Draft baseline and monitoring methodology AM0XXX

Introduction of hot supply of Direct Reduced Iron in Electric Arc Furnaces

I. SOURCE, DEFINITIONS AND APPLICABILITY

Sources

This baseline and monitoring methodology is based on the following proposed new methodology:

- NM0362 *"Greenhouse gas emission reduction through the introduction of hot supply of Direct Reduced Iron (DRI) in Electric Arc Furnaces (EAF)"* prepared by D'Appolonia S.p.A. & Perspectives Climate Change GmbH.

This methodology also refers to the latest approved versions of the following tools:

- Tool to calculate the emission factor for an electricity system;
- Tool to calculate project or leakage CO2 emissions from fossil fuel combustion;
- Combined tool to identify the baseline scenario and demonstrate additionality;
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption;
- Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period.

For more information regarding the proposed new methodology and the tools as well as their consideration by the Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM) please refer to <http://cdm.unfccc.int/methodologies/PAmethodologies/index.html>

Selected approach from paragraph 48 of the CDM modalities and procedures

"Existing actual or historical emissions, as applicable"

Definitions

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

Adequate heat: An adequate heat is a heat defined by a heat number which fulfils the following conditions: (i) it is not part of a ramp-up/restart of the EAF; (ii) it is not part of a performance test to determine the retrievable baseline; (iii) the iron bearing raw material used is 100 per cent DRI; and (iv) it is a heat for which a performance test exists. Such a performance test shall be based on the same types of raw material composition and the same equipment with regard to the energy efficiency.

Chemical feedstock: Chemical feedstocks are the materials used in EAF to provide the chemical energy or carbon to the charged material. The chemical feedstock can be coke, coal, natural gas, oxygen, charcoal, etc.

Cold DRI Charging System: The cold DRI charging system is a transportation system which transports the cooled discharge from the Direct Reduced Plant (DRP) to the melt shop for feeding to the EAF. This system can use the conveyor belts, baskets, truck for transportations and may use energy to preheat DRI, if applicable.

Cold DRI (CDRI): Cold DRI is the iron cooled to ambient temperature prior to charging into an EAF.

Consumables: Consumables are the materials consumed in EAF. This may include electrodes, lime, limestone, dolomite and inert gases.

Direct Reduced Iron (DRI): DRI is produced from direct reduction of iron ore (in the form of lumps, pellets, briquette or fines) by a reducing gas produced from natural gas or coal. The reducing gas includes among others Hydrogen (H_2) and Carbon Monoxide (CO)

Direct Reduced Plant (DRP): DRP is the manufacturing plant which produces DRI. DRP may include DRI kiln, cooler, gear, tyre, pinion, pinion shaft, shaft furnace, support roller, thrust roller, etc. The final product from DRP is the HDRI or CDRI.

Electric Arc Furnace (EAF): An EAF is used for steelmaking. It consists of a refractory-lined vessel, usually water-cooled in larger sizes, covered with a retractable roof, and through which one or more graphite electrodes enter the furnace. The electrode is fed into the melt at a controlled rate by which the arc length is automatically adjusted.

Existing and Greenfield facility: For facilities to qualify as existing, both the DRP and EAF have a history of operation for at least three years prior to the start date of project activity and it shall be demonstrated that the baseline is the continuation of the existing practice i.e. feeding of cold DRI in EAF prior to the start date of the CDM project. The baseline emissions are established from the characteristics of the existing systems using data from the immediately prior three years. If any one of the units (DRP or EAF) is a new construction or have less than 3 years of operational history, it shall be considered as Greenfield facility.

Heat: In steel making terms heat is defined as the *batch* produced from a single melting operation in EAF. In a *batch* (or heat) a pre-determined amount of material is fed for production process, resulting in the product in a pre-determined duration. In simple terms heat can be defined as one melting in an EAF.

Heat Number: Heat number is an identifying number assigned to one heat (or equivalent continuous quantity of produced steel form) of melting in an EAF.

Hot DRI (HDRI): Hot DRI is the iron not cooled prior to the discharge from the reduction furnace (DRP) and transported and charged into an electric arc furnace (EAF) immediately.

Hot DRI Charging System: The hot DRI charging system is a transportation system which transports the hot discharge from the reduction furnace (DRP) to the melt shop for direct feeding to the EAF. This may include the equipment for preheating of DRI, if applicable. Hot DRI charging system can be

- Conveying hot DRI in independent inert-gas flooded bin systems via mobile carrier and crane;

- Supply of hot DRI via pneumatic tube system using the excess pressure and the process gas from the reactor to the top of the EAF; or

- Any other system which will charge HDRI to EAF.

Performance test: A performance test measures the specific consumption of electricity during testing heats for an specific raw material composition and for the same equipment with regard to energy efficiency to identify the retrievable baseline. Previous performance tests are no longer considered adequate after refurbishments/ improvements to the EAF unit(s) which affect the level of energy efficiency. A performance test shall be constituted by at least 3 continuous heats every month.

Ramp-up/Restart: Ramp-up/Restarts are heats during which the specific energy consumption of the EAF(s) is higher due to the lower temperature of the equipment after an interruption in its operation.

Retrievable baseline: A retrievable baseline is a baseline that can be recreated and operated during the crediting period for a specific period of time. The operation in baseline conditions (without the use of a hot DRI charging system) allows project participant to collect the data inputs through trials for determining the baseline emissions. A baseline is only retrievable if either (i) the DRI charging system can be operated on cold DRI for many tap-to-tap cycles, or (ii) the EAFs have a hot and a cold DRI charging system.

Reference Plant: Commonly installed new plant in the industry sector in the country or region. The reference plant has to be identified for the purpose of its comparison with project plant implemented under the project activity to demonstrate the additionality. The reference plant section is mentioned in the section below..

Tap-to-tap cycle: Tap-to-tap cycle is the EAF operating cycle consisting of the following operations: furnace charging, melting, refining, de-slagging, tapping, and furnace turn-around.

Applicability

The methodology is applicable to project activities that use HDRI instead of CDRI in existing or new EAFs.

This methodology is applicable under the following conditions:

- The project EAF unit(s) uses DRI from an on-site[1] Direct Reduced Plant (DRP) as source of iron during the crediting period;

- The baseline is retrievable for the project activity;

- The quality of output from EAF in hot DRI charging can vary by ±5% from the quality of output from EAF in cold DRI charging. In case of existing EAF, the historical average of last three years should be considered for defining the quality of output. For new EAF, the

[1] On site DRP plant is the plant which is in the physical premises of the project EAFs or adjoining the premises of EAFs.

manufactures should provide the information on the quality of output with the use of cold DRI charging;

- In case where the DRP and the EAF belong to different parties and only one of them is the project participants, both the parties should be bound by a contract specifying that only project participant can claim emission reductions to avoid double counting;

- In addition, the applicability conditions included in the tools referred to above apply.

Finally, this methodology is only applicable if the most plausible baseline scenario, as identified per the section "Selection of the baseline scenario and demonstration of additionality" hereunder, is "Continuation of existing practice of cold DRI charging or reference plant for greenfield project activities using cold DRI charging"

II. BASELINE METHODOLOGY PROCEDURE

Project boundary

The **spatial extent** of the project boundary encompasses the following:

- The physical structure of the EAF. The EAF should include all the auxiliary equipment like electromagnetic steering, bottom blowing of inert gas, oxy-fuel burners and other equipment which consume electricity;

- The physical structure of the DRI charging/transportation system;

- In case of the electricity consumed in the project EAF unit(s) is sourced from the grid, the spatial extent of the grid is as defined in the *"Tool to calculate the emission factor for an electricity system"*.

Figure 1 : Baseline scenario

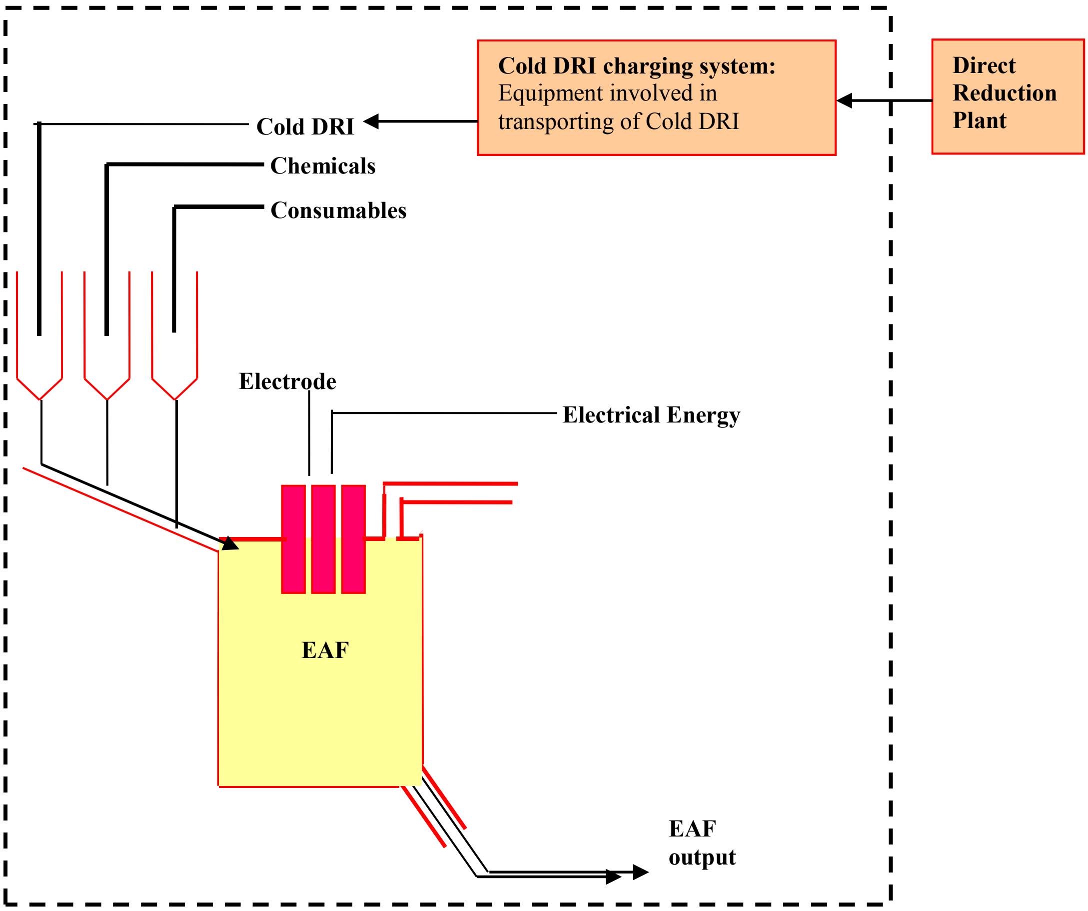
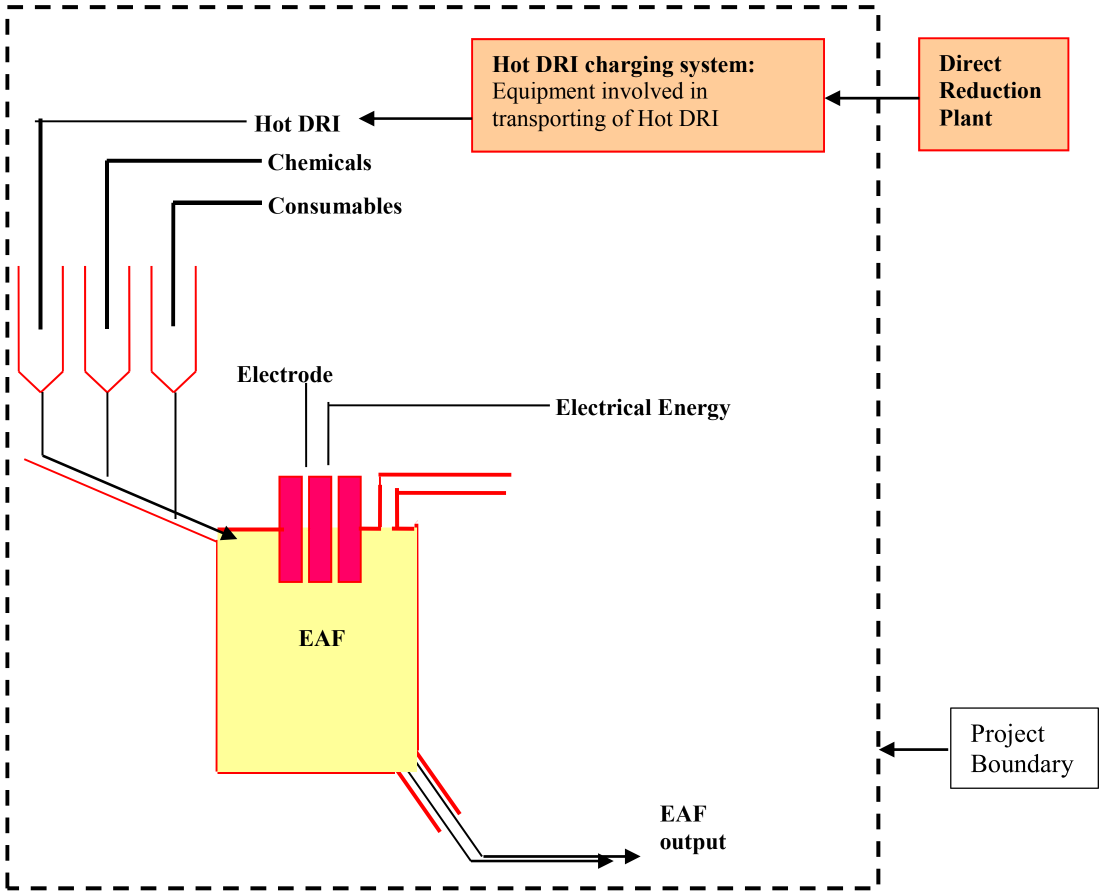


Figure 2: Spatial extent of the Project Boundary



The greenhouse gases included in or excluded from the project boundary are shown in **Error! Reference source not found.**

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

	Source	Gas	Included?	Justification / Explanation
Baseline	Emissions from consumption of electrical energy at EAF	CO_2	Yes	Main Emission Sources.
		CH_4	No	Excluded for Simplification. This is conservative.
		N_2O	No	Excluded for Simplification. This is conservative.
	Emissions from the consumption of chemical feedstock (oxidants, reductants, chemical energy, etc.) at EAF	CO_2	No	Excluded for Simplification. This is conservative.
		CH_4	No	Excluded for Simplification. This is conservative.
		N_2O	No	Excluded for Simplification. This is conservative.
	Emissions from other consumables (inert gases, electrodes, etc.) at EAF	CO_2	No	Excluded for Simplification. This is conservative.
		CH_4	No	Excluded for Simplification. This is conservative.
		N_2O	No	Excluded for Simplification. This is conservative.
	Emission from electrical energy at Cold DRI charging system	CO_2	Yes	Main Emission Sources.
		CH_4	No	Excluded for Simplification. This is conservative.
		N_2O	No	Excluded for Simplification. This is conservative.
	Emission from fossil fuel at Cold DRI charging system	CO_2	Yes	Main Emission Sources.
		CH_4	No	Excluded for Simplification. This is conservative.
		N_2O	No	Excluded for Simplification. This is conservative.
Project activity	Emissions from consumption of electrical energy at EAF	CO_2	Yes	Main Emission Sources.
		CH_4	No	Excluded for Simplification.
		N_2O	No	Excluded for Simplification.
	Emission from the consumption of chemical feedstock (oxidants, reductants, chemical energy, etc.) at EAF	CO_2	No	Excluded for Simplification.
		CH_4	No	Excluded for Simplification.
		N_2O	No	Excluded for Simplification.

	Emissions from other consumables (inert gases, electrodes, etc.) at EAF	CO_2	No	Excluded for Simplification.
		CH_4	No	Excluded for Simplification.
		N_2O	No	Excluded for Simplification.
	Emission from electrical energy at Hot DRI charging system	CO_2	Yes	Main Emission Sources.
		CH_4	No	Excluded for Simplification.
		N_2O	No	Excluded for Simplification.
	Emissions from fossil fuel at Hot DRI charging system	CO_2	Yes	Main Emission Sources.
		CH_4	No	Excluded for Simplification.
		N_2O	No	Excluded for Simplification.

Selection of the baseline scenario and demonstration of additionality

The selection of the baseline scenario and the demonstration of additionality shall be conducted using the latest version of the *"Combined tool to identify the baseline scenario and demonstrate additionality"*. The following additional guidance should be used when applying the tool.

When applying "Sub-step 1a" of the tool, alternative scenarios should include all realistic and credible alternatives to the project activity that are consistent with current laws and regulations of the host country and that provide output or service with comparable quality as the proposed CDM project activity. Comparable output or service shall be considered as same quality of raw material(s) input(s) in Electric Arc Furnace (EAF). The possible alternative scenarios in absence of the project activity could be as follows:

- Continuation of existing practice of cold DRI charging or reference plant for greenfield project activities (Reference plant is defined below) using cold DRI charging;
- Any mechanism (like pneumatic conveying of raw material or improvement in insulation during transportation of raw material or specially designed container for transportation of raw material) other than the project activity for retaining the heat energy content of the raw material(s) input(s)–and introducing the heated raw material(s) input(s) in the Electric Arc Furnace (EAF);
- Any mechanisms (like pre-heating of raw material) other than the project activity for introducing the raw material(s) input(s) in the Electric Arc Furnace (EAF) in a pre-heated condition;
- The project activity without CDM consideration.

Reference Plant Description

In cases where realistic and credible alternative(s) include the installation of a new DRI plant & EAF at the consumer's site (*reference plant*) the technology choice should be based on the common practice in the sector in the country or region and should be identified among those which provide the same service (i.e. same quality of raw material(s) input(s) in EAF). The identification of the reference plant can be done in following manner:

Option 1: Assessment of other existing plants/facilities

1. Calculate the applicable output range as 50% to 150% of the design output or capacity of the proposed project activity, if it is new or Greenfield;
2. In the applicable geographical area, identify all plants that deliver the same output or capacity within the applicable output range, calculated in point 1, as the proposed project activity and have started commercial operation before the start date of the project:
3. The plants/facilities identified above should be studied for the use of technology for DRI charging;
4. Analyse the practice of more than 75% plants/facilities in the list. For example the following situations can apply: (i) if more than 50% of the facilities do not use Hot DRI, it can be decided that the proposed Greenfield facility also would not have used the Hot DRI in the absence of CDM project; (ii) if more than 50% of the facilities use the Hot DRI partially or fully, the methodology is not applicable as it cannot be demonstrated that Hot DRI would not have been used in the absence of CDM project. Use operational information or manufacturer's specification of the facilities;
5. In case of more than 50% plants/facilities do not used Hot DRI, take the specifications of the latest facility and that can be considered as reference plant. Conduct the investment analysis based on the specification of this plant.

For the use of Option 1, it is necessary that at least five facilities are analysed to arrive at "reference plant".
Option 2: Assessment of alternative design of the project facility: This option is to be used if the project participants are not able to arrive at five facilities of similar type as the Greenfield project facility. The manufacturer of the project facility will be invited to submit an alternative design including the usage of Cold DRI under project. The project participants have to demonstrate through investment analysis that the use (or no use) of Cold DRI of such alternative design would have been the baseline scenario for the Greenfield facility.

Step 3 of the tool, investment analysis, is mandatory regardless of the outcome of Step 2 of the tool. In applying step 3, the project participants shall consider at least the following in the analysis:

(a) Savings related to the decrease in electricity, consumables and chemical feedstock consumption. In case of greenfield project activity, these saving should be calculated with respect to reference facility. Moreover the saving in metal due to less metal oxidation in case on project activity should be considered;

(b) Revenues related with the additional metal production due to increase in capacity should be included. The additional metal capacity should be calculated based on the tap-to-tap time in cold DRI charging and hot DRI charging;

(c) Expenses related to the operation and maintenance of EAFs;

(d) While conducting the investment analysis of the greenfield project activities, project participants should consider the investment for the similar capacity as in the project activity. For example, he project capacity is 1 million ton in hot DRI which required 2 EAFs; for the same production in the baseline (Cold DRI) there may be need of more than 2 EAFs since the tap-to-tap cycle may be longer. All these type of consideration should be taken into account;

(e) In case on the new DRI plant is installed with Greenfield EAF; saving on electricity due to avoidance of cooling fans (used for CDRI in baseline) should be considered in the analysis.

Baseline emissions

Baseline emissions will be determined based on the retrieval of baseline after the project implementation. The baseline emission will be computed as per the equation given below:

$$BE_y = (BE_{EAF,y} + BE_{DRI\_CH,y}) \times (1 - MS_y) \quad \textbf{(1)}$$

Where:

BE_y	=	Baseline Emissions in the year y (t CO_2)
$BE_{EAF,y}$	=	Baseline emissions from Electric Arc Furnace in the year y (t CO_2)
$BE_{DRI\_CH,y}$	=	Baseline emissions from DRI charging system (raw material transportation and/or preheating) in the year y (t CO_2)
MS_y	=	Market share of Hot DRI technology (defined as the share of hot metal produced by the Hot DRI process in relation to the total production of DRI)

Baseline emissions are calculated in the following steps:

Step 1: Determination of baseline emissions from EAF;

Step 2: Determination of baseline emissions from the DRI charging system.

Step 1: Determination of baseline emission from EAF[2]

The baseline emission of the project EAF unit(s) is calculated by multiplying the consumption of electricity by emission factor. In turn, the baseline emissions from the EAF unit(s) are calculated as follows:

$$BE_{EAF,y} = \sum_{j}\left(SEC_{BL\_EAF,j,y} \times \sum_{AdH} Q_{RAW,AdH,j,y} \right) \times EF_{ELECT,y} \quad \textbf{(2)}$$

Where:

$BE_{EAF,y}$	=	Baseline emissions from EAF in year *y* (t CO_2)
$Q_{RAW,AdH,j,y}$	=	Quantity of raw material composition *j* used in adequate heats *AdH* during the year *y* (tonnes/adequate heat)
$SEC_{BL\_EAF,j,y}$	=	Specific baseline electricity consumption for the raw material composition *j* introduced in the EAF during the year *y* (MWh/tonnes of raw material)
$EF_{ELECT,y}$	=	CO_2 emission factor for electricity generation in year *y* (t CO_2/MWh)
j	=	Type of raw material compositions used in the EAF; possible different types of iron ore to the DRI will produce different raw material compositions (different metallization) to the EAF (characterised by different metal component in weight)
AdH	=	Adequate heats for the raw material composition *j* during the year *y*

Sub-step 1.1: Determination of $SEC_{BL\_EAF,j,y}$,

Ex-ante estimation

For the purpose of the CDM-PDD elaboration, the $SEC_{BL\_EAF,j,y}$, is calculated based on ex-ante values for the consumption of electricity which can be determined as follows:

(a) For existing EAF unit(s) the specific consumption of electricity is based on historical data for the last three years prior to the start of the project activity;

(b) For Greenfield EAF unit(s), the design specific consumption of electricity can be derived from the manufacturer's specification.

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[2] There are three types of inputs to EAF i.e. Electricity, chemical feedstock and consumables. With the project activity all the inputs will be reduced. However, to simplify the methodology emission reductions are claimed only for electricity saving.

Ex-post estimation

During the crediting period, the baseline specific energy consumption shall be determined based on the testing heats for retrievable baseline scenario, which are calculated as follows:

$$SEC_{BL\_EAF,j,y} = \frac{\sum_{testH} EC_{EAF,testH,j,y}}{\sum_{testH} Q_{RAW,testH,j,y}} \quad \textbf{(3)}$$

Where:

$SEC_{BL\_EAF,j,y}$	=	Specific baseline electricity consumption for the raw material composition *j* introduced in the EAF during the year *y* (MWh/tonnes of raw material)
$EC_{EAF,testH,j,y}$	=	Quantity of electricity consumed by the EAF operation for the heats of raw material composition *j* during the testing heats *testH* in the year *y* (MWh/testing heat)
$Q_{RAW,testH,j,y}$	=	Quantity of raw material composition *j* used in testing heats *testH* during the year *y* (tonnes/testing heat)
testH	=	Testing heats during year *y*

<u>*Retrieval of the baseline emissions*</u>

The baseline performance level shall be retrieved from testing heats (as defined in "Performance Test" definition above) on an ex-post basis. A performance test for retrieving the baseline performance level shall be performed at least once every months (with three continuous heats), regardless of the number of different types of raw material compositions *j* used.[3]The result of performance test (testing heat) for a year should be weighted average to calculate the specific consumption in the baseline emissions.

Furthermore, performance test shall also be conducted after each of the following events:

(a) Change in the types of inputs/outputs compared to previously specifications if exceeding 5 per cent of raw materials composition in mass basis;

(b) Modification/retrofit of the project EAF unit(s) that leads to an increased energy efficiency. This can be checked based on the performance after every major shut down. If the energy efficiency (kWh/ton) is increased by 5 per cent based on the average last month's heats before shutdown; then it will be considered as modification/retrofit.

The temperature of the raw materials charging into the project EAF unit(s) during the testing heats (baseline scenario) should not be varied by more than ±5%. If the temperature of the raw materials

[3] Note: In case different composition of raw material *j* are used, for each category of raw material *j* for which the project proponent wishes to determine a baseline, a performance test is required. The raw material is considered different if the composition is varying more than +/-5% of previous specification e.g. in DRI the iron content is 94% in previous specification now if the iron content is 89% (variation more than 5%) then this will be considered as new type of raw material and separate performance test is required.

charging into the project EAF unit(s) for the testing heats during a performance test varies by more than this maximum permissible limits, testing heats must be repeated until the differences is less than the acceptable threshold. Moreover temperature of the liquid steel produced while performing the testing heats shall not be higher than the average in the project case in order to ensure a conservative approach.

Sub-step 1.2: Determination of $Q_{RAW,AdH,j,y}$

Under this methodology, emission reductions are calculated based on an adjusted quantity of raw material input. This quantity is based on the project input of raw material in adequate heats. This quantity is capped by the productivity which would have been expected in the baseline. These two steps of (i) excluding non-adequate heats, and (ii) capping the applicable quantity of raw material, are detailed below:

1) Exclusion of non-adequate heats

Only the “adequate heats’’ (defined above in definitions) of the EAF unit(s) are considered in the calculation of emission reductions.

2) Capping of the applicable quantity of raw materials

Capacity increase due to higher productivity of the project EAF unit(s) is found to be common due to the implementation of hot DRI charging system as less time is required to heat up the feedstock. The emission reductions for the capacity increase resulting from the project activity shall not be claimed throughout the crediting period for reasons of conservativeness. Therefore, the applicable quantity of raw material input shall not exceed what the baseline would have allowed to process.

The applicable quantity of raw materials is calculated as follows:

$$\sum_{AdH} Q_{RAW,AdH,j,y} = Q_{RAW\_REAL,j,y} \times MIN\left(1; \frac{Q_{BL\_CAPACITY,y}}{Q_{PJ\_PROD,y}}\right) \quad \textbf{(4)}$$

Where:

$Q_{RAW,AdH,j,y}$	=	Quantity of raw material composition *j* used in adequate heats *AdH* during the year *y* (tonnes/adequate heat)
$Q_{RAW\_REAL,j,y}$	=	Uncorrected quantity of raw material composition *j* used in all adequate heats during the year *y* (tonnes/adequate heat)
$Q_{BL\ CAPACITY,y}$	=	Baseline metal production capacity in year *y* (tonnes)
$Q_{PJ\ PROD,y}$	=	Project metal production in year *y* (tonnes)

Capacity of Greenfield EAF in baseline:

In case of the Greenfield project activity the baseline production capacity will be obtained from manufacturer's data on CDRI feeding condition. If this is not available; following procedure should be used:

The capacity of greenfield project activity should be calculated based on tap-to-tap time in testing heats and adequate heats. The baseline capacity should be calculated based on the equation below:

$$Q_{BL\_CAPACITY,y} = Q_{PJ\_CAPACITY,y} \times \frac{TT_{AdH\_AVERAGE}}{TT_{testH\_AVERAGE}} \quad \textbf{(5)}$$

Where:

$Q_{BL\_CAPACITY,y}$	=	Baseline metal production capacity in year *y* (tonnes)
$Q_{PJ\_CAPACITY,y}$	=	Project metal production capacity in year *y* (tonnes)
$TT_{AdH\_AVERAGE}$	=	Average tap-to-tap time for adequate heats in the project (minutes)
$TT_{testH\_AVERAGE}$	=	Average tap-to-tap time for testing heats for baseline scenario (minutes)

Sub-step 1.3: Determination** of **$EF_{ELECT,y}$

The "CO_2 emission factor for electricity generation in year *y*" should be computed with the latest version of *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"*. The electricity emission factor $EF_{EL,k,y}$ will be used as the $EF_{ELECT,y}$ in the project activity.

Step 2: Determination of baseline emissions from DRI charging system

The baseline emissions from the DRI charging system are estimated based on the energy emission sources that are significant and reasonable in the absence of the project activity, which are calculated as follows:

$$BE_{DRI\_CH,y} = \sum_j \left[\frac{\sum_{testH} EC_{DRI\_CH,testH,j,y}}{\sum_{testH} Q_{RAW,testH,j,y}} \times \sum_{AdH} Q_{RAW,AdH,j,y} \right] \times EF_{ELECT,y} + \sum_j \left[\frac{\sum_{testH}\sum_i (FC_{DRI\_CH,i,testH,j,y} \cdot COEF_{i,y})}{\sum_{testH} Q_{RAW,testH,j,y}} \times \sum_{AdH} Q_{RAW,AdH,j,y} \right] \quad \textbf{(6)}$$

Where:

$BE_{DRI\_CH,y}$	=	Baseline emissions from DRI charging system in year *y* (t CO_2)
$EC_{DRI\_CH,testH,j,y}$	=	Quantity of electricity consumed by the DRI charging system for the raw material composition *j* during testing heats *testH* in year *y* (MWh/testing heat)
$Q_{RAW,testH,j,y}$	=	Quantity of raw material from the raw material composition *j* used in testing heats *testH* during the year *y* (tonnes/testing heat)
$Q_{RAW,AdH,j,y}$	=	Quantity of raw material from the raw material composition *j* used in adequate heats *AdH* during the year *y* (tonnes/adequate heat)
$EF_{ELECT,y}$	=	CO_2 emission factor for the electricity generation in year *y* (t CO_2/MWh)
$FC_{DRI\_CH,i,testH,j,y}$	=	Quantity of fuel type *i* combusted for the operation of the DRI charging system for the raw material composition *j* during testing heats *testH* for the year *y* (mass or volume unit/testing heat)
$COEF_{i,y}$	=	CO_2 emission coefficient of fuel type *i* in year *y* (t CO_2/mass or volume unit)
testH	=	Testing heats during year *y*
I		fuel types used for combustion at DRI charge

The project participants shall derive CO_2 emission coefficient of fuel type in accordance with the latest version of *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"*.

Project emissions

Project emissions are calculated as follows:

$$PE_y = PE_{EAF,y} + PE_{DRI\_CH,y} \quad \textbf{(7)}$$

Where:

PE_y	=	Project emissions from adequate heats in year *y* (t CO_2)
$PE_{EAF,y}$	=	Project emissions from EAF for all adequate heats in year *y* (t CO_2)
$PE_{DRI\_CH,y}$	=	Project emissions from hot DRI charging system for all adequate heats in year *y* (t CO_2)

Project emissions are calculated in the following steps:

Step 1: Determination of project emissions from EAF;

Step 2: Determination of project emissions from the hot DRI charging system.

Step 1: Determination of project emissions from EAF

The project emission from EAF is the sum of all adequate heat numbers.

$$PE_{EAF,y} = \sum_{j}\left(\sum_{AdH} EC_{EAF,AdH,j,y}\right) \times EF_{ELECT,y} \quad \textbf{(8)}$$

Where:

$EC_{EAF,AdH,j,y}$	=	Quantity of electricity consumed by the project EAF operation for all adequate heats *AdH* of raw material composition *j* introduced in the EAF during the year *y* (MWh/adequate heat)
$EF_{ELECT,y}$	=	CO_2 emission factor for electricity generation in the year *y* (t CO_2/MWh)

Sub-step 1.1: Determination of $EC_{EAF,AdH,j,y}$

Quantity of electricity consumed by the project EAF operation for all adequate heats *AdH* of raw material composition *j* introduced in the EAF during the year *y* shall be directly measured during the crediting period.

Sub-step 1.2: Determination of $EF_{ELECT,y}$

The "CO_2 emission factor for electricity generation in year *y*" should be computed with the latest version of *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"*. The electricity emission factor $EF_{EL,j,y}$ will be used as the $EF_{ELECT,y}$ in the project activity.

Step 2: Determination of project emissions from the hot DRI charging system

The project emissions from DRI charging system are estimated based on the energy emission sources that are significant and reasonable in the project activity.

$$PE_{DRI\_CH,y} = \sum_{j}\sum_{AdH} EC_{DRI\_CH,AdH,j,y} \times EF_{ELECT,y} + \sum_{j}\sum_{AdH}\sum_{i}(FC_{DRI\_CH,i,AdH,j,y} \times COEF_{i,y}) \quad \textbf{(9)}$$

Where:

$EC_{DRI\_CH, AdH,j,y}$	=	Quantity of electricity consumed by the project hot DRI charging system from the raw material composition *j* during adequate heats *AdH* in year *y* (MWh/adequate heat)
$EF_{ELECT,y}$	=	CO_2 emission factor for electricity generation in the year *y* (t CO_2/MWh)
$FC_{DRI\_CH,i,AdH,j,y}$	=	Quantity of fuel type *i* combusted for the operation of the hot DRI charging system from the raw material composition *j* during adequate heats *AdH* during the year *y* (mass or volume unit/adequate heat);
$COEF_{i,y}$	=	CO_2 emission coefficient of fuel type *i* in year *y* (t CO_2/mass or volume unit)

The CO_2 emission coefficient of fuel type will be monitored on an ex-post basis. The project participants shall derive CO_2 emission coefficient of fuel type in accordance with the latest version of *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"*.

Leakage

No Leakage emissions are foreseen under the project activity.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \textbf{(10)}$$

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e)
BE_y	=	Baseline emissions in year *y* (t CO_2e)
PE_y	=	Project emissions in year *y* (t CO_2e)
LE_y	=	Leakage emissions in year *y* (t CO_2e)

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

Refer to the latest approved version of the *"Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period"*.

Data and parameters not monitored

Data / parameter:	$Q_{BL\_CAPACITY,y}$
Data unit:	Tonnes
Description:	Baseline metal production capacity in year *y*
Source of data:	Manufacturer's design specification for the annual capacity
Measurement procedures (if any):	
Any comment:	The baseline production capacity shall be re-determined in case of retrofits to the EAF and its charging system.

Data / parameter:	$SEC_{BL\_EAF,j,y}$
Data unit:	MWh/tons of raw material
Description:	Specific baseline electricity consumption for the raw material composition *j* introduced in the EAF during the year y
Source of data:	Plant data
Measurement procedures (if any):	This data is required for ex ante determination of emission reduction. This will be calculated based on the total electricity consumption and total raw material consumption; taken average of last three years before the project activity.
Any comment:	All the measurement should be based on the standard practice followed in the sector. This parameter is not applicable for greenfield project activity.

Data / parameter:	$Q_{PJ\_CAPACITY,y}$
Data unit:	Tonnes
Description:	Project metal production capacity in year *y*
Source of data:	Manufacturer's design specification for annual capacity
Measurement procedures (if any):	Not applicable
Any comment:	The project production capacity shall be re-determined in case of retrofits to the EAF and its charging system.

III. MONITORING METHODOLOGY

Data and parameters monitored

Describe and specify in the CDM-PDD all monitoring procedures, including the type of measurement instrumentation used, the responsibilities for monitoring and QA/QC procedures that will be applied. Where the methodology provides different options (e.g. use of default values or on-site measurements), specify which option will be used. All meters and instruments should be calibrated regularly as per industry practices.

All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. One hundred per cent of the data should be monitored if not indicated differently in the comments in the tables below.

In addition, the monitoring provisions in the tools referred to in this methodology apply.

Data / parameter:	$Q_{RAW\_REAL,j,y}$
Data unit:	Tonnes
Description:	Uncorrected quantity of raw material composition *j* used in all adequate heats during the year *y*
Source of data:	Plant records
Measurement procedures (if any):	The quantity of raw materials is either weighted on a platform scale or in continuous weigh-feeders or weigh-bridges to determine the mass fed into the furnace.
Monitoring frequency:	Per each adequate heat fed into the project EAF unit(s) during the monitoring period.
QA/QC procedures:	The weighting system will be calibrated as per the manufacturers' specification and/or the calibration institution and/or the industry practices. The parameters can also be further audited by a third party institution for ensuring its reliability.
Any comment:	-

Data / parameter:	$Q_{RAW,testH,j,y}$
Data unit:	Tonnes/testing heat
Description:	Quantity of raw material composition *j* used in testing heats *testH* during the year *y*
Source of data:	Plant records (Measurements performed during testing heats).
Measurement procedures (if any):	The quantity of raw materials is either weighted on a platform scale or in continuous weigh-feeders or weigh-bridges to determine the mass fed into the furnace.
Monitoring frequency:	Continuously and aggregate monthly for each testing heat
QA/QC procedures:	The weighting system will be calibrated at regular intervals as per the manufacturers' specification and/or the calibration institution and/or the industry practices. The parameters can also be further audited by a third party institution for ensuring its reliability.
Any comment:	-

Data / parameter:	$Q_{PJ\ PROD,y}$
Data unit:	Tonnes
Description:	Project metal production in year *y*
Source of data:	Plant records
Measurement procedures (if any):	The quantity of production output is either weighted on a platform scale or in continuous weigh-feeders or weigh-bridges to determine the mass of output from the furnace.
Monitoring frequency:	For all adequate heats performed during the crediting period.
QA/QC procedures:	The weighting system will be calibrated at regular intervals as per the manufacturers' specification and/or the calibration institution and/or the industry practices. The parameters can also be further audited by a third party institution for ensuring its reliability.
Any comment:	-

Data / parameter:	$EC_{EAF,testH,j,y}$
Data unit:	MWh/testing heat
Description:	Quantity of electricity consumed by the EAF operation for the heats of raw material composition *j* during the testing heats *testH* in the year *y*
Source of data:	Plant records (Measurements performed during testing heats).
Measurement procedures (if any):	The electricity consumed by the project EAF unit(s) during the testing heats shall be metered.
Monitoring frequency:	For all testing heats of each adequate performance test performed during the crediting period.
QA/QC procedures:	The meters will be calibrated in line with the manufacturers' specification and/or national standards. In case of electricity sourced from the grid, this data, along with other data from relevant meters, will be cross-checked with the bill from the grid operator to ensure consistency.
Any comment:	-

Data / parameter:	Raw material composition
Data unit:	%
Description:	Composition of raw material feed in the EAF
Source of data:	Plant records (measurements during all heats). The composition should be monitored based on the standard practice of industry. Minimum Iron and carbon percentage should be monitored.
Measurement procedures (if any):	Based on standard industrial practice.
Monitoring frequency:	For all heats
QA/QC procedures:	The meters will be calibrated in line with the manufacturers' specification and/or national standards. In case the variation in composition is more than 5%; new performance test is performed.
Any comment:	-

Data / parameter:	Modification/Retrofit
Data unit:	
Description:	Modification or retrofit of EAF during the crediting period.
Source of data:	Plant log sheet to be checked after every shutdown.
Measurement procedures (if any):	The electricity consumption ($EC_{EAF,AdH,j,y}$) and the quantity of production ($Q_{PJ\_PROD,y}$) are monitored continuously. The specific consumption (kWh/ton) after the every shutdown will be calculated and compared with the weighted average specific consumption of one month before shutdown. If the variation is more than 5% then the performance test will be repeated.
Monitoring frequency:	After every shut down .
QA/QC procedures:	
Any comment:	-

Data / parameter:	$EC_{EAF,AdH,j,y}$
Data unit:	MWh/adequate heat
Description:	Quantity of electricity consumed by the project EAF operation for all adequate heats *AdH* of raw material composition *j* introduced in the EAF during the year *y*
Source of data:	Plant records
Measurement procedures (if any):	Electricity meters: the electricity consumed by the project EAF unit(s) for all adequate heats shall be metered.
Monitoring frequency:	Measured continuously, aggregated monthly for all adequate heats
QA/QC procedures:	The meters will be calibrated in line with the manufacturers' specification and/or national standards. In case of electricity sourced from the grid, this data, along with other data from relevant meters, will be cross-checked with the bill from the grid operator to ensure consistency.
Any comment:	-

Data / parameter:	$EC_{DRI\_CH,testH,j,y}$
Data unit:	MWh/testing heat
Description:	Quantity of electricity consumed by the DRI charging system for the raw material composition *j* during testing heats *testH* in year *y*
Source of data:	i) Plant records (measurements performed during testing heats). If the operation on cold DRI for the retrievable baseline can also accurately reflect the baseline charging system which would have been operated in the absence of the project, this is the favoured source of data. It is necessary that the HDRI compressor and all the charging system electricity consumers are completely switched off during the testing heats, or that HDRI charging system electricity consumption is excluded from monitoring during testing heats. ii) Baseline plant manufacturer specifications.
Measurement procedures (if any):	Under option i) the electricity consumed by the project DRI charging system during the testing heats shall be metered.
Monitoring frequency:	For all testing heats of each adequate performance test performed during the crediting period.
QA/QC procedures:	The meters will be calibrated in line with the manufacturers' specification and/or national standards. In case of electricity sourced from the grid, this data, along with other data from relevant meters, will be cross-checked with the bill from the grid operator to ensure consistency.
Any comment:	-

Data / parameter:	$FC_{DRI\_CH,i,testH,j,y}$
Data unit:	mass or volume unit/testing heat
Description:	Quantity of fuel type *i* combusted for the operation of the DRI charging system for the raw material composition *j* during testing heats *testH* for the year *y*
Source of data:	i) Retrieve values during cold DRI operation for the test heats. It is necessary that the HDRI charging system fuel consumers are completely switched off during the testing heats, or that HDRI charging system fuel consumption is excluded from monitoring during testing heats.; or ii) Plant specification for the baseline solution (manufacturer data)
Measurement procedures (if any):	The fuels shall be measured using an appropriate mass or volume measuring equipment during testing heats.
Monitoring frequency:	For all testing heats of each adequate performance test performed during the crediting period.
QA/QC procedures:	The meters will be calibrated in line with the manufacturers' specification and/or national standards.
Any comment:	-

Data / parameter:	$EC_{DRI\_CH,AdH,j,y}$
Data unit:	MWh/adequate heat
Description:	Quantity of electricity consumed by the project hot DRI charging system for the adequate heats *AdH* of raw material composition *j* in year *y*
Source of data:	Plant records. If during adequate heats the CDRI transport system (conveyors) is working in idle, or in any case if it is not completely switched off, it is necessary to account also its electricity consumption.
Measurement procedures (if any):	The electricity consumed by the DRI charging system shall be metered.
Monitoring frequency:	Measured continuously, aggregated monthly for all adequate heats
QA/QC procedures:	The meters will be calibrated in line with the manufacturers' specification and/or national standards. In case of electricity sourced from the grid, this data, along with other data from relevant meters, will be cross-checked with the bill from the grid operator to ensure consistency.
Any comment:	-

Data / parameter:	$TT_{AdH\_AVERAGE}$
Data unit:	Minutes
Description:	Average tap-to-tap time for adequate heats in the project
Source of data:	Plant records
Measurement procedures (if any):	-
Monitoring frequency:	Continuous for each adequate heat during the monitoring period
QA/QC procedures:	-
Any comment:	Calculate the weighted average in year y.

Data / parameter:	$TT_{testH\_AVERAGE}$
Data unit:	Minutes
Description:	Average tap-to-tap time for testing heats for baseline scenario
Source of data:	Plant records (Measurements performed during testing heats).
Measurement procedures (if any):	-
Monitoring frequency:	For all testing heats of each adequate performance test performed during the crediting period.
QA/QC procedures:	-
Any comment:	- Calculate the weighted average for year y

Data / parameter:	$FC_{DRI\_CH,i,AdH,j,y}$
Data unit:	Tonnes/adequate heat or Litres/adequate heat
Description:	Quantity of fuel type *i* combusted for the operation of the hot DRI charging system for the adequate heats *AdH* of raw material composition *j* in the year *y*
Source of data:	Plant records. If during adequate heats the CDRI transport system (conveyors) is working in idle, or in any case if it is not completely switched off, it is necessary to account also its fuel consumption.
Measurement procedures (if any):	The fuel shall be measured using an appropriate mass or volume measuring equipment
Monitoring frequency:	Measured continuously, aggregated monthly for all adequate heats.
QA/QC procedures:	The meters will be calibrated in line with the manufacturers' specification and/or national standards.
Any comment:	-

Data / Parameter:	MS_y
Data unit:	Ratio
Description:	Market share of Hot DRI technology
Source of data:	Independent publications or survey
Measurement procedures (if any):	DRI plants and EAFs within the applicable geographic area, as identified according to the "Identification of the baseline scenario and demonstration of additionality" section of the methodology and with a comparable capacity from 50% to 150% of the EAFs, shall be evaluated. The parameter shall be the fraction of EAF plants which have Hot DRI implemented (irrespective of hot DRI transportation method), excluding activities implementing Hot DRI as a CDM project activity. If the market share of hot DRI technology is higher than 50% (i.e. MS_y is greater than 0.5), the parameter value shall be set at 1.
Monitoring frequency:	Parameter shall be evaluated at validation and updated every five years afterwards
QA/QC procedures:	-
Any comment:	-

IV. REFERENCES AND ANY OTHER INFORMATION

Not applicable.

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History of the document

Version	Date	Nature of revision(s)
01.0.0	21 September 2012	EB 69, Annex # To be considered at EB 69.
Decision Class: Regulatory **Document Type:** Standard **Business Function:** Methodology		