system) (tonnes of hot metal)

$EF_{Ind,BL}$	=	Emission factor to produce one tonne of hot metal in the baseline (t CO_2e/t of hot metal)
$Cc_{HM,BL,y}$	=	Carbon content per t of hot metal produced in the baseline year *y* (t C/t of hot metal)
$44/12$	=	Conversion factor from carbon to CO_2e; (dimensionless)

27. The emission factor to produce one tonne of hot metal is associated with the type of reducing agent on which the iron ore reduction system is based as per the identified baseline.

$$EF_{Ind,BL} = \sum_{i} \frac{\left(\%C_{BL,i} \times RA_{BL,i}\right)}{100} \times \frac{44}{12} \quad \text{Equation (3)}$$

Where:

$EF_{Ind,BL}$	=	Emission factor to produce one tonne of hot metal in the baseline (tCO_2e/t of hot metal)
$\%C_{BL,i}$	=	Carbon content in percent of reducing agent *i* (e.g. coal coke, charcoal, etc.) used in the baseline. It is considered equal to zero for renewable charcoal.
$RA_{BL,i}$	=	Quantity of reducing agent type *i* (e.g. coal coke, charcoal, etc.) required to produce one tonne of hot metal in the baseline (tonne of reducing agent/tonne of hot metal)[6]
$44/12$	=	Conversion factor from carbon to CO_2e (dimensionless)
i	=	Type of reducing agent *i* (e.g. coal coke, charcoal, etc.)

28. The carbon fixation factor in the baseline scenario is calculated as follows.

$$Cc_{HM,BL,y} = \frac{\%C_{HM,PJ,y}}{100} \quad \text{Equation (4)}$$

Where:

$Cc_{HM,BL,y}$	=	Carbon content fixed in hot metal per t of hot metal produced in year *y* (t C/ t of hot metal)
$\%C_{HM,PJ,y}$	=	Percentage of carbon in hot metal (%) in the project situation in year *y*

5.3.2. Baseline upstream emissions from the production and supply of reducing agents

$$BUE_{RA,y} = BUE_{PRA,y} + BUE_{FF,y} \quad \text{Equation (5)}$$

Where:

$BUE_{PRA,y}$	=	Baseline upstream emissions from the production of reducing agents in year *y* (tCO_2e)
$BUE_{FF,y}$	=	Baseline upstream emissions from production fossil fuels (tCO_2e) in year *y*

[6] In case of renewable and non-renewable reducing agent mix in the baseline reduction system, project participants shall take into account GHG emissions in proportion to the use of fossil fuel and renewable charcoal.

29. The coal distillation produces coal coke/metallurgical coke and result in both carbon dioxide and methane emissions. These emissions depend on the technology used in the coal coke production and shall be calculated as below.

$$BUE_{PRA,y} = P_{PJ,y} \times EF_{CO2e,coal\ coke,BL,y} \times RA_{BL,i} \quad \text{Equation (6)}$$

Where:

$BUE_{PRA,y}$	=	GHG emissions within the project boundary due to production of coal coke used in the iron ore reduction facility in the baseline scenario during year *y* (tCO_2/yr)
$P_{PJ,y}$	=	Hot metal production in year *y* (expected hot metal production of the new iron ore reduction system) (tonnes of hot metal)
$EF_{CO2e,coal\ coke,BL,y}$	=	Emission factor to produce one tonne of coal coke in the baseline scenario supply chain (tCO_2e/ t of coal coke)
$RA_{BL,i}$	=	Quantity of coal coke necessary to produce one tonne of hot metal; (t Coal coke /t of hot metal)

30. The emission factor of the coal coke production activity is directly associated with the type of technology used in the coal distillation process. Under this methodology, the coke oven emission factor accounts emissions associated with the coke oven gas flare (COG), CH_4 and CO_2 leakage emissions from coke oven doors and lids.

31. If the coal coke production step is not under the control of the project proponent, the default emission factors for emissions from coal coke production presented in the table below are to be used. They may also be used if no coal coke production operational data are available.

Table 3. Default emission factors for fugitive CH_4 and CO_2 emissions from coal coke production (COG)

Emission Bypassed COG (Kg/t of coal)		
	Uncontrolled	Flared
Carbon Dioxide	10.5	390
Methane	60	0.6
Total CO_2eq	1270.5	402.6

Source: EPA, 2007

32. Unless properly justified, the project proponent shall use the most conservative value (i.e. the lowest emission factor).

5.3.3. Baseline upstream emissions from coal production

33. The substitution of fossil fuels by renewable reducing agents, such as charcoal produced from dedicated plantations reduces indirect ("upstream") emissions associated with the production of fossil fuels ($BUE_{FF,y}$), which can be calculated as per "TOOL15: Upstream leakage emissions associated with fossil fuel use."

34. For coal, the following emission stages are considered:

(a) Emissions from the operation of mining machinery;

(b) Fugitive methane emissions from coal mines and coal processing;

(c) Coal transport to the coal coke production sites.

35. The project proponent shall only account upstream emissions that occur within the national boundary. In addition, taking into account the cost-effectiveness, simplification good practices and conservativeness rationale, the project proponent may choose to neglect all or part of the baseline upstream emissions.

5.4. Project Emissions

36. The following sources of project emissions shall be considered:

$$PE_y = +PE_{IR,y} + PUE_{RA,y} \quad \text{Equation (7)}$$

Where:

PE_y	=	Project emissions in year *y* (tCO_2e)
$PE_{IR,y}$	=	Project emissions in the iron ore reduction facility in year *y* (tCO_2e)
$PUE_{RA,y}$	=	Project upstream emissions associated with the production and supply of the renewable reducing agent in year *y* (tCO_2e)

5.4.1. Project emissions associated with iron reduction

37. Project emissions from the use of reducing agent in the new iron ore reduction process shall be calculated as follows:

$$PE_{IR,y} = \left(P_{PJ,y} \times EF_{Ind,PJ,y}\right) - \left(P_{PJ,y} \times Cc_{HM,PJ,y} \times \frac{44}{12}\right) \quad \text{Equation (8)}$$

Where:

$PE_{IR,y}$	=	Project process emissions in the iron ore reduction facility in year *y* (tCO_2e)
$P_{PJ,y}$	=	Hot metal production in year *y* (expected hot metal production of the new iron ore reduction system (tonnes of hot metal)
$EF_{Ind,PJ,y}$	=	Emission factor of one tonne of hot metal production under the project scenario (tCO_2e/t of hot metal) in year *y*
$Cc_{HM,PJ,y}$	=	Carbon content per t of hot metal produced in the year *y* (t C/t of hot metal)
$44/12$	=	Conversion factor from carbon to CO_2e (dimensionless)

38. The emission factor to produce one tonne of hot metal is associated with the type of reducing agent on which the new iron ore reduction system is based.

$$EF_{Ind,PJ,y} = \sum_i \frac{\left(\%C_{PJ,i} \times RA_{PJ,i}\right)}{100} \times \frac{44}{12} \quad \text{Equation (9)}$$

Where:

$EF_{Ind,PJ,y}$	=	Emission factor of one tonne of hot metal production under the project scenario (tCO_2e/t of hot metal) in year *y*
$\%C_{PJ,i}$	=	Carbon content in percent of reducing agent *i* (e.g. coal coke, charcoal, etc.) used in the project scenario. It is equal to zero for renewable charcoal
$RA_{PJ,i}$	=	Reducing agent type *i* (e.g. coal coke, charcoal, etc.) required to produce one tonne of hot metal (tonne of reducing agent/tonne of hot metal)
$44/12$	=	Conversion factor from carbon to CO_2e (dimensionless)
i	=	Type of reducing agent *i* (e.g. coal coke, charcoal, etc.)

39. The carbon fixation factor in the project scenario is calculated as follows:

$$Cc_{HM,PJ,y} = \frac{\%C_{HM,PJ,y}}{100} \quad \text{Equation (10)}$$

Where:

$Cc_{HM,PJ,y}$	=	Carbon content fixed in hot metal per t of hot metal produced in year *y* (t C/t of hot metal)[7]
$\%C_{HM,PJ,y}$	=	Percentage of carbon in hot metal (%)in year *y*

40. The project upstream emissions calculations shall be carried out as outlined below.

$$PUE_{RA,y} = PE_{PR,y} + PE_{BC,y} + PUE_{FF,y} \quad \text{Equation (11)}$$

Where:

$PUE_{RA,y}$		Project upstream emissions associated with production and supply of reducing agents in year *y* (tCO_2e)
$PE_{PR,y}$	=	Project emissions associated with the production of reducing agents within the project boundary in year *y*; (tCO_2/yr)
$PE_{BC,y}$	=	Project emissions associated with the cultivation of biomass in the dedicated plantation in year *y* (tCO_2e)
$PUE_{FF,y}$		Project upstream emissions from coal production (tCO_2e) in year *y*

5.4.2. Project emissions associated with the production of the renewable reducing agent

41. Methane emissions in the charcoal carbonization process are calculated as follows:

$$PE_{PR,y} = P_{PJ,y} \times EF_{CH4,charcoal,BL,y} \times F_{BL,charcoal} \times GWP_{CH4} \quad \text{Equation (12)}$$

[7] Adopting a conservative approach, the carbon fixed under the project scenario will be accounted as zero under this proposed new methodology.

Where:

$PE_{PR,y}$	=	Project emissions associated with the production of charcoal used in the iron ore reduction facility during year *y* (tCO_2/yr)
$P_{PJ,y}$	=	Hot metal production in year *y* (hot metal production of the new iron ore reduction system) (tonnes of hot metal)
$EF_{CH4,charcoal,BL,y}$	=	Emission factor to produce renewable charcoal identified in the project supply chain in the baseline scenario (tCH_4/t of charcoal)
$F_{BL,charcoal}$	=	Quantity of charcoal necessary to produce one tonne of hot metal in the baseline scenario (t charcoal/t of hot metal)
GWP_{CH4}	=	Global warming potential for CH_4 (tCO_2e/tCH_4)

42. The methane emission factor from the carbonization activity is associated with the type of technology used and the actual operation of the carbonization process. Project participants could choose between two options:

(a) Option 1: Calculation of methane emissions based on the best fit statistical relationship between methane emissions and gravimetric yield, in accordance with the most recent version of "ACM0021: Reduction of emissions from charcoal production by improved kiln design and/or abatement of methane". In this case, the methane emission factor of the carbonization process can be estimated as follows:

$$EF_{CH4,charcoal,BL,y} = f(Y_{BL}) \quad \text{Equation (13)}$$

Where:

$EF_{CH4,charcoal,BL,y}$	=	Emission Factor to produce one tonne of renewable charcoal identified in the supply chain in the baseline scenario (tCH_4/t of charcoal)
Y_{BL}	=	Carbonization gravimetric yield in the baseline scenario (t charcoal/t wood on dry basis)

(b) Option 2: Methane emission factor using helium tracing methods as per the most recent version of small scale methodology AMS-III.K.

5.4.3. Project emissions associated with the cultivation of biomass in the dedicated plantation

43. Project emissions associated with the cultivation of land in a dedicated plantation are estimated by following the provisions in "TOOL16: Project and leakage emissions from biomass".

44. Project participants should clearly document and justify in the CDM-PDD which emission sources are applicable to the project activity.

5.4.4. Project upstream emissions from coal production ($PUE_{FF,y}$)

45. In case the project scenario involves the use of coal coke as reducing agent in the iron ore reduction system, upstream emissions attributable to the production of coal can be calculated as per "TOOL15: Upstream leakage emissions associated with fossil fuel use".

46. The following emission stages are considered:

    (a) Emissions from the operation of mining machinery;

    (b) Fugitive methane emissions from coal mines and coal processing;

    (c) Coal transport to the coal coke production sites.

47. Project participants may neglect these sources of emissions under the project scenario if they are neglected under the baseline. Project participants should clearly document and justify in the CDM-PDD which emission sources are applicable to the project activity.

5.5. Leakage

48. The leakage emissions are calculated as follows:

$$LE_y = LE_{Activity,y}$$ Equation (14)

Where:

LE_y	=	Leakage emissions in year *y* (tCO_2)
$LE_{Activity,y}$	=	Leakage emissions due to shift of pre-project activities in year *y* (tCO_2)

49. Please note that the overall leakage emissions shall not be less than zero. In cases where, in year *y*, LE_y is less than zero, consider it as zero.

50. Leakage emissions due to shift of pre-project activities shall be calculated according to section 7 of the TOOL16: “Project and leakage emissions from biomass”.

5.6. Emission Reductions

51. Upstream emissions are to be counted in the emission reduction calculation only in case the project upstream emissions are higher than the baseline upstream emissions.

52. Despite the interdependency among the components of the iron ore reduction system, the differences in the total estimation of upstream emissions (production of reducing agents) in the baseline and upstream emissions in the project shall be accounted as zero if these emissions in the baseline are higher than those of the project. Thus, only emissions reductions based on the use of renewable reducing agents in the iron ore reduction facility will generate CERs.

53. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y - MAX\left(0, BUE_{RAy} - PUE_{RA,y}\right)$$ Equation (15)

Where:

ER_y	=	Emission reductions in year *y* (tCO_2e/yr)
BE_y	=	Baseline emissions in year *y* (tCO_2e/yr)
PE_y	=	Project emissions in year *y* (tCO_2/yr)
LE_y	=	Leakage emissions in year *y* (tCO_2/yr)

$BUE_{RA,y}$ = Baseline upstream emissions from the production and supply of the reducing agent in year *y* (tCO_2e)

$PUE_{RA,y}$ = Project upstream emissions associated with production and supply of reducing agents in year *y* (tCO_2e)

5.7. Data and parameters not monitored

54. 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.

Data / Parameter table 1.

Data / Parameter:	$\%C_{BL,i}$
Data unit:	%
Description:	Carbon content in percent of in the non-renewable reducing agent *i* in the baseline scenario
Source of data:	Refer to Baseline Emissions section for applicable guidance
Measurement procedures (if any):	N/A
Any comment:	The carbon content of renewable reducing agent shall be considered zero as this carbon is neutral due to its renewable biomass dedicated plantations origin

Data / Parameter table 2.

Data / Parameter:	$RA_{BL,i}$
Data unit:	tonne of reducing agent/tonne of hot metal
Description:	Reducing agent type *i* (i.e. coal coke) required to produce one tonne of hot metal
Source of data:	Refer to Baseline Emissions section, for applicable guidance
Measurement procedures (if any):	N/A
Any comment:	

Data / Parameter table 3.

Data / Parameter:	$EF_{CO2e,coal\ coke,BL,y}$
Data unit:	tCO_2e/ t of coal coke
Description:	Emission factor to produce one tonne of coal coke in the baseline scenario
Source of data:	Refer to Baseline Emissions section for applicable guidance
Measurement procedures (if any):	Estimated
Any comment:	

Data / Parameter table 4.

Data / Parameter:	GWP_{CH4}
Data unit:	(tCO_{2e}/tCH_4)
Description:	Global warming potential of CH_4
Source of data:	IPCC
Measurement procedures (if any):	Shall be updated according to any future COP/MOP decisions
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	$EG_{BL,blast\_furnace}$
Data unit:	MWh
Description:	Electricity generated from blast furnace recovered gas in the baseline scenario
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated electricity meters
Any comment:	Data collected from internal sources of an average of minimum 3 years of electricity generation. Measurement occurs continuously

Data / Parameter table 6.

Data / Parameter:	CF
Data unit:	tonnes C (tonne d.m.)-1
Description:	Carbon fraction of dry biomass
Source of data:	IPCC
Measurement procedures (if any):	N/A
Any comment:	

6. Monitoring methodology

55. All data collected as part of monitoring should be archived electronically and be kept for at least for two years after the end of the last crediting period. 100% of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

56. In addition, the monitoring methodology outlines the steps and procedures of monitoring, data collection, storage and reporting on the project throughout the crediting period and provides guidance in the implementation of the monitoring plan in order to transparently calculate the emissions associated with the project.

57. The monitoring of annual iron ore reduction under project activities facilitates the calculation of the emissions and emission reductions achieved under the project. The data to be collected in the project monitoring outlined below and the procedures to be followed in collecting the data shall be presented in the monitoring plan.

58. The monitoring and collection of data shall follow standard operational procedures. These standard operating procedures have to take the national and international standards into account, wherever required. The data collected should be archived electronically and be kept at least for 2 years after the end of the last crediting period.

6.1. Data and parameters monitored

Data / Parameter table 7.

Data / Parameter:	$P_{PJ,y}$
Data unit:	Tonnes of Hot Metal (t)
Description:	Hot metal production in project scenario in year *y* (expected hot metal production of the new iron ore reduction system)
Source of data:	Iron reduction facility operation
Measurement procedures (if any):	Total production is weighted
Monitoring frequency:	Measured daily, aggregated annually
QA/QC procedures:	Monitoring equipment shall be calibrated periodically
Any comment:	N/A

Data / Parameter table 8.

Data / Parameter:	$\%C_{PJ,i}$
Data unit:	%
Description:	Carbon content of the reducing agent *i*, in percent
Source of data:	Project monitoring data
Measurement procedures (if any):	Sample measurement shall be done using representative statistical calculations
Monitoring frequency:	Measured monthly, averaged annually
QA/QC procedures:	Standard Operating procedures (SOPs) including procedures of regular calibration of measuring equipment shall be applied
Any comment:	The carbon content of renewable reducing agent shall be considered zero as this carbon is neutral due to its renewable biomass dedicated plantations origin

Data / Parameter table 9.

Data / Parameter:	$RA_{PJ,i}$
Data unit:	tonne of reducing agent/ tonne of hot metal
Description:	Non-renewable reducing agent type *i* (e.g. coal coke, coal, etc.) requirement to produce one tonne of hot metal in the project scenario
Source of data:	Project monitoring data
Measurement procedures (if any):	Actual consumption of reducing agent will be measured, by appropriate methods
Monitoring frequency:	Measured monthly, averaged annually
QA/QC procedures:	Standard Operating procedures (SOPs) including procedures of regular calibration of measuring equipment shall be applied
Any comment:	N/A

Data / Parameter table 10.

Data / Parameter:	$\%C_{HM,PJ,y}$
Data unit:	%
Description:	Percentage of carbon in hot metal
Source of data:	Iron reduction facility operation
Measurement procedures (if any):	Sample measurement shall be done using representative statistical calculations
Monitoring frequency:	Measured monthly, averaged annually
QA/QC procedures:	Standard Operating procedures (SOPs) including procedures of regular calibration of measuring equipment shall be applied
Any comment:	The carbon content of the pig iron produced with renewable charcoal only is considered zero

Data / Parameter table 11.

Data / Parameter:	$EF_{CH4,charcoal,PJ,y}$
Data unit:	t CH_4/t of charcoal
Description:	Emission Factor to produce one tonne of renewable charcoal identified in the project supply chain
Source of data:	Project supply chain
Measurement procedures (if any):	Estimated based on the data monitored from the reducing agent supply operation to the iron ore reduction facility or based in the reliable data
Monitoring frequency:	Annual
QA/QC procedures:	
Any comment:	Local and regional value has the priority

Data / Parameter table 12.

Data / Parameter:	$F_{PJ,charcoal}$
Data unit:	Tonne of charcoal/tonne of hot metal
Description:	Quantity of renewable charcoal to produce one tonne of hot metal in the project scenario
Source of data:	Project operation
Measurement procedures (if any):	Actual data of Blast furnace operation
Monitoring frequency:	Monitored daily, calculated annually
QA/QC procedures:	SOPs
Any comment:	N/A

Data / Parameter table 13.

Data / Parameter:	$EF_{CO2e,coal\ coke,PJ,y}$
Data unit:	tCO_2e/t of Coal coke
Description:	Emission factor to produce one tonne of coal coke in the project scenario supply chain
Source of data:	Project supply chain
Measurement procedures (if any):	Estimated based on the data monitored from the reducing agent supply operation to the iron ore reduction facility or based in the reliable data
Monitoring frequency:	Annual
QA/QC procedures:	SOPs
Any comment:	Local and regional value has the priority

Data / Parameter table 14.

Data / Parameter:	$EG_{PJ,blast\_furnace}$
Data unit:	MWh
Description:	Electricity generated from blast furnace recovered gas in the project scenario
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated electricity meters
Monitoring frequency:	Annually
QA/QC procedures:	
Any comment:	Data collected from internal sources. Measurement occurs continuously

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Document information

Version	*Date*	*Description*
02.0	29 November 2018	EB 101, Annex 7 Revision to: • Simplify the title from "Use of charcoal from planted renewable biomass in the iron ore reduction process through the establishment of a new iron ore reduction system" to "Use of charcoal from planted renewable biomass in a new iron ore reduction system"; • Include reference to: - TOOL12: Project and leakage emissions from transportation of freight; - TOOL15: Upstream leakage emissions associated with fossil fuel use; - TOOL16: Project and leakage emissions from biomass. Removed provisions provided for in these three tools.
01.0	17 July 2009	EB 48, Annex 4 Initial adoption.

Decision Class: Regulatory
Document Type: Standard
Business Function: Methodology
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