CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

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Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Use of Charcoal from Renewable Biomass Plantations as Reducing Agent in Pig Iron Mill of ArcelorMittal Juiz de Fora, Brazil

Version: 02.7
Date: 21/06/2012

A.2. Description of the project activity[1]:

Description of the project activity

The present project activity is one of the GHG emission reduction components (described in further details below) of an iron ore reduction system using renewable charcoal from dedicated plantations for the production of pig iron, implemented by ArcelorMittal Juiz de Fora (pig iron and steel producer) and ArcelorMittal BioFlorestas (reducing agent producer), which are subsidiaries owned and operated by the the group ArcelorMittal Brasil S.A. (PP). Throughout the PDD, both companies will be cited depending on which part of the pig iron production's life cycle is presented or discussed.

The project activity encompasses the installation of two new charcoal-driven blast furnaces in the industrial facilities of ArcelorMittal Juiz de Fora, located in Minas Gerais state, Brazil. ArcelorMittal BioFlorestas establishes and manages dedicated *eucalypt* plantations and produce charcoal that is later utilized in the project's facilities. Plantations included in the project boundary consist of eucalypt forest plantations after their last rotation, 'reformed' by the project activity. In the absence of the project activity, such forests in the project boundary would not be replanted. Moreover, the project activity will utilize charcoal originated also from *new* forest plantations, which are being established under the auspices of ArcelorMittal BioFlorestas's Forest Producer Program known as PPF project.

As demonstrated in sections B.4 and B.5, in the baseline scenario, instead of renewable charcoal, the carbonaceous reducing agent to be used in the blast furnaces of the industrial facility ArcelorMittal Juiz de Fora would be coal coke, which would have led to higher GHG emissions.

The integrated charcoal-based steel and iron plant of Juiz de Fora started operating in 2007 (ArcelorMittal, 2007). Charcoal is supplied from ArcelorMittal BioFlorestas's reformed plantations while the new dedicated plantations are still being established in Zona da Mata region of Minas Gerais in frames of the PPF project. The ArcelorMittal BioFlorestas's Forest Producer Program – PPF are located mainly around Juiz de Fora, Santos Dumont, Leopoldina, Andrelandia and Lima Duarte municipalities with 7,000 ha total area and 680 ha planted area at the moment of contract signature. All areas located in Minas Gerais State.

Emission reduction components in the iron ore reduction system

The iron ore reduction system installed by ArcelorMittal Brasil S.A. encompasses three GHG emission reduction components, including the present project activity, as shown in Figure below:

[1] Section A.2. has been updated with project proponent's fact sheet that aims at providing clearer data on historical context of the project activity.

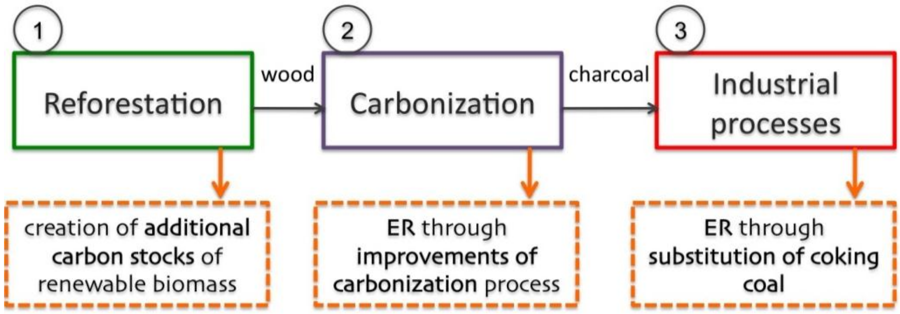


Figure 1. Components of the ArcelorMittal Brasil's charcoal-based emission reduction project

Component 1. There are two groups of forest plantations that supply wood for charcoal used by the industrial facility of ArcelorMittal Juiz de Fora (AMJF) steel and iron mill: (1) *reformed* areas of exhausted plantations established by ArcelorMittal BioFlorestas (former CAF Santa Barbara, see project proponent;s fact sheet below) back in 1960's and 70's, and (2) *new* forest plantations that are being established in frames of ArcelorMittal BioFlorestas's Forest Producer Program (known as PPF project). These *new* areas represent around 20% of the total of areas needed to sustainably supply charcoal to AMJF.

Component 2 aims at emission reductions during the charcoal production through various technological improvements. The project is still in development, with new methodology (NM0341) undergoing analysis by Meth Panel.

Component 3 is proposed in the present PDD and focuses at emission reductions through substitution of coal coke with renewable charcoal.

All of these components are based on ArcelorMittal Brasil Sustainability Program, which is described in detail in the sections below.

Project proponent's fact sheet

ArcelorMittal, created in 2006 from the fusion of Mittal Steel and Arcelor, is the largest steelmaking company in the world. It controls ArcelorMittal Brasil S.A., a company created from the assets union of ArcelorMittal Aços Longos (former Belgo, Companhia Siderúrgica Belgo-Mineira), ArcelorMittal Tubarão (former CST, Companhia Siderúrgica de Tubarão) and ArcelorMittal Vega (former Vega do Sul), and also the controlling shareholder of APERAM (former Acesita). ArcelorMittal Brasil S.A. is one of the main steelmaking companies of Latin America with a significant presence in the long and flat carbon steel sectors and annual production capacity of 15 million tons of steel.

The company is Brazil's leading manufacturer of wire rod and commercial and industrial wires. The company ArcelorMittal Juiz de Fora is certified according to ISO 14001, ISO 9001 and OSHAS 18001, and in 2005 it has been rewarded with the National Quality Award for excellence in management. In 2003 it became the first steelmaker in the world to be certified according to SA 8000 (Social Accountability). It was in 2003 that Belgo acquired the steel company Mendes Junior Siderurgia (MJS), owner of the Juiz de Fora-based plant (Minas Gerais), leased by Belgo since 1995 (Prêmio, 1995; Timeline Belgo, 2003). In 2006, the Juiz de Fora plant (included in the project boundary) became part of ArcelorMittal Brasil Group. Before the project activity, Juiz de Fora was a mill, which produced wire rod and bar. In 2007, as a result of

the project activity, it turned into an integrated[2] steel mill and iron that produces rolled long and drawn wire steel products from scrap and pig iron. It has an annual capacity of 1,000,000 metric tons of steel and 226,000 metric tons of dawn wire. Its products are widely used in building and in the agribusiness.

The history of ArcelorMittal BioFlorestas, the company that supplies renewable charcoal to project facility, started back in 1948 when Forestry Service of Belgo started planting the first eucalypt plantations in South America. In 1957, Belgo created a new company CAF (*Companhia Agrícola e Florestal Santa Bárbara*) so that it managed eucalypt plantations, manufacture charcoal and manage all rural programs of the former Belgo-Mineira. In 70's, there occured a great expansion of forestry areas under management of CAF which acquired the areas in Southern Bahia, Bom Despacho and Carbonita (Timeline CAF 1957). Between 80's and 90's, Belgo carried out a study whose results have demonstrated the feasibility of substitution of charcoal with mineral coke in the blast furnaces of Belgo.

In 2000, Monlevade, one of the industrial facilities of Belgo, installed one coke-driven blast furnace in substitution of five existent charcoal-based blast furnaces (Timeline Belgo 2000). This switch significantly reduced the demand for charcoal at Belgo facilities. Due to this fact, CAF started producing sawn wood and supply charcoal to independent pig-iron producers (Timeline CAF 2000). During that period, Belgo initiated a sale its forestry assets, however, this paralyzed the process in light of the opportunity of the development of the present project activity. In 2006, when ArcelorMittal was created, CAF turned into ArcelorMittal Florestas. In 2009, a fusion between ArcelorMittal Florestas and ArcelorMittal Jequitinhonha (forestry company of ArcelorMittal Inox) resulted in a new company called ArcelorMittal BioFlorestas.

Contributions of the project activity to sustainable development

The project activity contributes the host country's sustainable development in the following ways:

- **Contribution to local environmental sustainability**: the use of charcoal produced from renewable dedicated plantations results in significantly lower levels of GHG emissions in comparison to the utilization of mineral coke. Besides, the newly established and reformed eucalypt plantations serve as sources of carbon sink and contribute to climate change mitigation.
- **Contribution to local economic and social sustainability**: newly established plantations are established in partnership with local farmers. Eucalypt production diversifies their economic activities and positively influences their cash flow. Besides, these farmers have registered the first Brazilian cooperative COOPFLOS aimed at "carbon credits production". This has a strong positive impact on local social organization and social inclusion.
- **Contribution to technological learning and technological development**: the project activity may act as benchmark for other industries in which the same type of project could be replicated across Brazil.

A.3. Project participants:

Name of party involved (*) ((host) indicates a host Party)	Private and/or public entity (ies) Project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participants (Yes/No)
Brazil	ArcelorMittal Brasil S.A.	No

[2] Steel production at an integrated steel plant involves three basic steps: (1) the heat source used to melt iron ore is produced, (2) the iron ore is melted in a furnace, and (3) the molten iron is processed to produce steel. When these three steps can not be done at one facility, the fuel source is purchased from off-site producers (ISTC).

Brazil	Instituto Totum	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public t the stage of validation, a Party involved may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Federative Republic of Brazil.

A.4.1.2. Region/State/Province etc.:

Minas Gerais (MG) and Bahia (BA).

A.4.1.3. City/Town/Community etc.:

Figure 2 below shows the location of forest **forest production regions** in the project boundary, excluding the PPF project. Annex 5 lists the municipalities in which the dedicated forest plantations included in the project boundary are located. The new plantation sites and their coordinates from PPF programme will be inserted into the monitoring plan as soon as they be contracted and checked for meeting the applicability conditions. The sites of the PPF programme as well as future CPUs (carbon production units) that will serve this region are located in Zona da Mata in the Minas Gerais state.

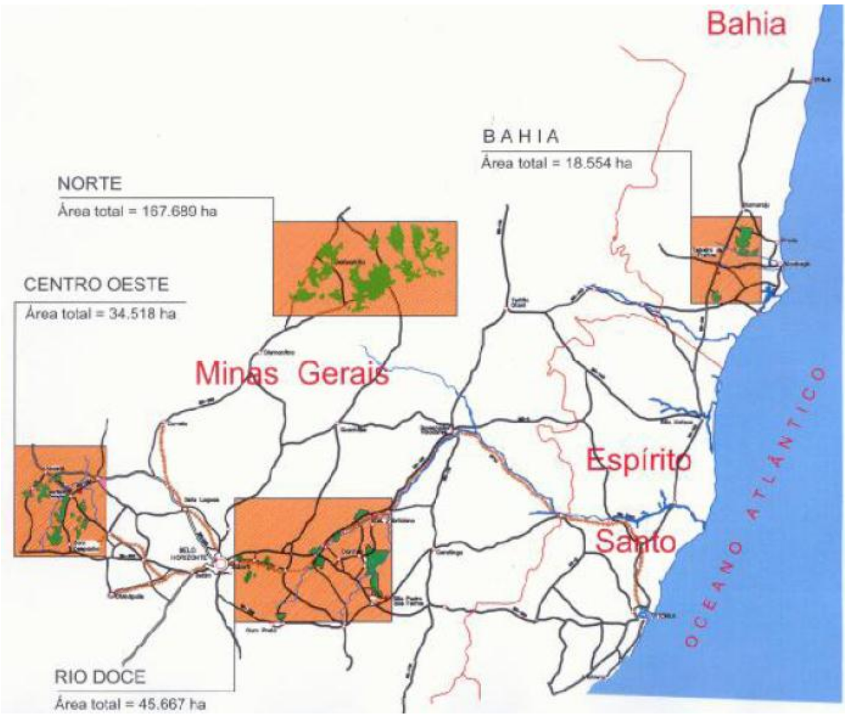


Figure 2. Location of forest production regions of ArcelorMittal BioFlorestas
Source: Forest Management Plan, ArcelorMittal BioFlorestas[3]

Table 1 lists the municipalities in which the **charcoal production units** in the project boundary are located.

[3] http://www.arcelormittalbioenergia.com.br/arquivos/PLANO%20DE%20MANEJO%20FLORESTAL_anexo_68.pdf

Table 1. Charcoal production units within the project boundary

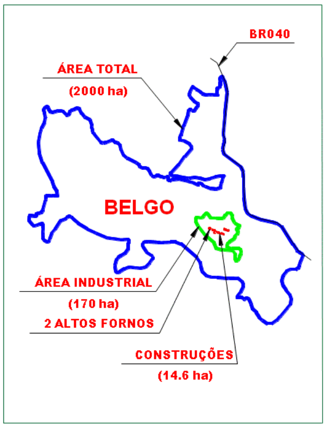
Region	Production Unit	Municipality
Centro Oeste (RCO)	Garça	Bom Despacho
Centro Oeste (RCO)	Fazendinha	Quartel Geral
Centro Oeste (RCO)	Buriti	Martinho Campos
Rio Doce (RRD)	Requerente	Dionísio
Carbonita (RJQ)	Forquilha	Carbonita

The charcoal production units that will process wood coming from PPF program will be located in *Zona da Mata* region of Minas Gerais state. Their exact location will be registered in the Monitoring Plan of the project as soon the decision on their location will be taken by ArcelorMittal BioFlorestas.

The steel and iron mill is located in the Juiz de Fora municipality.

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The details of the physical location of the integrated steel and iron plant, including information allowing its unique identification, are provided in Figure 3.

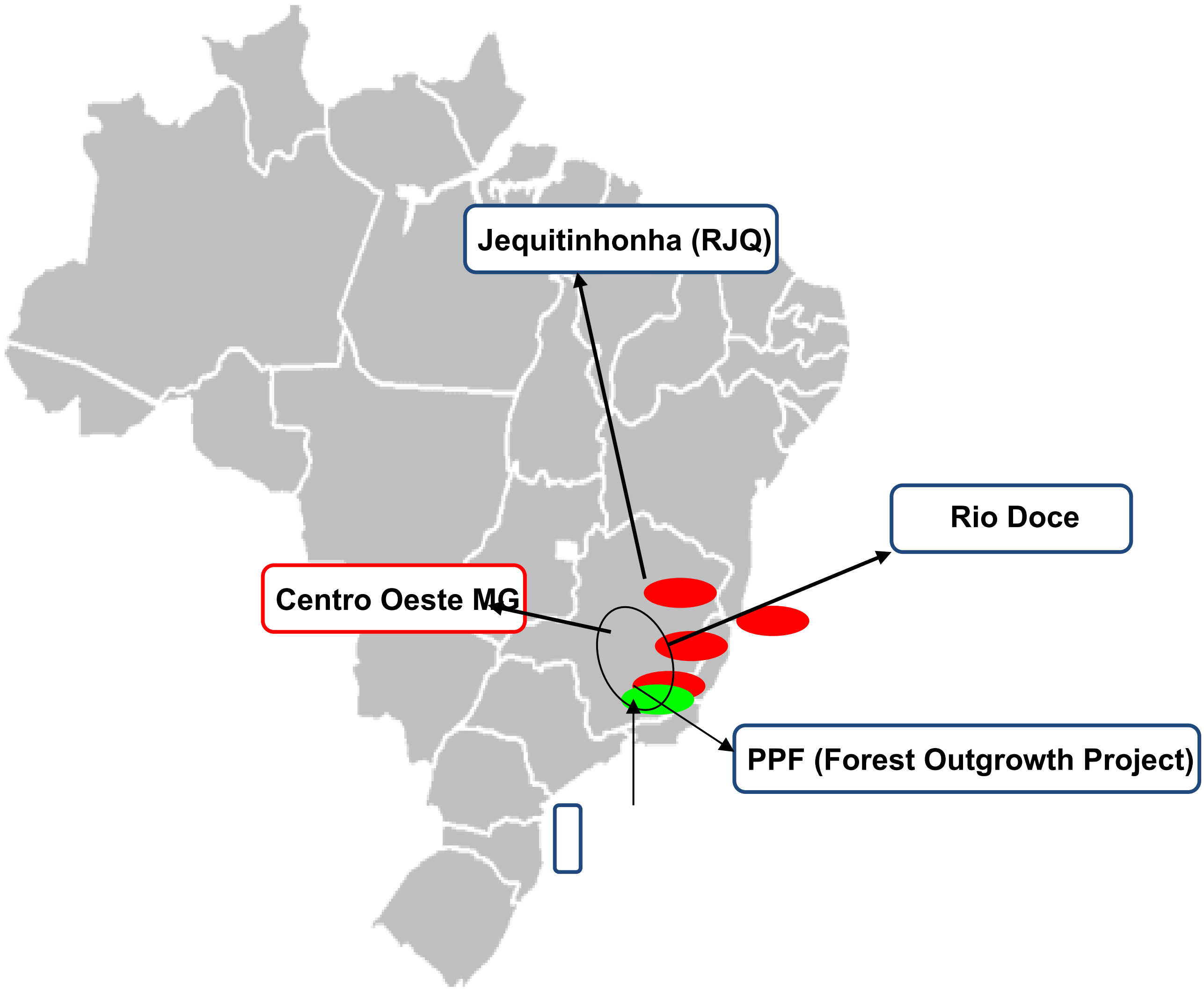


Address
BR 040 – Km 769 – Dias Tavares, Juiz de Fora, MG 36105-000, Brazil

Reference geographical coordinates: 21º37'40"S and 43º27'47"W.

Figure 3. Industrial plant of pig iron production ArcelorMittal Juiz de Fora.

The charcoal production units are located as shown on Figure 4 below.



The coordinates of the existing charcoal production units are listed in the table below:

Table 2. Reference geographical coordinates of the existing charcoal producing units included in the project boundary

Charcoal Production Unit (CPU)	Geographical coordinates
Garça	19º40'49"S; 45º22'38"W
Fazendinha	19º18'13"S; 45º27'33"W
Buritis	19º27'11"S; 45º18'18"W
Requerente	19º53'16"S; 42º36'36"W
Forquilha	17º41'25"S; 43º16'36"W

The coordinates of future CPUs will be registered in the monitoring plan as soon as the decision on their location will be taken.

A list with coordinates of all existing forest plantation sites is provided in Annex 5. Moreover, project participants possess detailed geo-referenced maps of the plantations included in the project boundary, which were made available during validation. The new plantation sites and their coordinates from PPF programme will be inserted into the monitoring plan as soon as they be contracted and checked for meeting the applicability conditions. The sites of the PPF programme as well as future CPUs that will serve this region are located in Zona da Mata in the Minas Gerais state.

A.4.2. Category(ies) of project activity:

Sectoral Scopes: 09: Metal production

Project activity: Production of iron and steel by using renewable reducing agents, i.e. charcoal produced from dedicated biomass plantations, instead of fossil fuel based reducing agents.

A.4.3. Technology to be employed by the project activity[4]:

As previously stated, the present project activity is one of the components of an iron ore reduction system using renewable charcoal from dedicated plantations for the production of pig iron, implemented by the PP.

The project activity encompasses the installation of two new charcoal-driven blast furnaces in the industrial facilities of ArcelorMittal Juiz de Fora, located in Minas Gerais state, Brazil. ArcelorMittal BioFlorestas establishes and manages dedicated eucalypt plantations and produce charcoal that is later utilized in the project's facilities. Plantations included in the project boundary consist of eucalypt forest plantations after their last rotation, 'reformed' by the project activity. In the absence of the project activity, such forests in the project boundary would not be replanted. Moreover, the project activity will utilize charcoal originated also from new forest plantations, which are being established under the auspices of ArcelorMittal BioFlorestas's Forest Producer Program (ArcelorMittal PPF).

As demonstrated in sections B.4 and B.5, in the baseline scenario, instead of renewable charcoal, the carbonaceous reducing agent to be used in the blast furnaces of the industrial facility of ArcelorMittal in Juiz de Fora would be coal coke, which would have led to higher GHG emissions.

The project entity applies advanced technologies either based on the results of its own R&D or available in the market although no technology transfer from Annex 1 countries takes place. Below follows the description of technologies employed by each component of the integrated project of ArcelorMittal Brasil, namely forestry operations, carbonization process and iron-ore reduction facility.

1) Forestry operations
The forestry operations rely on sustainable production practices and advanced plantation technology developed by ArcelorMittal BioFlorestas. The plantations are managed applying sustainable management practices of Forest Stewardship Council (AM BioFloresta FSC). The PPF sites are not FSC certified due to their small size and the fact that they remain property of the small farmers the participate in the PPF program. Figure 5 illustrated forestry operations employed by project proponent.

[4] Section A.4.3. has been updated with some additional details on the employed technology.

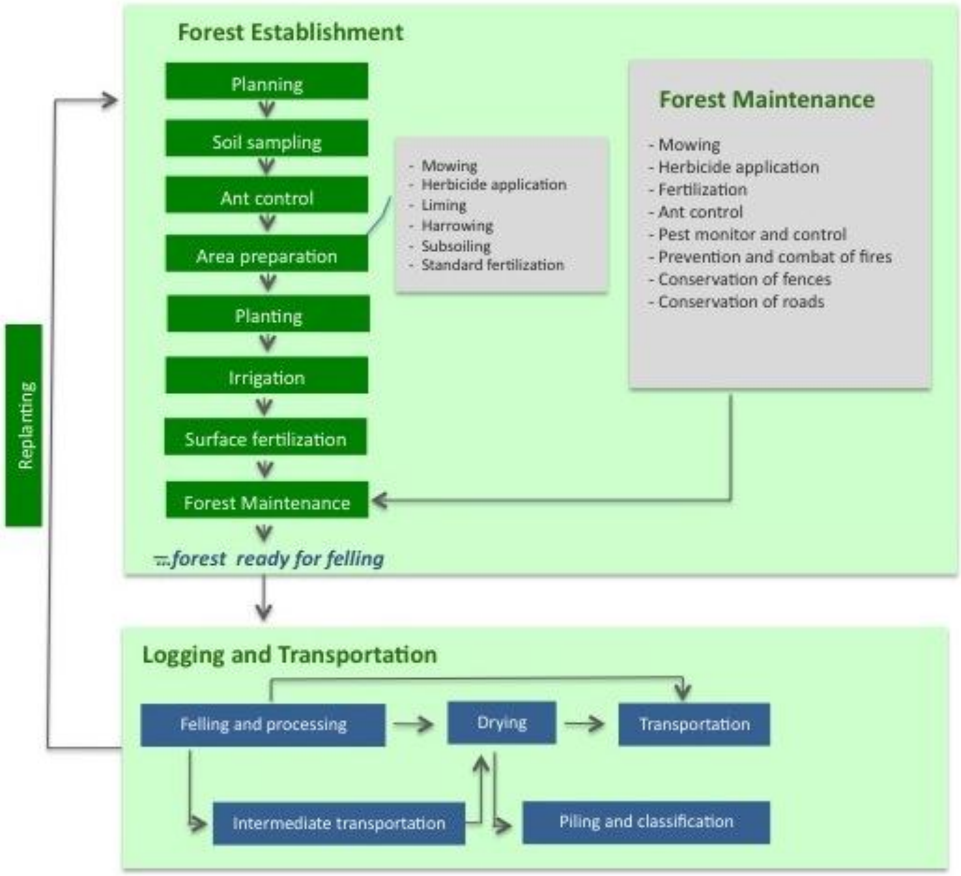


Figure 5. Forestry operations employed during the project activities

Production of seedlings

ArcelorMittal BioFlorestas is self-sufficient in its need for high-quality eucalypt seedling. It has two seedlings production units with total production capacity of 42 milions of seedlings per year and a permanent ongoing genetic research. The production work with the most advanced technology, use mini-gardens for cloning, large-scale greenhouses for rooting phase and rigorous operational control of seedlings growth. The rigorous selection process and propagation methods assure the production of high-quality cloned sprouts for plantation purposes**.**

Planting process

The planting process involves minimum tillage technique that reduces soil impacts. The seedlings are planted with application of special hydrogel to optimize water use. In order to better calculate fertilization rates and avoid wastes as well as to define the soil preparation technique, soil samples are collected in and analysed before the planting.

Forest maintenance

Fertilizers, herbicides and substances for pest control are used stricly following the application, storage and transportation procedures in order to minimize environmental impacts. The application of these products is performed based on periodic monitoring, conducted *in situ* that serves as a basis for agronomic prescriptions. Application equipment is calibrated and measured as per internal operation and quality procedures.

Productivity Management

The plantations are monitored continuously through scientifically-based forest inventory system (see Monitoring Plan) in order to guarantee the planned wood production. If the survival rate of seedlings shows high mortality the affected areas are replanted. To mitigate fire risks, ArcelorMittal BioFlorestas monitors the areas with observation towers and live cameras. Besides, it maintains special roads and trails, as well as properly equipped and trained fire-fighters that prevent spread of fire in case it happens in one of the sites.

Forest Harvest

The area subject to harvest is previously analyzed in order to minimize the impacts of harvesting. It relief, weather, roads network and operational risks. The Harvesting Plan includes definition of plots and strata as well as harvesting type and its starting date. When ready, Harvesting Plan is submitted to IBAMA, which analyzes and visits the areas before authorizing the harvest. The operation is started only after IBAMA approves the Harvesting Plan of the plot and/or farm (see Monitoring Plan for details).

Quality management system

The forestry operations are fully integrated into the quality management systmem of ArcelorMittal BioFlorestas which is certified according to ISO 9001 and ISO 14001 (AM BioFloresta ISO). Operational procedures are documented, recorded and monitoredaccording to internal operational (see Monitoring Plan).

2) Carbonization process

The process of wood carbonization is achieved by thermal degradation in oxygen-free environment (pyrolysis). The end products of carbonization under controlled conditions are pyroligneous acid, tar, gas and charcoal. Approximately 33% of original dry weight remains in the charcoal, when using technologically advanced carbonization kilns, being the remaining 67% released to the atmosphere.

Operations are fully integrated into the project entity's quality management system described in the Monitoring Plan and are certified in accordance with ISO 9001 and ISO 14001. Each operational procedure is registered, described and monitored as per the norms and standard operational procedures (which will be made available to the DOE). Social and environmental of the operations of the CPUs aspects are managed by a specific department within the project entity in order to ensure maximum compliance with legislation, corporate principles, and forestry certification schemes.

Figure 6. Charcoal production unit (CPU) of ArcelorMittal BioFlorestas.

The carbonization kilns used by ArcelorMittal BioFlorestas are rectangular brick kilns. The majority of CPUs are equipped with 32-meter-long kilns with production capacity of 180 meters of charcoal per cycle of carbonization with the following technical characteristics:

- reinforced concrete structure and brick walls with mortar coating;
- two concrete doors;
- controlled air admission, "tatus"
- net volume of 580 m^3;
- average production of 192 m^3 of charcoal;
- average cycle length of 12 days.

ArcelorMittal BioFlorestas constantly works on scientific research and development of technological improvements in carbonization process. Currently, it is testing some models of burners to destruct methane generated during wood carbonization.

When ready for industrial utilization, these burners will significantly reduce methane emissions and allow for the establishment of broader and unprecendent standards for clean and efficient charcoal production. ArcelorMittal BioFlorestas has recently submitted a new methodology for "Mitigation of methane emissions from charcoal production by recovering and burning carbonization gases" to Meth Panel that when approved will encourage charcoal manufacturers to implement methane emission reduction activities.

3) Iron reduction facility

The details of the new iron-ore reduction facility are listed below. During the iron-making process, iron ore, charcoal and fluxes are supplied through the top of furnace while heated air together with fine charcoal is blown into the bottom of the chamber. The blast furnace provides necessary conditions for reduction reaction of iron ore to occur. The process results in production of iron and slag as a byproduct.

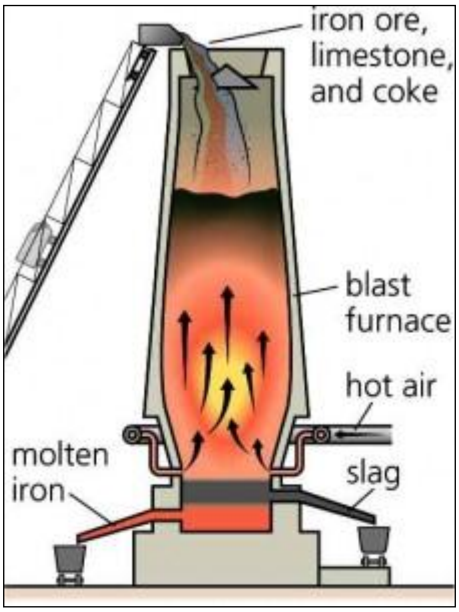
Before the start pof the project activity, the Juiz de Fora facility was a semi-integrated electric steel plant. With the installation of the project activity blas furnaces, the facility turned into integrated steel and iron mill.

The blast furnaces installed in result of the project activity are based on advanced technology, namely double supply cone system and slag granulator. Environmental impacts are controlled with dust removal systems using fabric filters, and a system for water processing and recycling.

The main characteristics of the newly installed blast furnaces:

- Number of Units — 2 units
- Nominal production — 514 t/day
- Nominal annual production: — 180,000t x 2 furnaces, 360,000 t
- Pig iron Continuous Casting Machine (carrousel) — 40t/h.
- Pig iron tapping — Intermittent type
- Ladle with capacity of 50 tons — 6 Units
- Blast air pre-heating — Glendon type
- Blowing air temperature — 800º C
- Blower — Two stage centrifugal fan
- Water systems: Closed circuit; Cooling water; Cleaning of BFG; Slag granulation.
- Dedusting system: Individual for the Furnace, Pig iron Continuous Casting and Charcoal discharge.
- Working volume — 250 m3

- Inner volume 285 m3
- Hearth Diameter (A) 4,300 mm
- Throat Diameter(B) 3,750 mm
- Effective height (C) 15,179 mm
- Blowing flow 28,000 Nm3/h
- Flow of generated gas 55,000 Nm3/h
- Blowing air temperature 800 °C
- Top pressure 0.35 bar (max)
- Number of tuyères 12
- Number of Glendons 4



A.4.4. Estimated amount of emission reductions over the chosen crediting period:

Years	Annual estimation of emission reductions in tonnes of CO_2e
01/01/2013	460,474
2014	460,474
2015	460,474
2016	460,474
2017	460,474
2018	460,474
31/12/2019	460,474
Total estimated reductions (tonnes of CO2e)	**3,223,318**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	460,474

A.4.5. Public funding of the project activity:

The project involves neither any Official Development Assistance (ODA) nor other sources of public funding from Annex 1 countries.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

The baseline and monitoring methodology applied to the project activity is "AM0082 - Use of charcoal from planted renewable biomass in the iron ore reduction process through the establishment of a new iron ore reduction system - Version 01".

The project activity also draws upon "AM0041 - Mitigation of Methane Emissions in the Wood Carbonization Activity for Charcoal Production – Version 01" and upon the following methodological tools:

- Combined tool to identify the baseline scenario and demonstrate additionality – Version 04;
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion – Version 02;
- Estimation of direct nitrous oxide emission from nitrogen fertilization – Version 01.

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

According to the applied methodology, the approach 48(b) is considered appropriate. It relies on publicly available data to determine the GHG emissions for the use as the reducing agent options, which represents the most economically attractive course of action, taking into account barriers to investment.
All required applicability conditions of the AM-0082 are met as evidenced below:
Project activities would generate emission reductions from partial or complete use of renewable reducing agents from dedicated plantations instead of fossil fuel based reducing agents in the iron ore reduction process:

- The project activity generates emission reductions through substitution of 187,900 t of mineral coke that would have been consumed per year in the baseline scenario by blast furnaces, with ca. 216,000 t of charcoal per year (see Sections B1.1 and B1.3) 100% of charcoal consumed in the project activity is renewable because it is produced with wood from dedicated plantations, listed in Annex 5.

Blast furnace technology is used in the iron ore reduction process:

- Two new blast furnaces that make part of new iron ore reduction system used in the project activity started operating in 2007 (ArcelorMittal, 2007)

- The project activity aims at the establishment of new iron ore reduction system characterized by a new investment. According to the applicability condition, the investment **type 4** is combined with the investment **types 1 and 2** within the same project boundary:

- **type 4**: Aquisition of two new blast furnaces in 2005 (PC 19-b);

- **type 1**: Charcoal (renewable agent) to be used in the production of iron and steel is produced from wood that comes from dedicated plantations that are being established as a result of investment made by the project entity (see Section B4).

- **type 2**: Approximately 20% of consumed charcoal is produced from wood that comes from the long-term binding forest outgrowth program (ArcelorMittal PPF) with small farmers' participation created and partially funded by the project entity (the contracts with small farmers will be made available to DOE). As shown in the sample contract, the implementation of plantations is characterized by a new investment and both their implementation and maintenance is under control of the project entity.

All corresponding land of the dedicated plantations within the project boundary is geographically identified:

- The renewable reducing agent (charcoal) is sourced from dedicated plantations that are under control of project participants. The list of own and outgrowth areas, both located in Brazil and destinated to production of charcoal for project activity, is provided in Annex 5. The ougrowth areas are under control of the project entity as demonstrated by a sample contract (provided to DOE).

- The dedicated plantations included in the project boundary are located only in tropical conditions, as demonstrated by geographical coordinates of these areas provided in Annex 5.

- As required by the applied methodology, the plantations in the project boundary belong to eligible categories. Plantations established on the own areas of the project entity fall in category (ii), i.e. the forest plantations after their last rotation[5]. The dates of their first establishment are listed in Annex 5, but majority of them have been planted in 70's, during the expansion period of former Belgo (see Section A2.). According to ArcelorMittal BioFlorestas Forest Management Plan (AMBio FMP), the 14-year cycle of eucalypt production is adopted: planting followed by six years of growth, harvesting at year 7, coppicing at year 8, harvesting at year 14 followed by new planting, also called reform.

- According to the plantation management practices in the region for the considered species, i.e. eucalypt , the typical cycle is composed of 2 or 3 rotations of coppicing after which the plantation site is replanted (Vital, 2009). As shown in the additionality section, these areas would not have been replanted in the absence of the project activity due to high investment costs and long payback period. Considering that the total area needed to produce the required amount of wood is approximately 82,800 hectares and the total investment per hectare is R$ 5,928.24 according to the Brazilian Agricultural Research EMBRAPA (EMBRAPA Florestas, 2003), the total forestry-related investments is R$ 490.86 million through 14 years[6].

- New plantations established in the outgrowth areas fall in category (i) grasslands, according to land eligibility study conducted by a specialized consulting company (ID 8). These plantations in frames of PPF project are covered under the A/R CDM PoA (AR-AMS0001) that will be submitted for validation in the beginning of 2011. The upstream emissions of biomass production within these plantations are accounted under the proposed PDD but they will be removed from the project boundary after the A/R CDM PoA registration[7]. As requested by the applied methodology, the first verification of this A/R CDM project activity will take place before the first harvesting of the wood takes place[8]. The DOE will 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 change of reductant in an iron ore reduction system). The dedicated biomass plantations that are not covered by the registered A/R CDM project are established through seedling.

[5] Lands that were previously stocked with human-induced forest plantations (e.g. pinus, palm trees, bamboo, eucalypt, etc.) at the end of their rotation cycle (i.e., which were harvested after their last rotation).

[6] The total planned area is divided in seven plantations that lasts an average eucalypt cycle in Brazil of seven years, resulting in fourteen years of investments.

[7] As per paragraph 38 of the of the twenty-fifth meeting of the Board decision, for the cases where renewable reducing agent is procured from a registered CDM AR project activity, project emissions are accounted within the respective project so as to avoid double counting of project emissions.

[8] 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.

- Neither renewable biomass nor the charcoal used in the new iron ore reduction system implemented by the project activity are acquired from the market. This condition is guaranteed through the continuous monitoring of origin and quantity of charcoal consumed in the project activity (see Monitoring Plan for details). Outgrowth areas that supply renewable wood for charcoal according to the long-term contracts are included in the project boundary and listed in Annex 5.

- The land areas of dedicated biomass plantations (both in the own lands and through outgrowth) are established through seedling, as stated in the Forest Management Plan of ArcelorMittal BioFlorestas (AMBio FMP).

- Flood irrigation doesn't make part of forest management practice of the project entity, , as stated in the Forest Management Plan of ArcelorMittal BioFlorestas (AMBio FMP).

- As demonstrated by the land eligibility study (ID 8), since 1989 there were no forest stocks on land where the dedicated plantations are being established.

- No blast furnace gas is recovered and used outside of the project boundary for electricity and/or heat generation in the baseline situation because the project activity is a greenfield project. The blast furnaces started operation in 2007 (ArcelorMittal 2007).

- The project scenario doesn't involve any (neither partial) consumption of the mineral coke in the project activity new iron ore reduction system. This applicability condition is guaranteed by continuous monitoring of charcoal consumption and of fuel rate (see Monitoring Plan for details). The most plausible baseline scenario is not a one using non renewable charcoal, as assessed and demonstrated in the baseline scenario identification procedure, as per the procedures presented in the corresponding section of the applied methodology.

As required by the applied methodology, the most plausible baseline scenario identified 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 fuel based.

The baseline selection and additionality procedures are performed, considering the activities of this project and the A/R CDM PoA together, so that the barrier analysis encompasses the iron ore reduction system as a whole (production of the biomass/reductant and the operation of the steel mill). The demonstration of additionality of the A/R CDM project activity complies with the requirements of the approved A/R CDM methodology AR-AMS0001. The project proponents refer to the integrated process in the two PDDs and will submit them for registration together although the crediting period of the iron ore reduction activity will only start after the first harvesting of the trees established in the context of the A/R CDM project activity.

B.3. Description of the sources and gases included in the project boundary[9]:

According to the baseline methodology, the physical delineation of the project boundary is the physical extent of the new iron ore reduction system constituted by the project activity, which includes: (i) the geographic boundaries of the reducing agents production sites (the plantation areas) and the carbonization units, (ii) the physical site of the blast furnace where the iron ore reduction process takes place and (iii) the transportation of the wood until the carbonization units and of the charcoal from the carbonization units until the blast furnace.

The processes and gases included in the project boundary of the project activity are sketched below.

[9] Section B.3. has been updated with the flowchart that illustrates project boundary, emissions soures and gases and the monitoring variables.

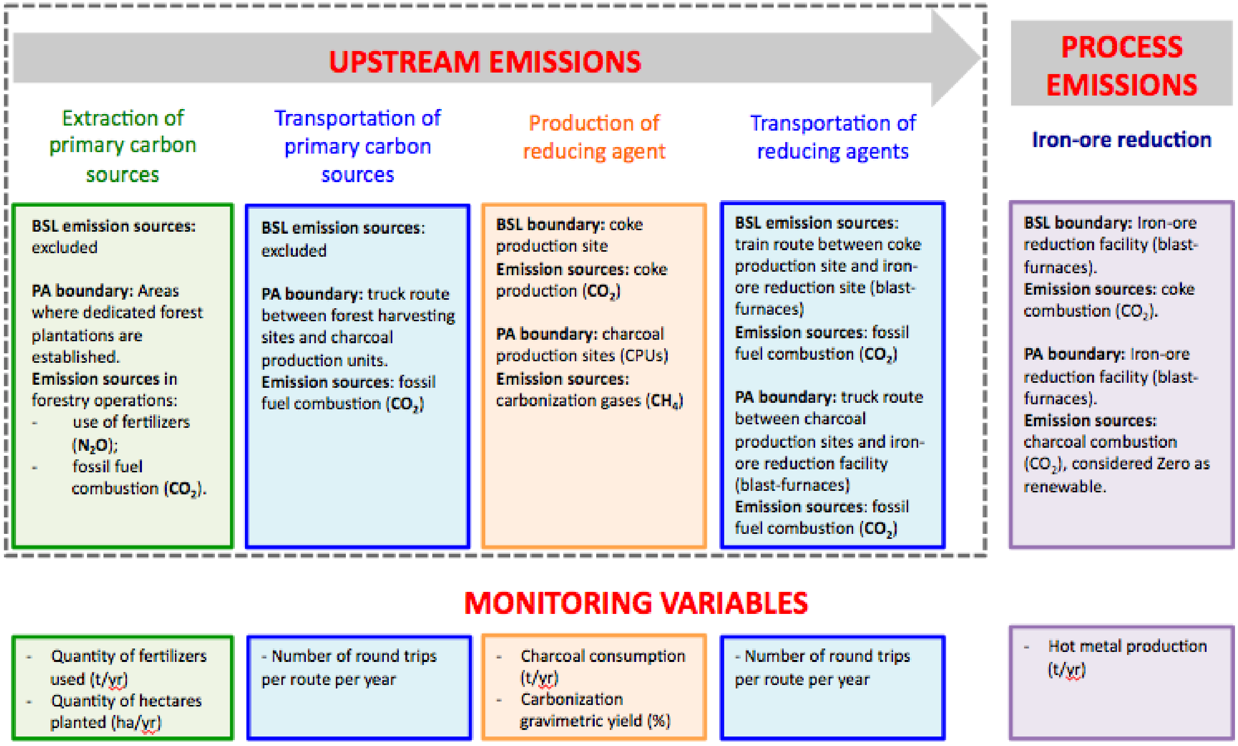


Figure 7. Project boundary, emissions soures and gases and the monitoring variables.

Emissions in the establishment of the dedicated plantations:
Dedicated plantations included in the project boundary consist of eucalypt forest plantations after their last rotation, 'reformed' by the project activity. In the absence of the project activity, such forests in the project boundary would not be replanted. Moreover, the project activity will utilize charcoal originated from *new* forest plantations, which are being established under the auspices of PPF. Hence, emission due to fossil fuel consumption and fertiliser application associated with the forestry operations of the project activity will be accounted accordingly.
Emission in the carbonization process:
CH_4 emissions in the reducing agent (renewable charcoal) production process are calculated and monitored according to the procedures of the approved methodology AM0041 "Mitigation of Methane Emissions in the Wood Carbonization Activity for Charcoal Production". They will be included in the estimation of project emissions and emission reductions.
Emissions in the iron ore reduction process:
CO_2 emissions in the iron ore reduction process are calculated and monitored. The emissions reduction conservatively account the carbon fixed in the hot metal under the baseline calculation and do not account it in the project scenario, reducing the net process emissions reduction in almost 10% of the total ERs.
Although project upstream emissions due to primary carbon (wood) source extraction and to transportation of primary carbon sources are being accounted as project emissions, as a measure of conservativeness, equivalent emissions for coal (baseline fuel) are not accounted as baseline emissions.

Table 3. Sources and gases included in the project boundary

	Source	Gas	Included?	Justification/Explication
Baseline	Iron ore reduction process	CO_2	Yes	Main source of baseline emissions
		CH_4	No	Negligible and excluded for simplification
		N_2O	No	Negligible and excluded for simplification
	Reducing agents	CO_2	Yes	Coal coke transportation emissions

	transportation	CH_4	No	Negligible and excluded for simplification
		N_2O	No	Negligible and excluded for simplification
	Reducing agents production	CO_2	Yes	Coal coke production emissions
		CH_4	No	Coal coke/charcoal production
		N_2O	No	Negligible and excluded for simplification
	Transportation of primary carbon sources	CO_2	No	Existent but conservatively neglected
		CH_4	No	Negligible and excluded for simplification
		N_2O	No	Negligible and excluded for simplification
	Primary carbon source extraction	CO_2	No	Existent but conservatively neglected
		CH_4	No	Existent but conservatively neglected
		N_2O	No	Existent but conservatively neglected
Project activity	Iron ore reduction process	CO_2	Yes	Due to the renewable biomass source and its fixation during the process, the CO_2 emissions are negative. Considered Zero for conservativeness.
		CH_4	No	Negligible and excluded because the differences in the baseline and project activity are not substantial.
		N_2O	No	Negligible and excluded because the differences in the baseline and project activity are not substantial.
	Reducing agents transportation	CO_2	Yes	Fossil fuels consumption
		CH_4	No	Negligible and excluded because the differences in the baseline and project activity are not substantial
		N_2O	No	Negligible
	Reducing agents production	CO_2	No	CO_2 emissions in the carbonization process are expected to be neutral since all the wood carbonized will come from renewable sources.
		CH_4	Yes	Biomass carbonization process
		N_2O	No	Negligible and excluded because the differences in the baseline and project activity are not substantial.
	Transportation of primary carbon sources	CO_2	Yes	Fossil fuel consumption
		CH_4	No	Negligible and excluded for simplification
		N_2O	No	Negligible and excluded for simplification
	Primary carbon source extraction	CO_2	Yes	Fossil fuels combustion in silvicultural operations
		CH_4	No	Biomass burning in the plantation establishment will not occur
		N_2O	Yes	Application of fertilizers in the planting activity.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

In accordance with the provisions of the methodology, this PDD uses the "*Combined tool to identify the baseline scenario and demonstrate additionality*", version 04, EB60, and incorporates issues that are specific to the new iron ore reduction system, as required by the applied methodology AM0082, version 01.

STEP 1. Identification of alternative scenarios

This step results in identification of all alternative scenarios that are available to the project participants and that provide outputs or services with comparable quality, properties and application areas as the proposed CDM project activity.

Considering the methodology approach based on the new iron ore reduction system, the following alternative scenarios are listed for the use of reducing agents in the project entity's metal production in the absence of the proposed project activity:

Alternative Scenario 1 - Metallurgical coke-based[10] iron ore reduction system.

> *Under this scenario, the project participant would operate coke-based blast furnaces and there would be no need to guarantee supply of charcoal.*

Alternative Scenario 2a - Renewable charcoal iron ore reduction system from wood produced in newly established dedicated plantations;

> *Under this scenario, the project participant would operate charcoal-fed blast furnaces, would opt for renewable charcoal from dedicated plantations and would establish these plantations in order to meet his own demand.*

Alternative Scenario 2b - Renewable charcoal iron ore reduction system from wood produced in existing dedicated plantations.

> *Under this scenario, the project participant would operate charcoal-fed blast furnaces, would opt for renewable charcoal from dedicated plantations and would obtain it from the market or internal plantation that already exists and will not be at its last rotation (as defined under this methodology) doesn't demanding new investment at the new iron ore reduction system.*

Alternative Scenario 3 - Non-renewable charcoal-based iron ore reduction system.

> *Under this scenario, the project participant would operate charcoal-fed blast furnaces and would opt for non-renewable charcoal from natural forests (either available on the market and/or produced by project entity).*

Alternative Scenario 4a and 4b - Iron ore reduction system based on the use of a mix of reducing agents.

a) *Under this scenario, the project participant would operate charcoal-fed blast furnaces, mixing renewable charcoal plus up to 10% of non-renewable charcoal (as per Law nº 14,309/02)*;
b) *Under this scenario, the project participant would operate the blast-furnaces with renewable charcoal mixed up to 20% of coal coke (as per regulation DN COPAM #49 of 28/09/2001).*

In this section, PPs discuss the indentified alternative scenarios and the additionality of the project activity in the context of Integrated Iron & Steel companies (IISCs), such as ArcelorMittal Brasil in its operation in Juiz de Fora.

It is important to highlight that the context of the following discussion should not be confused with that of Non-Integrated Small Pig-iron Producers (NISPPs or "*Guseiros*"), since *Guseiros* and IISCs differ from each other in the following aspects:

[10] The term coal coke is used in this document since the use of Petroleum Coke (Pet Coke) is technically unfeasible. This source of energy represents only 0.9% of total fossil fuel consumption in the whole Brazilian Industry, according to the Brazil's Initial National Communication to the UNFCCC.

- **The use of reduction agent:** IISCs use majorly coal coke and the *Guseiros* use majorly charcoal from non-renewable sources as thoroughly demonstrated in the sub-step 1a-b;
- **The management and ownership of the companies:** IISCs are public companies and the *Guseiro*s have mostly limited liability ownership;
- **The size of the companies:** illustrating the differences in the scales of IISC and *Guseiros*, one may mention that in 2002, 9 IISCs were responsible for 74% of the Brazilian pig-iron production, whereas 62 *Guseiros* were responsible for the remaining 26%;
- **The public awareness and constraints:** IISCs are worldwide known and the *Guseiros* are not;
- **The final product of the companies:** IISCs produce pig iron and/or acquire it from the market in order to produce steel and other alloys, whereas *Guseiros* produce only pig iron and sell it to integrated or semi-integrated Iron&Steel companies (the IISCs).

Sub-step 1a: Compliance with actual laws and regulations

Laws and regulations related to the use of coal coke (Alternative 1)

In the 90's the Brazilian government initiated a privatization process of all the Iron & Steel sector and on 15th March 1990 the government eliminated the laws limiting the importation of coal coke and extinguished the import tax to incentive the competitiveness and the modernization of the national industry (Crossetti, da Silva, & Garcia, 2006). Hence, legal restrictions or limitations upon coal coke imports and upon its use by the Brazilian industry do not exist.

Laws and regulations related to the use of charcoal (Alternatives 2, 3 and 4)

The production of renewable and non-renewable charcoal is regulated by the Brazilian Forestry Code, issued in 1934 (Decree 23,973/34), which was reedited in 1965 by the federal law nº 4,771/65. According to the article 21 of this law, iron mills and other companies which are based on the comsumption of charcoal or other forestry feedstoks are obligated to maintain forestry assets for its rational exploration or to form, directly or by means of entrepreneurships in which they possess equity, forests destined to their supply. The deadlines for the compliance with the abovementioned obligation ranges from 5 to 10 years. Yet, the production of charcoal using wood from natural forests without proper licenses is qualified as crime, as determined by the Decree 97,628/89.

The Minas Gerais State Forestry Law 10,561/91 replaced afterwards by Law nº 14,309/02 (Law 14,309/02 MG), requires that entities based on the consumption and commercialization of forest products observe a minimum of 90% of wood from renewable sources renewable and a maximum of 10% from non-renewable wood sources (provided that a fee is paid). If the forest products come from other states, the origin and nature of wood (i.e. renewable or non-renewable) shall be documented.

In spite of the existence of strict forestry regulations, the aspects of enforcement should be commented. In that sense, Brazil’s Initial Communication to the UNFCCC in the year 2004 (page 194) states "*The majority of the wood processed in the transformation of coal used to be harvested from natural forests, contributing to deforestation. This practice has occurred in Brazil since the colonial period, being justified by both technological and social factors.*" (BIC UNFCCC, 2004).

Several illegal schemes of commercialization of products deriving from illegal logging and falsification of licenses for charcoal production and transportation have been reported in the recent past (Viríssimo, 2007). It occurs due to the fact the human resources available to make the inspections were not sufficient to cover

the national territory. The lack of enforcement over the forestry law together to the high availability of wood from natural forests and its obvious economic attractiveness (comparing to alternatives that require investments, as the renewable charcoal) have resulted in a classic problem: illegal deforestation.

In addition, the illegal practice of logging causes not only the depletion of the natural forests but also social and biodiversity degradation due to the production of non-renewable charcoal, which most of the times leads to some highly precarious labour conditions[11] and in many cases the non-renewable charcoaling process is connected with slavery and child work practices (Ripper)[12]. The Brazilian legislation prohibits the use of precarious labour, but it can still be found mainly in the countryside, especially in agricultural, logging and non-renewable charcoal production activities, as mentioned in the reports of *Observatório Social* magazine (Veras & Casara, 2004). So, based on the abovementioned social, environmental and legal issues, the alternative scenarios encompassing the complete or partial utilization of non-renewable charcoal (Alternative Scenarios 3 and 4a) are excluded from further consideration.

The Environmental Politics Council of the Minas Gerais State (COPAM) stated in the regulation DN#49 from 28th September 2001 that "*It will be admitted the substitution of charcoal by coal coke ut to 20% of weight without the need of a new environmental license issuance*". However, the DN#49[13] is directed to Independent Small Pig-iron Producers (ISPPs or "*Guseiros*"), as explained above they are Non-Integrated Plants. It was presented the Environmental Impact Analysis, Internal Board Documentation dated prior to the investment decision and the Blast-furnaces' License of Implementation stating that only charcoal would be used. In 2004[14], there was no regulation for the Integrated Iron&Steel company to use both charcoal and coal coke in its process and so the Alternative Scenario 4b was excluded from consideration.

Outcome of *Sub-step 1a:* Only alternative scenarios 1 and 2 (a and b) comply with applicable laws and regulations. Alternative scenarios 3 and 4 (a and b) are excluded from further consideration.

Sub-step 1b: Assessment of supply and demand of reducing agents

The availability of reducing agents has a major impact for the assessment of baseline scenarios and alternatives to the project activit. Hence, the supply and demand at the time of the project implementation of reducing agents to be used in those alternative scenarios remaining after sub-step 1a will be assessed.

<u>Alternative Scenario 1</u>

As cited in the sub-step 1a above, the Brazilian economy was opened after the redemocratization and by the second half of 1990 all major iron and steel public companies were privatized, and in parallel the tax incentives for forestry plantations aimed at supplying renewable charcoal were extinct by the Federal Government along with coal coke import tax (Crossetti, da Silva, & Garcia, 2006). The Brazilian Government declared *"With the privatization, many companies integrated with the charcoal production were shut down and the process shifted to imported coal. With lower costs, over the short and medium term the use of coal facilitates the increase in scale of production"* (BIC UNFCCC, 2004). The increase in scale

[11] http://papelsocial.files.wordpress.com/2011/08/iron_2.pdf

[12] http://www.ibama.gov.br/noticias-ambientais/operacao-corcel-negro-multa-siderurgica-santa-barbara-em-r-1-milhao-no-espirito-santo

[13] http://www.siam.mg.gov.br/sla/download.pdf?idNorma=132

[14] The first IICs to use a flex-fuel blast-furnace was the VSB, which declared the investment in this new technology in 2007 http://www.abmbrasil.com.br/news/clipping/clipping_por_data.asp?dia=20&mes=6&ano=2007

also relates to technological barriers not faced by the coal coke based blast furnaces, explained in the Barrier B1d.

The National Social and Economic Development Bank (BNDES) published a paper named "Possibilities of using Brazilian metallurgical coke" (free translation from the Portuguese *Possibilidades de Aproveitamento do Carvão Metalúrgico Brasileiro)* on March 2006 informing the importance and interest of this institution in financing new researches and investments to develop a national market infrastructure to explore and to produce 13 million tons of coal per year, so the country would become less dependent on imports by the Iron and Steel Industry (Crossetti, da Silva, & Garcia, 2006) since the totality of the coal used by the iron & steel industry is imported (IAB, 2007). Coal imports totaled 18.5 and 17.3 Mt in 2004 and 2005, respectively. Imports came from Australia (28%), the United States (21%), China (19%), Canada (9%), South Africa (5%), and other countries (18%) (USGS, 2005). In spite of the dependence of the Brazilian Iron and Steel industry upon imported coal coke, a possible shortage of this raw material cannot be foressen within the crediting ceriod of the present project activity, since its availability exceeds 300 years considering the worldwide reserves and consumption (Crossetti, da Silva, & Garcia, 2006).

The high availability of coke, lower operation costs and easier control over the operations of coke-based blast furnace influenced the decision of the project proponent to substitute its four charcoal-based blast furnaces in João Monlevade unit with a coke-based blast furnace in 2000.

This trend has been recently confirmed (Reuters, 2010) by ArcelorMittal's decision to invest $1.2 billion to double output capacity at its Joao Monlevade unit to 2.4 million tonnes (CSN, 2009), based on coke. The program was suspended right after the intensification of the global credit crisis in late 2008 led to a tumble in demand for steel and other commodities around the world (SMR, 2010).

<u>Alternative Scenario 2a</u>

The availability of renewable charcoal from newly established plantations is discussed in step 2.

<u>Alternative Scenario 2b</u>

The analisys of the scenario takes in account two possible scenarios of supply from existing plantation, one is supply by the market and the second the supply internally by ArcelorMittals own plantation without using newly stablish plantation.

- Supply by the market analysis

In response to the growing demand for wood-based industries and to limit deforestation practices, a fiscal incentives program (*Fundo de Investimentos Setoriais* de *Florestamento e Reflorestamento*; Sectorial Investment Fund of Aforestation and Reforestation - FISET) was implemented by the national government under the law 5106, in September 2nd, 1966. FISET aimed at the stimulation of the establishment of forestry plantations mainly for suppling paper and pulp and iron and steel industries (Pereira). After the end of the program in 1988, declining trends in plantation activities were observed in the state of Minas Gerais (Figure 8), which historically dominated the Brazilian forestry plantation sector, especially in terms of plantations for charcoal supply. The decline of forest plantations concomitant with the increase of production of pig-iron industry in Brazil (247% in the last 20 years prior to the project implementation) elicited a defict in eucalypt forest plantation (SBS, 2003), as illustrated by Figure 8 and Figure 9, respectively.

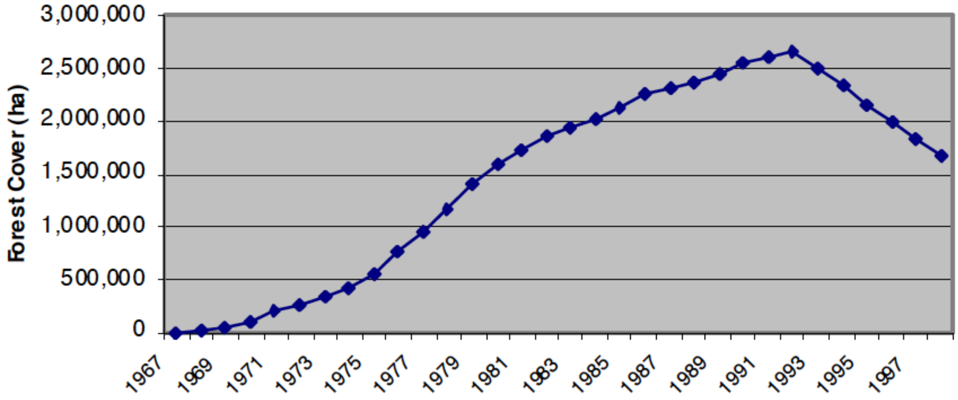


Figure 8. Historical development of forest plantations in Minas Gerais state. Source: IPEF, 2000

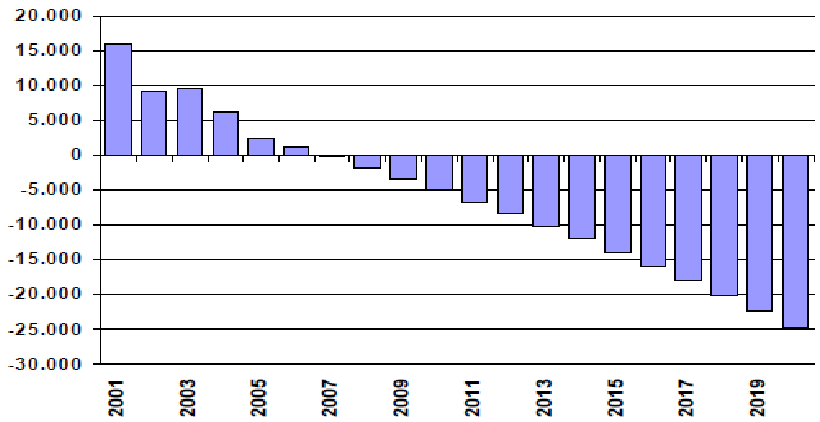


Figure 9. Available biomass from eucalypt plantations for the wood-based industries in Brazil in m^3/year (Source: AMS, 2009)

Historical and current data demonstrate that in spite of cyclical fluctuations in charcoal consumption – in this case a function of charcoal-based iron demand – plantation deficit is a trend of the next years in the Minas Gerais state (AMS, 2009) as shown on Figure 10. The most frequently mentioned causes for the "forestry blackout" are: lack of adequate debt funding, inadequate long-term policy, high interest rates in Brazil (FDC, 2004), complex environmental policy and plantation legislation, and the prevalence of perverse social-economic incentives to use non-renewable native wood sources due to lack of enforcement, which is a common conclusion found in scientific literature and published reports (BIC UNFCCC, 2004; Veras & Casara, 2004).

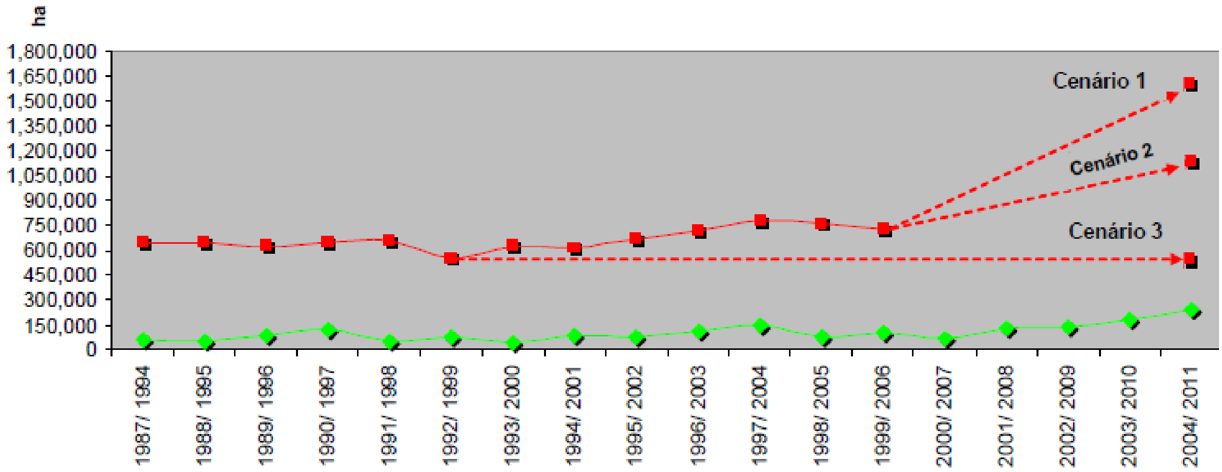


Figure 10. Comparison between (i) the ex post consumption of reducing agents expressed in equivalent plantation area and (ii) effective planted area, as per the seven year rotation of eucalypt (Brazil). Source: Research on AMS; SINDIFER, 2006.

In accordance to the National Social and Economic Development Bank, the charcoal industry is currently the most affected by the ever increasing demand for wood sources, given the near exhaustion of the forest plantations established under the fiscal incentives, and the lack of new plantations (AMS, 2009; SBS, 2003).

- Internal supply without new investment

The methodology AM0082 at its Definitions, stated that "**NewIronOreReductionSystem**. An iron ore reduction system that results from a new investment (see eligible types of new investments in the applicability conditions section) undertaken in at least one of its two interdependent components, i.e., the production of reducing agents (Component 1) and the iron ore reduction facility (Component 2)", and also states at its applicability conditions that "The eligible types of new investments for projects under this methodology are:

Type 1: Production of reducing agents to be used in the production of iron and steel by investing in dedicated plantations by the project entity; ……"

The definition of dedicated plantation as per the methodology is "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 mustbe newly established as part of the project activity". Also in applicability conditions the methodology lists the type of areas that are eligible as áreas for newly dedicated plantaion as "Grasslands; (ii) Forest plantation after its lastrotation; (iii) Degraded areas". The methodology also defines: "Forest plantation after its last rotation. Lands that were previously stocked with human-induced forest plantations (e.g., pinus, palm trees, bamboo, eucalyptus, etc.) at the end of their rotation cycle (i.e., which were harvested after their last rotation)."

Continuing the applicability conditions, the methodology states that "In case the plantation is implemented on land previously hosting a forest plantation after its last rotation, it shall be demonstrated that this land would not be replanted in the absence of the project activity. In order to demonstrate that a forest plantation is in its last rotation, the project proponent shall refer to the plantation management practices which are common practice in the region for the considered species."

As informed in page 15th of this PDD, at 3rd bullet: "Plantations established on the own areas of the project entity fall in category (ii), i.e. the forest plantations after their last rotation. The dates of their first establishment are listed in Annex 5, but majority of them have been planted in 70's, during the expansion period of former Belgo (see Section A2.). According to ArcelorMittal BioFlorestas Forest Management Plan (AMBio FMP), the 14-year cycle of eucalypt production is adopted: planting followed by six years of growth, harvesting at year 7, coppicing at year 8, harvesting at year 14 followed by new planting, also called reform." The 4th bullet complements the rationale stating that: "According to the plantation management practices in the region for the considered species, i.e. eucalypt , the typical cycle is composed of 2 or 3 rotations of coppicing after which the plantation site is replanted (Vital, 2009)."

This PDD, at its step 2 - Barrier Analysis, demonstrates that those lands would not be replanted after its last rotation in the absence of project activity, showing that the most plausible scenario is to use coke in pig iron production.

Therefore, it is demonstrated that existing forest plantation of ArcelorMittal Bioflorestas can be categorized as forest at its last rotation that is a scenario of a new investment so shall be considered as a scenario 2.a, demonstrating that scenario 2.b tha involves internal plantations of ArcelorMittal Bioflorestas can be excluded.

In order to complement the analysis, we present bellow a simulation of using forest plantation after its last rotation as a source of wood for charcoal production.

As evidenced by the "Comodato - 22/2003" contract between Belgo and CAF signed on 01.09.2003 the total area of forest plantations used for charcoal production by the company was 97.605,14 hectares at the moment of project decision. This plantations are in a stage of "forest in exhaustion" having been managed already for 20 or 30 years for wood production. Therefore we assume a productivity of 17,2 m^3 (mean annual increment) for forests in exhaustion at the end of their last rotation for this area.

As stated by Marcus H.F. Vital (2009) p. 88, the Brazilian forest research institute (IPEF) identified a productivity loss of 30% per rotation period, for forest plantations in case no fertilization (which is one of the most important measures and expense in forest plantation management) is applied.

As evidenced in excel sheet "Plantation supply Calculations – Juiz de Fora", the yearly pig iron production capacity of the project blast furnace of 360.000 t can be transformed to a yearly charcoal demand of the projects industrial unit of 213.840 t applying the blast furnace consumption factor of 2,7 used in PDD. This factor can be considered as a conservative value, since Marcus H.F. Vital (2009) p. 97 indicated a higher factor of 3,8. Applying this factor a supply shortage would already occur in 2003.

The simulated scenario below, where the exhausted plantations of the company would be used in order to supply the charcoal demand of the blast furnaces of Juiz de Fora, is shown in Table 4 for one rotation period of 7 years, from 2003 (project decision) on, until 2009. The productivity loss without fertilization leads to a supply capacity for the blast furnaces assuring still 106,0 % of the demand in 2006 (year of industrial operation start) but decreasing to 82,4 % of the demand in 2009 leaving a supply deficit of 37.565 tons of charcoal.

Therefore the simulation clearly shows, that even if the companies forests in exhaustion would be used to supply the blast furnaces, considerable additional investment would be necessary in planation management (fertilization, ant combat, replanting, etc) as well as investments in additional plantations, configuring the scenario 2.a.

Table 4 - Supply simulation of company forest plantations

Charcoal production capacity (ton)**	Year	Supply capacity of 97.605 ha	Yearly deficit of charcoal without PP's investment (ton)
251.821	2003	117,8%	37.981
239.230	2004	111,9%	25.390
226.639	2005	106,0%	12.799
214.048	2006	100,1%	208
201.457	2007	94,2%	-12.383
188.866	2008	88,3%	-24.974
176.275	2009	82,4%	-37.565

** Calculation considering: Wood density = 0.5 (ton/m^3) and Gravimetric yield = 0.3 tonne charcoal/ tonne wood

The finding of the analyses conducted in the sub-steps are summarized in Table below:

Table 5. Defined realistic scenarios

Alternative Scenarios	Description	Step 1a: Compliance with mandatory applicable laws and regulations	Step 2a: Assessment of supply and demand of reducing agents
1	Metallurgical coke-based iron ore reduction system	Compliant	Raw material available
2a	Renewable charcoal iron ore reduction system from wood produced in newly established dedicated plantations	Compliant	Raw material available
2b	Renewable charcoal iron ore reduction system from wood produced in existing dedicated plantations	Compliant	Raw material not available
3	Non-renewable charcoal-based iron ore reduction system	Not compliant	Not assessed
4a-b	Iron ore reduction system based on use of a mix of reducing agents	Not compliant	Not assessed

Outcome of Step 1: Based on national and state legislation, it is not legal to use non-renewable charcoal produced from natural forests to supply the iron production in industrial scale. Therefore, the alternative of using non-renewable charcoal (Alternative 3 and 4) was eliminated from further consideration.

Analyzing the use of biomass from existing plantations, it was possible to conclude that the availability of biomass in the market is not enough to supply the demand of the wood sector and mainly to fulfill the increasing charcoal production needs (Alternative 2b) and so this alternative is also eliminated from further consideration.

STEP 2. Barrier Analysis

Step 2. Barrier Analysis

Sub-step 2a: Identify barriers that would prevent the implementation of alternative scenarios

As result of the previous alternative analysis, the remaining alternatives are:

Alternative Scenario 1 - Coal coke-based iron ore reduction system (Alternative Scenario 1);

Alternative Scenario 2a – Iron ore reduction system based on renewable charcoal from newly established dedicated plantations and from reformed existing plantations at their last rotation;

The barriers analysis was conducted as per guidance provided by AM0082/Version 01, and the "*Combined tool to identify the baseline scenario and demonstrate additionality*", Version 04, following the steps outlined below.

Sub-step 2b. Eliminate alternative scenarios that are prevented by the identified barriers

B1. Investment barriers

Alternative Scenario 1

There is no need of capital for investment to produce the reducing agent due to the fact that there is an established market where it can be promptly obtained and the pig-iron sold rapidly pays the raw materials and human resources applied in the process. The risks (e.g. logistical structure, scale) associated to the operation of a pig iron production based on coal coke are marginal comparing to investments made in establishing forest plantations (further described in the sections below).

In addition to that, coal reserves worldwide are estimated in >847 billion tones, which suffice for approximately 119 years of consumption at the current rates. Moreover, coal reserves are available in almost every country worldwide, with recoverable reserves in approximately 70 countries (Worldcoal).

Many facts support a coal coke-based industry. Between 1994 and 2006, the iron and steel industry in Brazil benefited from the Brazilian program for modernization and from tax incentives to import coal and coke. Theses incentives resulted in the scale growth of the sector. For instance, investments on the sector reached USD 19 billion and more than USD 35 billion will be invested with priority to coal coke-based production capacity increase (IAB, 2007). Moreover, other sources indicate investments in the order of USD 82 billion in coal coke-based iron and steel production (CSN, 2009).

In the other hand, the incentives mentioned above caused sharp decreases in the consumption of charcoal in integrated steel industries: the yearly consumption dropped from 11.3 to 3.8 millions m^3 (Δ = -66%) during the period between 1988 and 2000 (Monteiro). It is noteworthy the fact that such charcoal consumption decrease is not related to a corresponding reduction in the production of pig iron. Quite on the contrary, pig-iron production by integrated steel industries increased 15.14% in the same period (IAB, 2007).

In light of the facts presented above, one concludes that alternative scenario 1 faces no Investment Barriers.

Alternative Scenario 2a

The establishment of forest plantations requires significant investment with overwhelmingly long Payback Periods. In spite of the productivity of eucalypt plantations in Brazil being considered one of the best in the world (SIF, 2010), the first harvest for most economic uses, including charcoal, occurs 6 to 7 years after the establishment of the plantation (Sturion , Pereira, & Chemin, 1988). Therefore, primary revenues are obtained at least 7 years after the first disbursements.

Such upfront investments are unattractive in comparison to the use of readily available fossil fuels. For instance, adding difficulty in the establishment of industrial forests, in Brazil, investors face high real interest rates. These interest rates are sustained by a strict monetary policy implemented in the early 90's, which aims at curbing inflation.

Moreover, the Brazilian macroeconomic environment adds difficulties to decision-making process for long-term investments, such as the forestry component of the project activity. In that sense, long-term forecast or the establishment of probabilities in regards to key indicators of the Brazilian economy, including those indicators affecting a forestry-based project, is elusive. This fact is indicated by the instability in the historic series of data pertaining to some of the main Brazilian macroeconomic indicators, as depicted in the table below:

Year	Macroeconomic Indicators			
	Inflation - IPCA (%)	R$/US$	GDP (%)	Trade Balance (US$ Million)
2000	5,9743	1,9546	4,3062	-697,7475
2001	7,6733	2,3196	1,3131	2650,4670
2002	12,5303	3,5325	2,6581	13121,2970
2003	9,2999	2,8884	1,1466	24793,9241
2004	7,6006	2,6536	5,7123	33640,5407
2005	5,6897	2,3399	3,1597	44702,8783
2006	3,1418	2,1372	3,9710	46456,6287
2007	4,4573	1,7705	5,6673	40031,6266

Source: Institute of Applied Economic Research (IPEA)

Another example of the instability of macroeconomic indicators is provided by the evolution of the Special System of Clearance and Custody rate (SELIC rate**)** the main reference for interest rates in the country, which is determined by the Monetary Policy Committee (*Comitê de Política Monetária* - COPOM) and a strong instrument of monetary policy in Brazil.

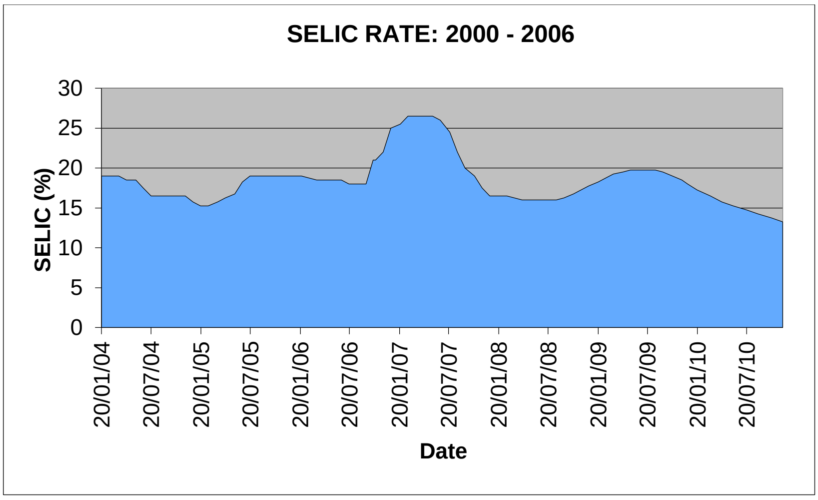


Figure 11. Variations in the SELIC rate (2000-2006) ***(Source: IPECE, 2007)***

The chart above makes the significant variations in the SELIC rate evident. It reached a minimum of 13.25% per year in 2006, and a maximum of 26.5% per year from February to May, 2003, with an annual arithmetic average of 18.5% to the period.

Large debt financing lines with long-term characteristics would alleviate the upfront investments required in projects such as the project activity. In fact, there are several financing mechanisms for forest plantations in Brazil, available in the Ministry of Agrarian Development (*Ministério de Desenvolvimento Agrário* - MDA) and in the Ministry of Agriculture, Livestock and Supply (*Ministério de Agricultura Pecuária e Abastecimento* - MAPA), which are operated by federal banks like Development Bank of Minas Gerais (*Banco de Desenvolvimento de Minas Gerais* - BDMG). The main credit lines are the Commercial Plantation and Forest Recovery Program (PROPFLORA – *Programa de Plantio Comercial e Recuperação de Florestas*) and the National Agricultural Family Strengthening Program (PRONAF – *Programa Nacional de Fortalecimento da Agricultura Familiar*).

Another important source of capital are the Constitutional Funds for regional development (Constitutional Funds for the North – FNO, Constitutional Funds for the Center-West – FCO and Constitutional Funds for the Northeast – FNE). The amounts disbursed by these funds usually meet states in the Amazon Region. Since the proposed project is located in the Southeast region, these funds are not applicable to the project activity.

At the time of the decision-making, the main financing sources available for the establishment of planted forests in Brazil were PROPFLORA, PRONAF and Constitutional Funds (this source must be excluded from the analysis as it contemplates different regions than the project activity's) (ABRAF, 2006).

Through PRONAF Forest, Federal Government aims to support sustainable forest activities, such as agroforestry systems and native forest management, which requires incentives different from those needed in silviculture. Moreover, the reduced financing value of PRONAF Forest (R$36,000.00 cap) is insignificant in relation to the required investments of the project.

PROPFLORA aims at the implementation of livestock and silviculture projects (cattle ranching and forest) and agroforestry projects and at the recovery and maintenance of permanent preservation and legal reserve areas. PROPFLORA is only suitable for small farmers that desire to get involved in industrial wood production. It provides loans of up to 144 months duration, with either semestrial or annual payments. For reforestation activities for industrial use, PROPFLORA guarantees an interest-only period until the first harvest; for reforestation for other uses it allows 12 months of interest-only period. The figure below shows its resources availability and disbursements during the period between 2002 and 2008:

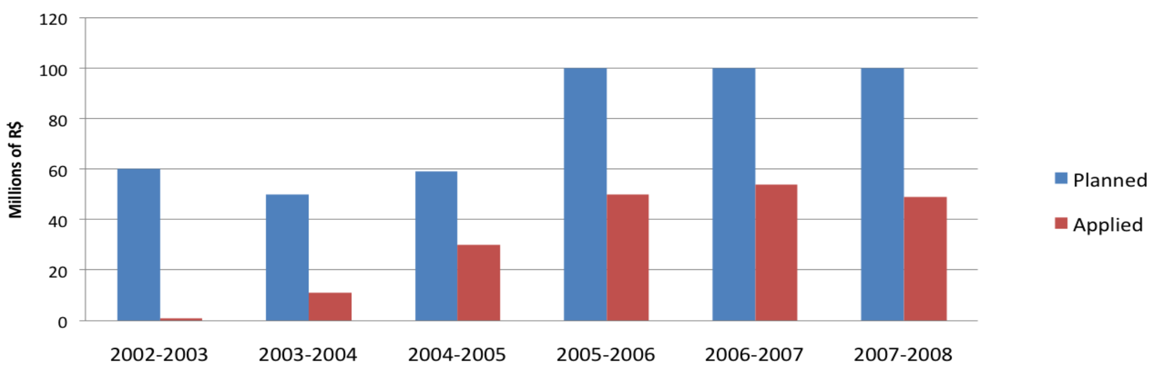


Figure 12. Planned and applied financial resources of PROPFLORA in 2002 – 2008
(Source: Brazilian Ministry of Agriculture)

As it can be seen, only half of available resources were applied demonstrating the difficulties and inefficiency of the program for potential forestry projects. In addition to that, the total amount disbursed is not very representative in terms of large scale projects (e.g. the amount disbursed in 2005 and 2006 was around R$ 50 millions), as the required investments for the forestry base of the related project is around R$ 490.86 millions (further analyzed in this section).

The newly established plantations to be used in the project activity, developed under the auspices of PPF, are located in the region known as *Zona da Mata.* In this region, historical land use resulted in exhausted and partially eroded soils (Souza, 2006), being considered one of the least productive regions in the state (Souza, Toledo, & Filho, 2009). *Zona da Mata* is typically occupied by small and medium farmers that traditionally produced milk and coffee, i.e. are used with faster cash-flow in their economic activities and have no experience with commercial plantations. The lack of previous experience in eucalypt cultivation and their inability to provide loan guarantees renders the above-mentioned incentives inaccessible to independent small farmers from *Zona da Mata*.

As demonstrated previously the scenario for Alternative 2a regarding investment barriers is very deficient and could strongly prevent the occurrence of the project activity, as the required capital would not be obtained. The conclusion regarding this alternative without the CDM incentive is that there is no credit line available that combines a significant amount of required capital with a financing model that supports weak characteristics of the project such as guarantees, return in the long term, high forestry risks, lack of technical expertise, technology and others. This leaves as only option that the required capital would have to be achieved through equity capital and the shareholders would have to absorb all forestry risks and would have a large amount of capital and asset destined to an activity other than the core business (Steel) and that has a overwhelmingly long payback.

Due to all these difficulties for the implementation of the project activity the CDM became a fundamental driver favorable to the occurrence of the project activity and was seriously and continuously considered by ArcelorMittal's decision makers (further discussed in item B.5. and supported by numerous evidences) for two main reasons:

A. Alleviating the negative cash flows in the initial 6-7 years of the project, financing part of the project activity, shortening the long payback period and forestry associated risks;
B. Promoting the outgrowth program, which is fundamental for achieving the required wood production and for reducing capital expenditures of land acquisitions.

In financial terms, CER revenues are a fundamental decision driver to ArcelorMittal, since the large-scale investment and long payback of the project generates a negative cash flow in the first 6-7 years of the project. Such negative flow is reduced by CER revenues, which represents an amount of a total income of R$ 108.02 millions (considering the RIMA scenario elaborated in 2004 of 3 renewable period of seven years and a CER price of USD 4[15]). This amount is very significant if compared to the investments required in project activity (Forestry-related investments is R$ 490.86 million through 14 years[16] and investment in blast furnaces is R$ 77.28 millions (PC 19). For that reason, the CER revenues can alleviate the lack of debt financing structure in Brazil (calculations can be seen at spreadsheet "Arcelor - Investment Barriers").

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[15] The Environmental Impact Report (RIMA) pertaining to the installation of the blast furnaces in Juiz de Fora documents the CERs price range expectation at the time of investment decision: USD 3.00 to USD 5.00 per CER and R$/USD 2.852 (mean of exchange rates from the Brazilian Central Bank).

[16] The total area to produce the required amount of wood is approximately 82,800 hectare and the total investment per hectare is R$5928.24 according to the Brazilian Agricultural Research Corporation's - EMBRAPA (source: (EMBRAPA Florestas, 2003). The total planned area is divided in seven plantations that lasts an average eucalypt cycle in Brazil of seven years, resulting in fourteen years of investments.

In the study of potential CDM projects at CAF Santa Barbara, PwC pointed out a forest outgrowth scheme as an alternative to obtain the necessary wood for charcoal production for AMJF industrial facility. The program assists farmers in overcoming significant barriers previously mentioned that would prevent them from carrying out forest cultivation, thus, making possible the establishment of new plantations dedicated to the project activity. For instance, in order to stimulate the participation of farmers into in the program, PPs assisted the creation of the Cooperative of Farmers/Producers of Sustainable Planted Forest (COOPFLOS) in *Zona da Mata*. By means of COOPFLOS, carbon credit incomes may be anticipated to its members. In that sense, COOPFLOS is the first Brazilian farmer cooperative aimed at carbon credits related activities.

When structuring the reforestation program, the project proponent considered four models of carbon credit distribution, as suggested by PwC (PPF/PwC, 2005):

- Model 1: 100% of carbon credits belong to the project proponent, this would guarantee better price of wood for farmer;
- Model 2: 50% of carbon credits belong to farmer. Arcelor has the right to buy the credits of farmer under market price;
- Model 3: 100% of carbon credits belong to farmer. Arcelor has the right to buy these credits for pre-determined price.
- Model 4: 100% of revenues from carbon credits sell would be dedicated to socio-economic projects such as recuperation of degraded areas, forest certification etc.

Model 2 was adopted, since it is the most interesting from the point of view of both the project proponent and the forest farmers, as both share CDM revenues. As requested by farmers, in order to guarantee their rights for carbon credits, the item regarding farmers' rights for carbon credits was included in the official contract between farmers and ArcelorMittal BioFlorestas that will be made available to DOE.

In Table 6 below, there is a list of the main barriers related to the project activity to the small farmers and how they are overcome:

Table 6. Barriers for small farmers and how they are overcome in the Outgrowth Program

Access to credit	The only forestry-oriented credit line available for farmers from the project region is Propflora. Members of COOPFLOS have access to financial resources of this credit line through the agreement that the project proponent signed with the bank responsible for concession of BNDES funds. The project proponent is at the same time the loan Guarantor and principal Financial Responsible, overtaking all risks of the reforestation activities. Usually, the loan guarantee involves possession of property, i.e. in case of some failure of wood production the farmer loses the property. For farmers with no experience with eucalypt the risk of failure is often considered too high, thus turning unreasonable a decision to start silvicultural activities. In the absence of the project activity and, consequently, of the outgrowth program, the participating would not be able to use this credit line due to the barriers and would not have any other option to obtain investment capital for reforestation activities.
Environmental compliance	To be eligible for a loan, an applicant farmer must be in compliance with environmental legislation, i.e. have demarked Reserva Legal and APP areas at his property (Propflora, 2010). This process involves an excess of bureaucracy, making it very complicated for a small farmer with no experience of dealing with government environmental agencies. The forest program solves this barrier by providing all technical and juridical assistance to farmers on the delimitation of special protected areas and on the representation of their interests in communications with responsible environmental agencies.

	According to internal registries of the project entity, no participating farmer had these areas delimited at the moment of first contact with the project entity. As discussed in the Regulatory Barrier below.
Loan conditions	Propflora credit line considers productive cycle of eucalypt and has a grace period of 96 months (Propflora, 2010). Although, it doesn't consider a possibility that applicant cannot sell produced wood: it doesn't accept payment in product (wood) neither can it extend the deadline for payment. This barrier turns to be very restrictive for a farmer if he doesn't have a signed contract for future purchase of wood. In forestation program, besides the project entity is responsible for all payments (interest, delay fees etc.) it guarantees the future purchase of wood so that participating farmer doesn't face the risk of indebtedness with bank.
Technology and know-how	A small farmer wishing to establish a commercial eucalypt plantation usually faces a difficulty to find the proper technical assistance and quality planting material. As the project region doesn't have a tradition of planted forests, consequently there are neither skilled workers, nor a proper technology and infrastructure to execute and maintain the plantations. Thus, even in case of available financing mechanisms, it is operationally impossible for a small farmer to establish new plantations because the technical assistance should be brought from outside the region, which turns such project much more complex. Within the frames of the proposed program, the Executing Entity develops local forestry companies to provide high-quality services to farmers. Besides, this entity provides farmers with the best planting material to guarantee high productivity of the forest plantations.

In light of the fact presented above, one concludes that Alternative 2a faces financial barriers that could prevent its implementation. Moreover, these barriers are alleviated by the CDM.

The reasons of risk increase accounting in the small farmers environmental non-compliance with laws and regulations are going to be presented and discussed in the Regulatory Barrier below.

B2. Regulatory barriers

According to the Brazilian laws, entrepreneurships, such as those under an iron ore reduction system, must apply for environmental licensing prior to their implementation and operation stages. The absence of an environmental license, in spite of the real polluting or damaging impact of an entrepreneurship, is considered a crime. In that sense, any delays or refusal by the environmental agencies in license issuance or renewal, as well difficulties in complying with the requirements established by these agencies during the course of the licensing process may threaten, or even derail, the installation, operation and expansion of new or ongoing projects (Gerdau; Ecoa, 2005). This is particularly the case of Minas Gerais, whose environmental legislation (DN COPAM 74/04[17]) is known as one of the most severe in the country (as in Brazil, the state have authority to strict but not to flexiblize the environmental legislation)..

A federal legislation about Legal Reserve in rural lands was signed in 23rd January 1934 by the decree nº 23,793 It was the First Forest Code, which divided the rural land in 2 areas, the exploration area and the preserved area (Legal Reserve) which represented 25% of total area.

[17] DN COPAM nº 74/2004 - http://www.siam.mg.gov.br/sla/download.pdf?idNorma=5532 *(accessed on 15/08/2011).*

The called Second Forest Code was signed in 15th September 1965 by the Law nº 4,771 and defined the Legal Reserve was defined as 20% of the total land area in the South, Southeast and in the south of the Middleeast of Brasil, where the most part of the small farmers involved in the project activity is located, and 50% of the total land area in the North and in the north of Middleeast. No mention was done related to the Northeasteast macro-region of Brazil at that time. Nowadays, it is 20% of the total land, which in most of small farmers cases is unfeasible to achieve.

However, the Forest Code was never followed, as presented in the Table 5 above in "Environmental compliance" section, and it results into more expenditures with project activity implementation. In the state Minas Gerais and Bahia, where the project plantations were established.

The percentual of farmers with Legal Reserve registered is respectively 10.70% and 2.01% of the states in terms of quantity of existent farmers terms and in terms of total rural area it is 4.92% and 3.26%, which increases the risk of increasing the cost and/or failure in the project activity implementation. On the average, only 7.04% of the Brazilian properties have their Legal Reserve registered at INCRA (National Institute for Colonization and Agrarian Reform)[18].

The studies show that for many small farmers, the Legal Reserve registration is:

- From an economic point of view, an enormous burden to immobilize such extensive areas.
- Not respected due to no environmental agency (federal or state) is endowed with financial and human resources to perfrom efficient surveillance on the rural properties of the country[19.]
- A loss of opportunity costs inherent to the use of soil;
- A costly task as all the expenses have to be covered by the land owner[20].

A qualitative research published by the Brasilia Federal University (UnB)[21] makes clear the actual situation in the rural areas related to the Legal Reserve (LR) and native vegetation conservation and/or recuperation through the results of a survey applied in conventional farmers, as presented below:

• Do you know about Legal Reserve?	4% answered YES.
• Do you think 20% of area for LR too small?	0% answered YES.
• Do you think plantations and reforestation could take place as LR?	4% answered NO.
• Would you make a loan for recuperation of the LR?	77% answered NO.
• Do you know the LR registration is obligatory?	66% answered NO.
• Have you tried to register the LR?	83% answered NO.

To complement the argument, the same article shows that 40% of the farmers state that there is no Legal Reserve area available in their farm, 80% has no intention of recuperating it and even among the farms which there is LR, around 40% of them it is smaller than the law declares it shall be.

The loans to invest in plantation is only approved due to the fact the project proponent is at the same time the loan Guarantor and the principal Financial Responsible. The PP pays the Legal Reserve delimitation and registration, overtaking all risks of the reforestation activities, also it gives technical support to the small farmers and pre-purchase their planted biomass, as disccussed in the Alternative 2a.

[18] Table 1 and 2 pages 193-194 - http://ageconsearch.umn.edu/bitstream/56831/2/REA_Artigo3_V1N2_2003.pdf (*Acessed on 15/08/2011)*
[19] Bacha, C.J.C. Efficacy of Legal Reserve Policy in Brazil.http://www.sober.org.br/palestra/12/06O368.pdf (*Acessed on 15/08/2011)*
[20] Environmental Policy: An evaluation of the Legal Reserve efficacy. www.alasru.org/.../14%20GT%20Claudinei%20Antonio%20Rigonatto.pdf (*Acessed on 15/08/2011)*
[21] http://www.fazendeiro.com.br/Cietec/artigos/ArtigosTexto.asp?Codigo=368, accessed on 07/06/2010.

As presented to DOE, the official amount of forest plantations on Minas Gerais state was enlarged by 85,000 ha in 10 years (between 2000-2009), but the Brazilian Forestry Association (ABRAF) published that, during only four years (between 2005 – 2009), the total area of planted forests in Minas Gerais increased by 170,826 ha. This shows that a large part of the existing planted forests is not licensed to the present day. It is important to emphasize that the increase in the plantation's area does not mean that all the areas have a license and so, it represents a major barrier to implement charcoal based blast-furnaces.

There are 3 environemntal licenses do be obtained during the project life cycle, the Previous License (LP), the Installation License (LI) and the Operational License (LO), following the Steps below to achieve:

1. Filling out of the document FCE
2. Emission of the document FOBI
3. Present request documentation for formalization of the process
4. Environmental Agency Analysis
5. Auditing
6. Complementary Informations requested
7. Technical Opinion
8. Environmental Agency Votation
9. Environmental License Issuance
10. Repeat the Steps 3-9 for the issuance of the LI and LO, when more documents are requested.

The documentation cited in the Step 3[22] is the detailed below and apply to the Scenarios 1 and 2a:

EIA/RIMA – A detailed Environmental Impact Analysis (EIA) and Enviromental Impacts Report (RIMA).

Environmental Control Plan and Report (CPA and RCA) – A detailed data of parameters used to measure and prevent environmental impacts caused by the project activity implementation, as well as to implement corrective actions and opportunits of improviment.

Assessment Report of Environmental Performance of the Control System of Mitigation Actions (Rada) – has the finality of giving subsidies to the analysis of revalidation of the Operational License (LO) according to the article 3º of the DN 17/96and works as part of the EIA/RIMA.

Authorization for any kind of water use - law 13.199/99 – State Act of Water Resources Management;

As previously mentioned, an iron ore reduction system encompasses the obtainment of primary carbon sources, the production of the reducing agents, and the iron ore reduction facility. However, licensing process for obtainment of primary carbon sources (coal or charcoal) and in the production of the reducing agents significantly differs in the two alternative scenarios. The charcoal based scenario have to obtain specific rural licenses for its own rural area, for the small farmers and to the process of carbonization the biomass into charcoal.

Alternative Scenario 1

Used as source of primary carbon, the coal, is extracted overseas and the production of reducing agents (i.e. coal coke) would take place in the existing coking facility *ArcelorMittal "Sol" Coqueria*. Therefore, no

[22] http://www.meioambiente.mg.gov.br/licenciamento/369?task=view *(accessed on 15/08/2011).*

additional environmental licensing would be needed for the components of the iron ore reduction system of this alternative scenario as only the Juiz de Fora blast furnace would need a license.

In the Alternative Scenario 1, there is low initial cost for licensing compared to the land, iron ore reduction facility and in the plantation of the Charcoal based production (as discussed in Investment Barrier above), and also no compromises with banks loans, environmental agencies and with the small farmes, only to cite some direct stakeholders, has to be assumed by the PP. Also, it is not necessary to spend time to develop such activity for coke, supplied by the market, when compared with the licensing processes necessary that charcoal based production depends to the implementation of dedicated forest plantation and charcoal production.

Alternative Scenario 2a

Includes the establishment of new eucalypt plantations, the reformation of exhausted eucalypt plantations and the installation of charcoaling facilities, their corresponding environmental licensing requirements may pose regulatory barriers to its implementation. It is noteworthy that requirements in the environmental licensing for forest plantation are acknowledged as being stricter than those for other agribusiness sectors (Vieira, 2008).

The licensing process in the Minas Gerais state follows, in both Alternative Scenarios, the Normative DN COPAM 74/04, which establishes the sequence steps for licensing and necessary documentation to the license issuance, as evidenced to DOE.

While in the Alternative Scenario 1, only 1 environmental licenses would be necessary to be issued, the Alternative Scenario 2a requests permits not only for the blast furnace but also for forest plantation and charcoal production. In the case of forest plantation, ArcelorMittal depends on the environmental adequacy of the small farmers included in the project activity.

In the Alternative Scenario 2a, besides the blast furnace environmental licenses, it is necessary to issue more 6 specific licenses for rural areas has to be issued, which represents a large expenditure of time, human resources, documentation, trips, development of georreferenced maps, and other related cost. Due to the regulatory barrier faced by the project ativity, the Scenario 2a has a much higher risk of failure and the CERs revenues act as an extra income to encourage overcoming the regulatory barrier.

Specific Environmental Licenses for rural enterprises, which are not necessary only for charcoal based iron ore reduction facilities (Scenario 2a), as they use forestry raw materials:

Rural Land Registry – presenting the caracteristics of the geography and only possible to adquire if there is Legal Reserve and Permanent Protection Area delimited.

Term of Legal Reserve Area - law 14.309 from 19/06/2002 and Decree nº 43710 from 08/01/2004;

Permanent Proctetion Area - law 14.309 from19/06/2002 and Decree nº 43710 from 08/01/2004;

License of interfere in native areas – law 14.309 from 19/06/2002 and Decree nº 43710 from 08/01/2004;

License for change in the land use - law 14.309 from 19/06/2002 and Decree nº 43710 from 08/01/2004; For any change in the land use, it is necessary to present a Plano of the Intention of Use approved by the FEAM, as defined by the Portaria 19.187/2005;

License for the exploration of planted area - law 14.309 from 19/06/2002 and Decree nº 43710 from 08/01/2004**;** The harvest and trade of products and subproducts originated from planted areas rely on previous communication to IEF (State Institute of Forest of Minas Gerais), through the "Declaration of Harvest and Trade", defined by the Portaria 191/2005. A payment fee of R$ 1.20 / m^3 of wood has to be made to IEF during land exploration in order to follow the law (ID 7).

Specific requirements for the project activity's Environmental License issuance:

- License for fertilizers use and its packs destination;
- Quantitative and Qualitative Monitoring of ground and freshwater in the project region;
- Atmospheric Emissions Monitoring - CONAMA 03/1990 and COPAM 01/1981 and 01/1992;

To implement the Alternative Scenario 2a, the PP needed to pursue 1 license for the blast furnace (the same as in the Alternative Scenario 1) and additional licenses to the implementation of the forest plantation and carbonization units, transportation, and for the 198 small farmers properities involved in the project activity biomass supply (with 6 specific licenses to obtain each one). As demonstrated in the discussion above, in Brazil the farmers has low interest in regularizing its land and follow the legislation to guarantee the Legal Reserve. The CDM project has been a important incentive to the legal barrier to be overcomed by the PP.

The PP provide all the technical and law assistance, free of cost to the small farmers, in order to make them able of licensing their lands. In addition, it is clear that the issuance of at least 6 environmental licenses for each of the 198 small farmers plus the licenses to itself (Forestry, Carbonization and Blast-Furnace) in the Alternative Scenario 2a (totalizing over 1,190 licenses) is much more difficulty and costly than the issuance of only 1 license in the Alternative Scenario 1. The PP, due to this regulatory barrier, is assuming the market-risks of pre-purchasing biomass to harvest in the 7º year after the small farmers join the project activity and start their plantation.

Due to the regulatory barrier, the 198 small farmers that are part of the project activity supply chain, since 2005, have legalized or are applying to achieve the environmental licenses necessary to land use in Brazil, cited in the alternative Scenario 2a below, with ArcelorMittal BioFloresta's technical and financial support.

None of the 198 small farmers that are part of the project activity supply chain had regular environmental status when the decision of implementation was taken in 2005. However, with the PP's support, among 98 have licensed their Legal Reserve Area (almost 50% of all farmers) and the others are applying to become regular and so, able to harvest legally the biomass they have planted.

The intention of pursuing the CDM registration was a determinant factor for the acceptance of the project activity by local non-governmental organizations, which also play an important role in the environmental licensing processes of entrepreneurships. That was the case of the Minas Gerais' Association of Environmental Defense (Associação Mineira de Defesa do Meio Ambiente - AMDA).

During of licensing process of the project activity, AMDA convened a public hearing, which took place on March 15th 2005, in Pró Música Theater, Juiz de Fora. The hearing was recorded in video and was made available to DOE during validation process. At the occasion Amda declared its support to the implementation of the project activity, in special due to the intention ArcelorMittal of seeking the CDM status. In that sense, Amda's executive superintendent, Maria Dalce Ricas, in a personal communication registered and presented to DOE states that "*In case of ArcelorMittal, the structuring of a Sustainability Program with focus on carbon credits projects in pig iron production was a determinant factor to the success of the public hearing which took place during the licensing program, culminating in the issuance of the licenses required to State Council of Environmental Policy".*

As expressed above, the CDM benefits were essential to overcome the licensing costs, as well as the public and the AMDA's opinion regarding to the environmental license issuance for the project implementation, which configures a great regulatory barrier in the Host Country and mainly in the Minas Gerais State.

Outcome of Step 2b: In summary, in contrast to the alternative scenario 1, we argue that the project activity without CDM (alternative scenario 2a) may face regulatory barriers related to the environmental licensing. Hence, alternative scenario 1 is the most likely baseline scenario. Importantly, the barriers faced by the project activity are alleviated by the intention of the project proponents in seeking the CDM, which certifies the commitment of the project developers in achieving environmental gains, specially in regards to GHG emission reductions, and in the promotion of sustainable development.

Table 7. Summary of barrier analysis

Alternative Scenarios	Prevented by some of the existing barriers?
Scenario 1 Metallurgical coke iron ore reduction system.	**No**
Scenario 2a Renewable charcoal iron ore reduction system from new planted biomass.	**Yes** (eliminated alternative)

Step 3. Investment analysis

As per methodological tool option of the "Combined tool to identify the baseline scenario and demonstrate additionality", Version 04, this Step 3 will not be applied.

Step 4. Common practice analysis

In the steel production chain, there are very different working conditions: on one side, steel plants certified by international standards; on the other, precariousness of charcoal handicrafts, with intensive and predatory use of forest resources, work exploitation in subhuman conditions, including children and teenagers, applying rudimentary technology. In that sense, in 2002, according to estimates, 30% of the charcoal used in Brazil was produced from native forests, especially from Cerrado (Dias, Assunção, Guerra, & Prais, 2002) .

There's also indication of the migration of the charcoal non certified industry to the Eastern Brazilian Amazon area whereas, until the 90's, such producers were almost exclusively located in the Brazilian southeast (Monteiro).

Therefore, only integrated plants are reasonably comparable to the project proponent and will be further discussed in the common practice analysis. Even considering only the large players of the sector, in the transition from the 70's to the 80's, one of the main points of technological research was the energy efficiency of charcoal. Later, at the end of the 80's, there was a strong environmental movement against the use of charcoal as an energy input of the national steel industry. For example, in the National Environmental Council (CONAMA), the civil society was linked to approve a resolution that prohibited definitely the use of charcoal at the steel industry (Boson, 2009).

Since the early 1990's, major companies of the charcoal-based sector, including the PP, switched charcoal blast furnaces to coal coke, responding to the increasing difficulties associated with the society pressure, lack of supply of charcoal and advantageous technological and logistical issues of coke based plants (sub-step 1b, Alternative 1).

It is important to note that, as identified in sub-step 1b above, the iron and steel companies in general have been undergoing a severe supply shortage of renewable charcoal as a reducing agent. This fact can be used as a conservative proxy for the assessment of availability of biomass in the market, and consequently of charcoal to be used as iron ore reducing agents. It reflects that it is not a common practice neither a trend to use charcoal from dedicated plantations.

As exposed in the regulatory barriers section, the estate of Minas Gerais deals with extra difficulties to implement activities at the current project level. Those difficulties consist mainly in specific legislation of the estate and environmental entities acting as stakeholders (i.e. Amda). Thus, only projects in the estate of Minas Gerais are comparable in regulatory aspects.

Another important factor regarding common practice analysis, as shown in sub-step 1b, alternative 1, the privatization process in the country represents a significant incentive to coke-based plants, through the extinction of the coal import tax and also causing bankruptcy and insolvency of integrated charcoal based companies. In that sense, possible integrated companies developing its processes through charcoal based plants tend to be prior to the privatization process of the steel sector.

Finally, existing CDM project activities related to charcoal based plants under the same conditions could also be evidence of additionality. So it is necessary to identify whether there is any similar project developed without the CDM income, because that would provide a plausible way of implementation without the revenue of CERs. The PP analyzed essential distinctions among operational companies of the sector in Brazil and in order to conduct the common practice analysis at the project level the following criteria were used:

Table 8: Criteria used to analyze the common practice at project level

Number	Criteria	Rationale
1	Integrated and non-integrated iron and steel companies	Due to large differences in compliance with current laws and regulations, working conditions and information unavailability, scales of production and other differences.
2	Charcoal or coal based blast-furnace technologies and fuel sources	Subjected to distinct set of barriers as demonstrated in the Barrier Analysis, depending on the reducing agent used.
3	The state of Minas Gerais as geographical location	The project activity as well as the largest pig-iron production pool in the host country are both located in this state[23]. Besides, this region has specific laws and regulations regarding forest establishment and exploitation of native forests that are quite different in other states.
4	Sector's privatization process	This criterion is used to guarantee that the analyzed practices have been taken place, in terms of decision making, in the same investment environment that the current project activity (as explained in sub-step 1b, alternative 1).
5	CDM project activities	If the project activity also required the CDM benefits, it must be excluded from the common practice analysis.

[23] Some forest plantations of ArcelorMittal BioFlorestas are located in Bahia but their size correspond to less then 10% of the total area used by the project entity for wood production, therefore they are considered not representative.

The criteria chosen in the previous table were used to analyze all integrated plants in Brazil. The Second National Anthropogenic Emissions Inventory, made by Instituto Aço Brasil (Brazil Steel Institute) and its Associates, provided a list of all these plants, including their location (MCT, 2010). All identified plants were analyzed concerning their similarities and differences to the proposed project activity, in order to evaluate common practices in the sector. The results are exposed in Table 9 and its the criteria were defined as:

✓ = similar; **X** = significantly different; and **?** = unknown):

Table 9. Common Practice Demonstration and Assessment Integrated Companies

Company	**Criteria**				
	1	**2**	**3**	**4**	**5**
1) ArcelorMittal Inox Brasil (ACESITA) – Timóteo (Inox, 2004)	✓	**X**	✓	**X**	**X** [24]
2) Gerdau Açominas (Gerdau, Diário Oficial, 2004)	✓	**X**	✓	**X**	✓
3) Gerdau Aços Longos – Barão de Cocais (Poso, 2007), Divinópolis (Gerdau Div)	✓	✓	✓	**X**	✓
4) Gerdau Aços Longos – Usiba (Gerdau Usiba)	✓	**X**	**X**	**X**	✓
5) V&M do Brasil (V&M)	✓	✓	✓	**X**	**X** [25]
6) ArcelorMittal Aços Longos – Monlevade (Timeline CAF 2000)	✓	**X**	✓	**X**	✓
7) Project Activity without the CDM benefits - ArcelorMittal Aços Longos – Juiz de Fora	✓	✓	✓	✓	✓

Step 4a: The proposed CDM project activity(s) applies measure(s) that are listed in the definitions section above

As per the Guidelines on Common Practice v.01, the following steps were taken:

Sub-step 4a (1): Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.

- *The blast-furnaces do not differ technologically and their production capacity are not revealed.*

Sub-step 4a (2): In the applicable geographical area, identify all plants that deliver the same output or capacity within the applicable output range, calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number Nall. Registered CDM project activities and projects activities undergoing validation shall not be included in this step.

- *The number of Integrated Iron & Steel Companies is 5 (N_{ALL} = 5).*

Sub-step 4a (3): Within the plants identified in Step 2, identify those that apply technologies different to the technology applied in the proposed project activity. Note their number $\mathbf{N_{diff}}$.

- As *discussed in the Table 9, all the alternatives differ from the project activity is 4 (N_{DIFF} = 4)*

Sub-step 4a (4): calculate factor F = 1 – $\mathbf{N_{diff}}$ / $\mathbf{N_{all}}$ representing the share of similar projects using a measure / technology similar to the measure / technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.

[24] http://cdm.unfccc.int/Projects/Validation/DB/VD1SJF1AL7BKNCNEJ58HBNZ1TSY0X4/view.html *(acessed on 01/11/12)*

[25] http://cdm.unfccc.int/Projects/Validation/DB/UEHN0DNLJ3ZTFJH92YQ56OATC021DA/view.html *(acessed on 01/11/12)*

- The factor of common practive F equals to 0.20, as F = 1 – N_{DIFF} / N_{ALL} due to 4 / 5 = 0.80

Step 4b: The proposed CDM project activity(s) does not apply any of the measures that are listed in the definitions section above

The discussion shows that similar activities are observed but essential distinctions between them can reasonably be demonstrated. The calculation above shows that F = 0.2 and N_{DIFF} - N_{ALL} < 1 as it equals 1, therefore the proposed project activity cannot be considered to be a common practice.

Outcome of Step 4: The proposed project activity is not regarded as common practice and is additional.

Table 10 below summarizes the conduction of the Baseline and Additionality Assessment of the Project:

Table 10. Baseline and Additionality Assessment of the project under the AM0082 version 01

Baseline and Additionality Assessment of Alternatives	Step 1a. Compliance with actual laws and regulations	Step 1b. Assessment of supply and demand of reducing agents	Step 2. Barriers analysis	Step 3. Investment analysis	Step 4. Common practice analysis
Scenario 1: Metallurgical coke iron ore reduction system	Yes	Yes	Yes	N/A	**Yes**
Scenario 2a: Renewable charcoal (produced with new renewable forest plantations sources) iron ore reduction system.	Yes	Yes	No alternative eliminated	N/A	**No**
Scenario 2b: Renewable charcoal (produced with existing renewable forest plantations sources) iron ore reduction system.	Yes	No alternative eliminated		N/A	**No**
Scenario 3: Non-renewable charcoal (produced with non-renewable sources e.g. native forests) iron ore reduction system.	No alternative eliminated			N/A	**No**
Scenario 4a: Iron ore reduction system based on the use of a mix of reducing agents (renewable and non-renewable native	No alternative eliminated			N/A	**No**
Scenario 4b: Iron ore reduction system based on the use of a mix of reducing agents (charcoal and coal coke).	No alternative eliminated			N/A	**No**

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

As required by applied methodology AM0082, the assessment and demonstration of additionality is conducted according to the latest version of the “Combined tool to identify the baseline scenario and demonstrate additionality” as demonstrated in the Section B.4 above.
According to the "Guidelines on the demonstration and assessment of prior consideration of CDM, version 3", the project is classified as an *existing project* activity due to the fact that its starting date, that corresponds to blast furnaces purchase, is 06 April 2005, i.e. before 02 August 2008. Therefore, as per the above mentioned guidelines, in order to demonstrate that the CDM was seriously considered in the decision to implement the project activity, the decision-making process concerning the present project is presented below.

Up to 2000, the blast furnaces of the Monlevade facility were fueled with charcoal, which required continuous maintenance of eucalypt stock in order to guarantee its sustainable production. In 2000, the company installed one coke-driven blast furnace in substitution of the five existent charcoal-based blast furnaces, increasing its total daily pig iron production capacity to 3 thousand tons. According to the company, the reasons for the switch from charcoal to coal coke in the blast furnaces in Monlevade encompassed reduction of final cost of production of wire rod, enhanced environmental performance of the plant, and the expansion of production (of more 600 ton a day) (AM B29, 2004).

Due to the charcoal-to-coke switch in Monlevade, which reduced the demand for forestry products in Belgo’s facilities, CAF specialized itself in production of sawn wood for various destinations and Belgo started a process of selling its forestry assets (Timeline CAF 2000). However, this process was paralyzed in light of the opportunity of the development of the present project activity.

In 2002, Arcelor contracted Pricewaterhouse Coopers (PwC) for elaboration of a diagnosis, contemplating the analysis of status, risks and opportunities of CDM in Brazil. The final report (PC 1) indicated the identified opportunities in Belgo and other units, as summarized in Table 11 bellow.

Table 11. CDM Opportunities for Arcelor in Brazil

CDM Type	*CST*	*Belgo*	*Acesita*	*Vega*
Energy Efficiency		*	*	
Energy Generation		*		
Energy Co-generation	*	*	*	
Sinter-plant Efficiency	*	*		
Charcoal-based Plant		**	**	
Reforestation		**	**	
Carbonisation Improvement		**	**	
Biodiversity		*	*	*

* Medium term opportunities
** Significant stream of cost effective credits

During the development of the diagnosis, took place in September 2003 the Encounter Arcelor Brazil / South America, in which participated representatives from ArcelorMittal Brazil, including a representative

of Belgo Juiz de Fora. During the event, the carbon market was discussed with focus on the potential of CERs as driver for good businesses (PC 2; PC 3).

Afterwards, PwC was also contracted for performing the evaluation of potential CDM projects in CAF (PC 4; PC 5) (currently, ArcelorMittal BioFlorestas). The study investigated technological alternatives for increasing pig iron production in Belgo, focusing on the CER generation potential in the switch from coke-based to a charcoal-based production (PC 6). It is important to notice that upon the conclusion of the study, in June 2004, discussions pertaining to strategy for the expansion of the pig iron production in Belgo were still ongoing.

In July 2004, PwC proposed the elaboration of Belgo's Sustainable Development Program (PC 7) and its final presentation took place in September of that same year, with the participation of the Board of Directors of the Company (PC 8; PC 9). The program aimed at the promotion of initiatives that contribute to the development of CDM projects in the new investments of the company, being the current project activity the first initiative under its auspices (Miranda). The "ArcelorMittal Sustainability Program" was developed in order to guarantee sustainable forestry growth, charcoal production and industrial activities of this new production system. The structure of the Program and its objectives are shown in the figure below:

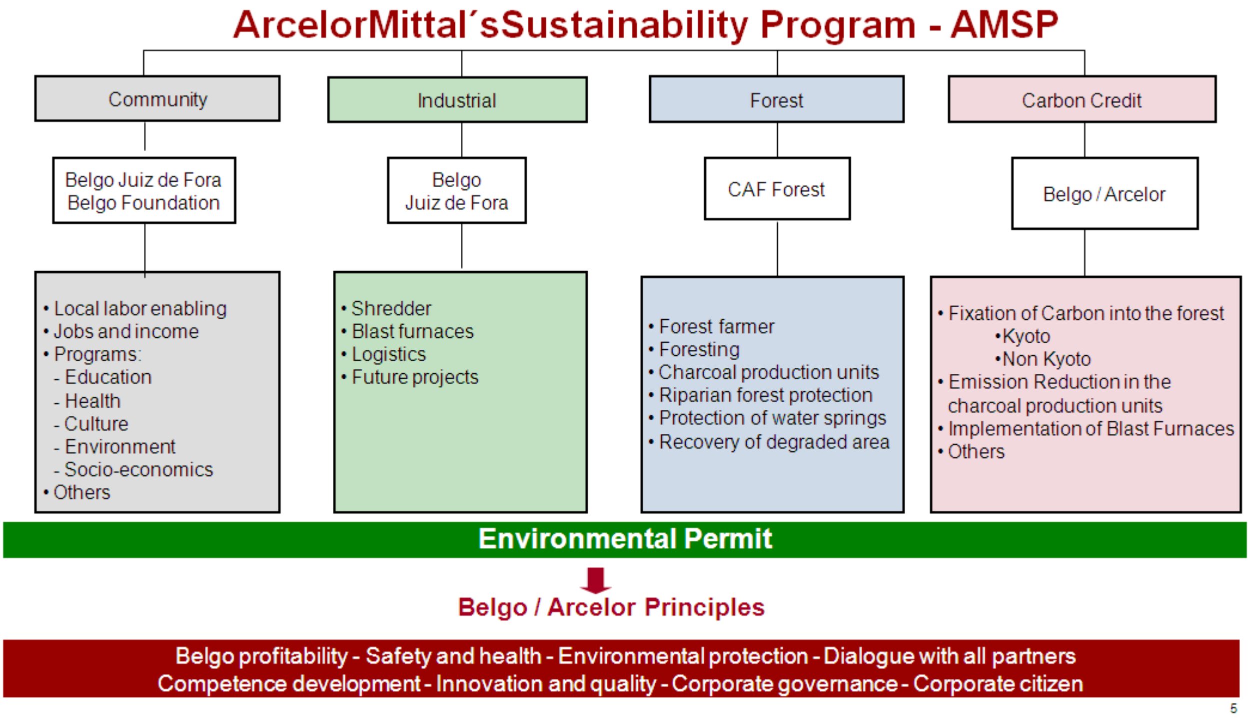

Figure 13. Belgo Sustainability Program

In conclusions of the Program, it was defined that Arcelor would participate in the structuring of a Technical Group for Renewable Charcoal in order to promote discussions and guarantee support to CDM projects and methodology approval in pig iron production chain based on renewable charcoal.

In October 2004, the Environmental Impact Report (RIMA) of the deployment of two blast furnaces in Belgo Juiz de Fora was concluded (PC 20; PC 21; PC 10), which contemplated an evaluation of emissions reduction of the project. According to the report: "*...another fundamental aspect, which concerns directly the present undertaking, is related to the guidelines and goals set in the Protocol of Kyoto about climatic changes, which aim the reduction of carbon dioxide emissions. In recent study conducted by Belgo group,*

simulations were made about the competitive and environmental advantages of carbon dioxide fixation in steel processes in function of the use of charcoal in substitution to metallurgical coke. The carbon emissions in processes of pig iron production based on charcoal, considering the fixation of this compound in wood production in seven years, gets to the order of eighteen times less if compared to carbon emissions originated in the process of iron pig production using metallurgical coke. So, considering the emerging market of carbon trade, with transaction values already published of about 3 to 5 US$/ton CO2, the enterprise considers as safe and promising the activity of sustainable production of wood, and also of coal supply for its steel processes...". This document had the direct participation of the Board of Directors, which is evidenced through the print screens taken from the administration system of the Company (PC 22).

In the meanwhile, a Brazilian company V&M submitted a new methodology of switch from coal coke to charcoal in pig iron production to EB. This methodology received "C" in 2003 (NM0029) and was reproved again in 2005 (NM0104).

In March 2005, a meeting took place with representatives from CAF, Belgo and PwC, aiming at the presentation of the conceptual aspects of CDM and at the delivery of draft PDDs, including the one corresponding to the present project (PC 11).

Still in the same year, in June, there was a meeting with the presence of José Domingues Miguez (Secretary of the Inter-ministerial Commission on Climate Change – CIMGC, Brazil's DNA), Fídias Miranda (Environment Corporate Manager of Belgo), Carlos Delpupo (Belgo Sustainability Program Manager of PwC), among others, for exposure the current project to Brazilian DNA (PC 12). In this meeting, the participants of the Charcoal Technical Group exposed the new methodology to be developed (which is better explained later in this section) and sustainability benefits to the country.

The starting date of a CDM project activity is the earliest of the date(s) on which the implementation or construction or real action of a project activity begins/has begun (EB33, Para 76/CDM Glossary of terms/EB41, Para 67). In that sense, the starting date of this project of activity is the signature date (12/08/2005) of the consolidated business proposal issued by Paul Wurth, regarding the purchase of two blast furnaces by Belgo (PC 19).

In order to indicate that continuing and real actions were taken to secure CDM status for the project in parallel with its implementation, the time line description in terms of CDM consideration continues to be described below, even after the starting date of the project.

In February 2006, took place a meeting of the directorship for monitoring of PBS (Belgo Sustainability Program), including the situation of the project in matter (PDD development and methodology) (PC 13).

In the year of July 2007, the proposal of Totum Institute for elaboration of CDM projects in Belgo (ArcelorMittal Juiz de Fora) and CAF (ArcelorMittal BioFlorestas) was presented. Afterwards, ArcelorMittal changed its consulting company from PwC to Instituto Totum, which redesigned the project documents. The contract was signed in March 2008 (PC 14; PC 15).

In December 2007, in between the issuance of the proposal mentioned above and the signature of the contract between the two parts (Totum Institute and ArcelorMittal), a workshop took place, in order to instruct the Charcoal Technical Group on the decisions of COP 13, as well as to deliberate about the next steps regarding CDM projects in of pig iron production based on charcoal (PC 16).

Yet in 2008, a new methodology was submitted to Meth Panel (NM0110) as a result of the efforts of ArcelorMittal, Plantar and Instituto Totum, with support of many professionals involved on the methodology development. The participation of ArcelorMittal in the development of this new methodology

is evidenced through its participation in the Charcoal Technical Group, of which Plantar was also a member. In July of 2009, the methodology was finally approved by the Executive Board (NM0110-rev).

In October 2009, an “Indicative Term Sheet for a Transaction of Emission Reductions Certificates” was formulated, between KfW Bank (Germany) and ArcelorMittal Brazil, concerning the project activity in matter (PC 18).

In order to synthesize the time line of key events involving CDM aspects through the development and implementation of the activity, Table 12 is presented.

Table 12. Timeline of CDM Pior Consideration

Year	Event	Evidence
2002	Hiring of PwC for a diagnosis, contemplating CDM in Brazil	• PC 1 - PwC Report - CDM Brazil (AMJF05)
2003	Encounter Arcelor Brazil / South America	• PC 2 - Encounter Register (AMJF02) • PC 3 - Encounter Presentation (AMJF03)
2004	Proposal and hiring of PwC	• PC 4 - PwC Proposal - CDM CAF (AMJF11) • PC 5 - PwC Contract - CDM CAF (AMJF10) • PC 6 - PwC Report - CDM CAF (AMJF20)
2004	PwC proposal to elaborate Belgo Sustainable Development Program	• PC 7 - PwC Proposal - PBS (AMJF14) • PC 8 - PwC Presentation - PBS (AMJF12) • PC 9 - PwC Conclusions - PBS (AMJF43)
2004	Environmental Impact Report (RIMA) of the blast furnaces	• PC 10 - Furnaces RIMA (AMJF16)
2005	Structuring of a Technical Group for Renewable Charcoal	• PC 9 - PwC Conclusions - PBS (AMJF43)
2005	Meeting with representatives from CAF, Belgo and PwC	• PC 11 - CDM Concept and Initial PDD (AMJF21)
2005	Meeting with the Secretary of Brazil's DNA	• PC 12 - DNA Meeting (AMJF07)
2005	**Starting Date: Purchase of blast furnaces**	• **PC 19 - Paul Wurth - Purchase Furnaces (AMJF15)**
2006	Meeting of the directorship for monitoring of PBS	• PC 13 - Current PBS (AMJF23)
2007	Changing of consulting company from PwC to Instituto Totum	• PC 14 - Totum Proposal - CDM (AMJF33) • PC 15 - Totum Contract - CDM (AMJF34)
2007	Workshop about the decisions of COP 13	• PC 16 - Workshop COP-13 and CDM (AMJF32)
2008	New methodology submitted	
2009	Indicative Term Sheet for Transaction of Emission Reductions Certificates	• PC 18 – Term Sheet KfW (AMJF42)
2009	Methodology AM0082 approval	• ACM0082 v.01 was approved in EB48 held on July 2009

The facts and evidences presented above demonstrate CDM awareness of PPs prior to the starting date of the project activity, the fact that CDM incentives were crucial in the decision to proceed with the project activity and the fact that continued actions were taken in order to secure the CDM status of the project activity.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Baseline Emissions (BE_y)

According to AM0082/Version 01, emissions attributable to the baseline iron ore reduction system encompasses two components, namely:

Baseline upstream emissions, which represent emissions associated with production of baseline reducing agents and their transportation

Baseline process emissions, which are associated with the use of reducing agents within the iron ore reduction process in the absence of the project activity

The following formulae applies:

(1) $$BE_y = RAE_{BL,y} + IRE_{BL,y}$$

Where:

BE_y = Total baseline emissions in the iron ore reduction system in year *y* (tCO_2e)

$RAE_{BL,y}$ = Baseline upstream emissions in the reducing agent supply in year *y* (tCO_2e)

$IRE_{BL,y}$ = Baseline process emissions in the industrial facility in year y (tCO_2e)

Baseline upstream emissions

Baseline upstream emissions are accounted as follows:

(2) $$RAE_{BL,y} = PCE_{BL,y} + RAP_{BL,RA,y} + RAT_{Vehicle,BL,y}$$

Where:

$RAE_{BL,y}$ = Baseline upstream emissions associated with the supplies of the reducing agent (tCO_2e)

$PCE_{BL,y}$ = Emissions from Primary carbon extraction in the baseline scenario during year *y* (tCO_2e /yr)

$RAP_{BL,RA,y}$ = GHG emissions from the production of reducing agents within the boundary under the baseline scenario during year *y* (tCO_2e /yr)

$RAT_{Vehicle,BL,y}$ = CO_2e emissions in fossil fuel combustion in the transport of reducing agent(s) to iron ore reduction facility during year *y* in the baseline scenario (tCO_2e /yr)

Baseline emissions from primary carbon extraction and baseline emission from the production of reducing agent

As previously mentioned, in the absence of the project activity, coal coke would be the reducing agent utilized in the ArcelorMittal’s facility in Juiz de Fora. Yet, such coal coke would be produced in CST ArcelorMittal Tubarão "Sol", in Vitória, Espírito Santo State.

Since baseline primary carbon sources extraction (i.e. coal mining and related activities) occur outside the host country, baseline upstream emissions associated with this source are not taken into account (AM0082/Version 1, Annex 1). Moreover, due to the ineligibility of bunker fuels under the CDM (EB 25/Para. 25), and due to the fact of coal transportation to the coke production site not being under the control of the project proponent (coal is transported to CST ArcelorMittal Tubarão "Sol" by overseas maritime transport) this baseline upstream emission source is not accounted (AM0082/Version 1, Annex 1). Therefore, $PCE_{BL,y} = 0$.

Baseline emissions from the production of reducing agents ($RAP_{BL,RA,y}$), pertains to the production of coal coke in CST ArcelorMittal Tubarão "Sol" ($RAP_{BL,RA,y} = RAP_{BL,coal\ coke,y}$), which are accounted as described below. $RAP_{BL,coal\ coke,y}$ will be ex-post by the monitoring of $P_{PJ,y}$.

(3) $$RAP_{BL,coal\ coke,y} = P_{PJ,y} \times EF_{CO_2,coal\ coke,y} \times RA_{BL,i}$$

Where:

$RAP_{BL,coal\ coke,y}$ = 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* (tonnes of hot metal)

$EF_{CO2e,coal\ coke,y}$ = Emission factor to produce one tonne of coal coke in the iron ore reduction system baseline scenario (tCO_2e/t of coal coke). For conservativeness, the lowest default emission factor in AM0082/Version 1, Annex 1, Table 3 (option “flared”) will be used (EF = 0.4026 tCO_2e / t coal coke).

$RA_{BL,i}$ = Quantity of coal coke necessary to produce one tonne of hot metal (t coal coke/t hot metal)

$RAP_{BL,coal\ coke,y}$ will be calculated ex-post applying the formula above to monitored values of $P_{PJ,y}$ and to the ex-ante defined values of $EF_{CO2e,coal\ coke,y}$ and $RA_{BL,i}$.

$RA_{BL,i}$ is a key parameter for the calculation of both baseline upstream and baseline process emissions. Since the proposed project is a greenfield project, historical data coal coke usage and pig iron production in the project plant, used in the determination of $RA_{BL,i}$, is not available. Hence, for the determination of this parameter, historical data from ArcelorMittal’s plant in João Monlevade (Minas Gerais) was used as reference due to the fact that this plant is the newest (constructed in 2000) in ArcelorMittal Brasil Group.

Baseline emissions in the transport of reducing agent

For accouting baseline emissions in the transportation of reducing agent, Option 1 (AM0082/Version 1, Annex 1) (Baseline emissions from transport based on fuel consumption of vehicles) was adopted. This emission source ($RAT_{Vehicle,BL,y}$) is estimated ex-ante, and applied ex-post to emission reduction calculations. The steps and formulae outlined below apply:

Step 1: Information on vehicle type and distance traveled from production sites to the project activity

As previously mentioned, the coal coke to be used in the project activity would be produced in CST ArcelorMittal Tubarão "Sol". From that location, the coal coke would be transported to the project plant by train. The figure below illustrates the path that would be followed fom Vitória to Juiz de Fora (calculated distance: 626 km).

Figure 14. Railroads connecting the project plant in Juiz de Fora to Vitória, where the site (Arcelor Mittal Tubarão "Sol" coking facility) that would produce the baseline reducing agent is located. Source: Ferrovia Centro-Atlântica, accessed 02/12/2011, <http://www.fcasa.com.br/wp-content/uploads/2010/02/mapacompleto.pdf>. Distance between the project plant to the coking facility: 626 km – calculated using "Minas Gerais' Railroald" shapefile (source: *Centro de Sensoriamento Remoto*/Remote Sensing Center /CSR of the *Instituto Brasileiro de Meio Ambiente*/Brazilian Environment Institute/IBAMA, accessed 22/10/2010, <http://siscom.ibama.gov.br/shapes/>), using the GPS TrackMaker software.

Step 2: Indentify applicable factors

As per AM0082/Version 01, "Country specific emission factors shall be used. In the absence of country specific emissions factors, the IPCC 2000 and IPCC GPG 2006 guidelines or other reliable sources on the GHG emissions assessment can be used.

Train fuel consumption data in Brazil can be obtained from the Brazilian Land Transportation Agency (ANTT). According to the source mentioned above, the historical train fuel consumption of the Concessionaries that control the rail flow between Vitória/ES and Juiz de Fora/MG is 0.00337 litres of diesel per tku ($l.t^{-1}.km^{-1}$). Considering the estimated yearly pig iron production (360,000 t pig iron/year) and

the factor $RA_{BL, i}$ (0.517 t coke/t pig iron), the total yearly amount of coke to be transported in the baseline corresponds to 186,120 t. Hence, in order to transport the totality of coke to be consumed in one year in the baseline scenario, diesel consumption in the baseline scenario would correspond to 2002.98 l/km.

The calculation of the CO_2 emission emission factor of diesel oil (2.575 kg CO_2/l) was based on data from the National Energetic Balance, 2010 (*BEN*, *2010* - Net calorific value, 10.100 kcal/kg; and specific mass, 840 kg/m^3) and from IPCC 2006 (Volume 2, Chapter 1, Table 1.4 - Default CO_2 emission factor for combustion) (CO_2 emission factor for diesel combustion, 72,600 kg CO_2/TJ).

Step 3. Calculation of $\boldsymbol{RAT_{Vehicle, BL,y}}$

CO_2 emissions from coal coke transportation in the baseline were calculated as follows, using the data inventoried above in steps 1 and 2 applied to the following formulae: from the baseline data on vehicle use, and fuel consumed in the transportation of coal

(4) $$RAT_{Vehicle,BL,y} = \sum_{v,BL} \sum_{f,BL} \frac{EF_{vf,BL} \times FC_{vf,BL,y}}{1000}$$

(5) $$FC_{vf,BL,y} = n_{vf,BL,y} \times k_{vf,BL,y} \times e_{vf,BL}$$

Where:

$RAT_{Vehicle, BL,y}$ = CO_2 emissions within the project boundary due to fossil fuel combustion from vehicles used to transport coal coke to iron ore reduction facility in the baseline scenario, (tCO_2/yr);

$EF_{vf, BL}$ = Emission factor for vehicle type *v* with fuel type *f* in the baseline scenario, (kg CO_2/litre);

$FC_{vf,BL,y}$ = Consumption of fuel type *f* of vehicle type *v* in the baseline scenario; (litres per year *y*);

$n_{vf,BL,y}$ = Number of vehicles of type *v* with fuel type *f* in year *y* in the baseline scenario;

$k_{vf,BL,y}$ = Kilometers traveled by each of vehicle type *v* with fuel type *f* in the baseline scenario, (km per year *y*);

$e_{vf,BL,y}$ = Average fuel consumption of vehicle type *v* with fuel type *f* in the baseline scenario, (litres/km).

v_{BL} = Vehicle type in the baseline scenario

f_{BL} = Fuel type in the baseline scenario

Baseline process emissions (IRE $_{BL, y}$***)***

Baseline process emissions will be accounted according to the following formulae:

(6) $$IRE_{BL,y} = \left(P_{PJ,y} \times EF_{Ind,BL}\right) - \left(P_{PJ} \times Cc_{HM,BL} \times 44/12\right)$$

Where:

$IRE_{BL, y}$ = Baseline process emissions within the iron ore reduction facility (tCO_2e);

$P_{PJ,\,y}$ = Hot metal production in year y (tonnes of hot metal);
$EF_{Ind,\,BL}$ = Baseline emission factor to produce one tonne of hot metal (tCO_2e / t of hot metal);
$Cc_{HM,\,BL,\,y}$ = Carbon content in tCO_2e per tonne of hot metal produced in year y (t C / t of hot metal);
44/12 = Conversion factor from carbon to CO_2e (dimensionless).

For the calculation of $IRE_{BL,\,y,}$ the ex-post monitored values of $P_{PJ,\,y}$ and $Cc_{HM,\,BL,\,y}$ will be applied to $EF_{Ind,\,BL}$, which are determined ex-ante.

The following formula was applied in the determination of $EF_{Ind,\,BL}$:

(7) $$EF_{Ind,BL} = \sum_i \frac{\left(\%C_{BL,i} \times RA_{BL,i}\right)}{100} \times 44/12$$

Where:
$EF_{Ind,\,BL}$ = Baseline emission factor to produce one tonne of hot metal (tCO_2e /t of hot metal);
$\%C_{BL,\,y}$ = Carbon content in percent of reducing agent i (coal coke) used in the baseline;
$RA_{BL\,i}$ = Reducing agent type i (i.e. coal coke) 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).

Calculation of carbon fixation factor under the baseline scenario, $Cc_{HM,\,BL,\,y}$, is calculated as below:

(8) $$Cc_{HM,BL,Y} = \frac{\%C_{HM,PJ,Y}}{100}$$

Where:

$Cc_{HM,\,BL,\,y}$ = Carbon content fixed in hot metal expressed in t CO_2e per t of hot metal produced in year *y* (t CO_2 e/ t of hot metal).
$\%C_{HM,\,PJ,\,y}$ = Percentage of carbon in hot metal (%) in the project situation.

It is noteworthy that, if pig iron is produced using renewable charcoal only, AM0082/Version 01 considers $\%C_{HM,\,PJ,\,y}$ as zero.

Project Emissions (PEy)

According to AM0082/Version 01, project emissions associated to the new iron ore reduction system encompasses two components: project upstream emissions and project process emissions.

In the present project activity, project emissions are accounted in accordance to the the investment decision undertaken in the project scenario (i.e. a new planted biomas charcoal iron ore reduction system). Hence, project upstream emissions encompass emissions attributable to (a) the plantation establishment, (b) renewable charcoal production and (c) its transportation to the iron ore facility.

Yet, for a part of the dedicated plantation covered under a registered A/R CDM project activity, the GHG emissions related to the corresponding area of land shall are not accounted in the project upstream emissions, in compliance with the paragraph 38 of the twenty-fifth meeting of the Board decision.

Hence, project emissions are calculated as follows:

(9) $$PE_y = RAE_{PJ,y} + IRE_{PJ,y}$$

Where:
PE y = Total project emissions in the new iron ore reduction system in year *y* (tCO_2e);
RAE $_{PJ, y}$ = Project upstream emissions associated with the reducing agent production and transportation in year y in the project scenario (tCO_2e);
IRE $_{PJ, y}$ = Project process emissions in the iron ore facility in year *y* (tCO_2e).

Project upstream emissions (RAE $_{PJ, y}$)

The project upstream emissions calculations are carried out as outlined below:

(10) $$RAE_{PJ,y} = PCE_{PJ,y} + RAP_{PJ,RA,y} + RAT_{Vehicle,PJ,y}$$

Where:
RAE $_{PJ, y}$ = Project upstream emissions associated with the reducing agent production and transportation in year y in the project scenario (tCO_2e)
PCE $_{PJ, y}$ = Primary carbon source extraction emissions in the project scenario (tCO_2e)
RAP $_{PJ, RA, y}$ = Emissions associated with production of reducing agents within the project boundary for use in the iron ore reduction facility in the project scenario during year y (tCO_2/yr)
RAT $_{Vehicle, PJ, y}$ = CO_2 emissions due to fossil fuel combustion from vehicles used to transport reducing agent(s) to iron ore reduction facility within the project boundary during year y of the project scenario (tCO_2/yr)

In the present project activity, emissions related to the Primary Carbon Extraction (PCE $_{PJ, y}$) encompass those emissions arising from the establishement of plantation and production of biomass, which is accounted as follows:

(11) $$PCE_{PJ,y} = EP_{PJ,y} = E_{FuelBurn,PJ,y} + PE_{BB,y} + N_2O_{direct-N_{fertilizer},PJ,y} + EP_{Vehicle,PJ,y}$$

Where:

EP $_{PJ, y}$ = GHG emissions of the establishment of plantations to produce biomass in the project scenario during year y (tCO_2/t biomass)

E $_{FuelBurn,PJ, y}$ = CO_2 emissions from combustion of fossil fuels within the project boundary in the project scenario (tonnes CO_2/yr)

PE $_{BB, y}$ = Project emissions arising from field burning of biomass at the plantation site (tCO_2e/yr).

N_2O $_{direct - fertilizer N PJ, y}$ = N_2O emissions as a result of direct nitrogen application within the project boundary in the project scenario (tonnes CO_2/yr)

$EP_{Vehicle, PJ, y}$ = CO_2 emissions within the project boundary due to fossil fuel combustion from vehicles used to transport biomass to carbonization unit during year y of the project scenario (tCO_2/yr)

The project proponent employs the good practices in the establishement and maintenance of the forest plantations used to supply renewable wood to the project activity. Hence, field burning practices do not take place in the project activity. For that reason, the emission source $PE_{BB, y}$ is considered as not relevant.

Emissions from fossil fuel combustion in the establishement of plantations ($E_{FuelBurn,PJ, y}$) are accounted as per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" at its most recent version (stated at section B.1), as presented below:

(12) $$E_{Fuelburn,PJ,y} = PE_{FC,i,y} = \sum_i FC_{i,j,y} \cdot COEF_{i,y}$$

Where:

$PE_{FC,j,y}$ = CO_2 emissions from fossil fuel combustion in process j during the year y (tCO_2/year)

$FC_{i,j,y}$ = Quantity of fuel type i combusted in process j during the year y (liter/year)

$COEF_{i,y}$ = CO_2 emission coefficient of fuel type i in year y (tCO_2/liter)

i = Fuel types combusted in process j during the year y

Since the quantity of fuel are measured and expressed by the PP in liters (volume unit), the parameter $COEF_{i,y}$ is calculated as states the following formulae:

(13) $$COEF_{i,y} = NCV_{i,y} \times EF_{CO_2,i,y}$$

Where:

$COEF_{i,y}$ = CO_2 emission coefficient of fuel type i (tCO_2/liter);

$NCV_{i,y}$ = Average net calorific value of the fuel type i in year y (TJ/liter);

$EF_{CO2,i,y}$ = Average CO_2 emission factor of fuel type i in year y (tCO_2/TJ);

i = Fuel types combusted in process j during the year y.

Emissions due to transportation of biomass to carbonization sites ($EP_{Vehicle, PJ, y}$) will be accounted as per Option 2 (Project emissions from transport based on distance traveled by vehicles) of AM0082/Version 01, Annex 2, Item A.2.1, using the formulae below:

(14) $$EP_{Vehicle,PJ,y} = N_{v,PJ,y} \times AVD_{i,PJ,y} \times EF_{v,km,CO_2,PJ,y}$$

Where:

$EP_{VEHICLE, PJ, Y}$ = CO_2 emissions within the project boundary due to fossil fuel combustion from vehicles used to transport biomass to the carbonization site(s) during year *y* of the project scenario (tCO_2/year);

$N_{PCE, PJ, y}$ = Number of round trips (to and from) per type *v* of vehicle in project activity in the year *y;*

$AVD_{PCE, PJ, y}$ = Average round trip distance (to and from) between the plantation site(s) and the reducing agent type *v* production site(s) of the project activity during the year *y* (km);
$EF_{v,km,CO2,y}$ = CO_2 emission factor for type v of vehicle during the year *y* (tCO_2/km).

The project emissions due to nitrogen fertilizer application ($N_2O_{direct - fertilizer N PJ, y}$) in dedicated plantations are calculated according to the provisions in A/R tool "Estimation of direct nitrous oxide emission from nitrogen fertilization", as follows:

(15) $$N_2O_{Direct-N,t} = (F_{SN,t} + F_{ON,t}) \cdot EF_1 \cdot MW_{N_2O} \cdot GWP_{N_2O}$$

(16) $$F_{SN,t} = \sum_{1} M_{SFi,t} \times NC_{SFi} \times (1 - Frac_{GASF})$$

Where:

$N_2O_{direct- Nt}$	=Direct N_2O emission as a result of nitrogen application within the project boundary (tCO_2 / yr);
$F_{SN,t}$	= Mass of synthetic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_X, (tN / yr);
$F_{ON,t}$	= Mass of organic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_X,(tN / yr). Organic fertilizer is not used in the project activity. Hence, this parameter is considered null;
$M_{SFi,t}$	= Mass of synthetic fertilizer type i applied, (tonnes in year t);
$M_{OFj,t}$	= Mass of organic fertilizer type j applied, (tonnes in year t). Zero (organic fertilizers are not applied);
EF_1	= Emission Factor for emissions from N inputs, tonne-N_2O-N /(t-N input);
$Frac_{GASF}$	= Fraction that volatilizes as NH_3 and NO_X for synthetic fertilizers (dimensionless);
$Frac_{GASM}$	= Fraction that volatilizes as NH_3 and NO_X for organic fertilizers (dimensionless);
MW_{N2O}	= Ratio of molecular weights of N_2O and N (44/28), (tN_2O / tN);
GWP_{N2O}	= Global Warming Potential for N_2O, (tCO_2e / tN_2O) (IPCC default = 310, valid for the first commitment period);
$NC_{SF, i}$	= Nitrogen content of synthetic fertilizer type i applied (gN / 100g fertilizer);
$NC_{OF, j}$	= Nitrogen content of organic fertilizer type j applied (gN / 100g fertilizer);
i	= Number of synthetic fertilizer types;
j	= Number of organic fertilizer types.

Project emissions from the production of reducing agents consist in the emissions arising from the charcoaling process ($RAP_{PJ, RA, y}$ = $RAP_{PJ, charcoal, y}$). Methane emissions in carbonization is accounted as follows:

(17) $$RAP_{PJ,charcoal,y} = P_{PJ,y} \times EF_{CH_4,charcoal,PJ,y} \times F_{PJ,charcoal} \times GWP_{CH_4}$$

Where:

$RAP_{PJ, charcoal, y}$ = GHG emissions within the project boundary due to 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 (tonnes of hot metal);

$EF_{CH4, charcoal, PJ, y}$ = Emission Factor to produce one tonne of renewable charcoal identified in the project supply chain in the project scenario (tCH_4/t of charcoal);

$F_{PJ, charcoal}$ = Quantity of charcoal necessary to produce one tonne of hot metal in the project scenario (t charcoal/t of hot metal);

GWP_{CH4} = Global warming potential for CH_4 (tCO_2e/tCH_4).

The emission factor of CH_4 emissions in the carbonization activity is associated with the type of technology used and in the actual operation of the carbonization process. Project participants could choose between two options:

- Option 1: calculation of methane emissions based on procedures of "AM0041 - Mitigation of Methane Emissions in the Wood Carbonization Activity for Charcoal Production";

- Option 2: Helium tracing as per the most recent version of the Annex 2 of approved small scale methodology AMS-III.K.

In this project activity, $EF_{CH4,charcoal,PJ,y}$ will be estimated and monitored using **Option 1**, i.e. based on the best fit statistical relationship between methane emissions and gravimetric yield:

(18) $$EF_{CH_4,charcoal,PJ,y} = f\left(Y_{PJ}\right)$$

Where:

$EF_{CH4,charcoal,PJ,y}$ = Emission factor to produce one tonne of renewable charcoal identified in the project supply chain; (tCH4/t of charcoal);

Y_{BL} = Carbonization gravimetric yield (tCharcoal/tWood, dry basis), as per procedure provided below.

The estimated relation between methane emissions and carbonization gravimetric yield (CGE) is based on experimental measurement at the Palmeiras Charcoal Production Unit of ArcelorMittal BioFlorestas, from 10 October, 2007 to 25 January, 2008. The activities involved participation of four Ph.D. specialists (two Chemists and two Forest Engineers) from *Escola Superior de Agricultura "Luiz de Queiroz"* (Superior School of Agriculture "Luiz de Queiroz" - ESALQ) of the Universidade de São Paulo (University of São Paulo - USP) and three middle-level technicians. ArcelorMittal's specialists also assisted and supervised the experiments.

The data was collected as per the implementation of the carbonization research protocol, as described in the Appendix 1 of AM0041, and following the statistical requirements presented in Appendix 2 of the same methodology.

As required by the AM0041, an independent third party (ESALQ/USP) implemented the carbonization research and reviewed the statistical procedures followed in the estimation process. The report on the choice of the approach and its justification as required by the methodology, the report includes all calculations, and the supporting documentation on the carbonization process improvements implemented.

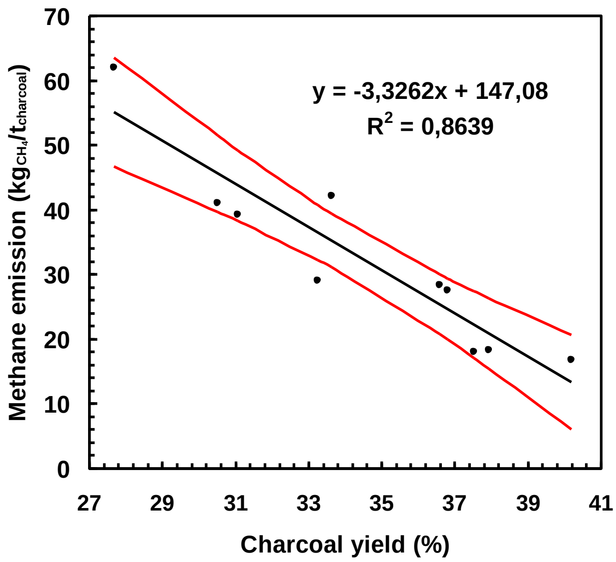

Figure 15. Correlation between methane emissions and charcoal yield

According to the results of the experiment, methane emissions in charcoal production were negatively correlated with charcoal yield (Figure 15). The best fit between the two variables was obtained by means of a simple linear regression (i.e. $y = \beta 0 + \beta 1x + \varepsilon$; where: y = dependent variable: methane emissions; x = independent variable: gravimetric yield in carbonization; β_1 = slope: regression coefficient; β_0 = adjusted line intercept; ε = random error that is the part of y that is not explained by x). According to the coefficient of determination (R_2 = 0.8639), the gravimetric carbonization yield explains 86% of the total variation in methane emissions.

As expressed by the linear model, 1% increase in charcoal yield could eliminate emissions of about 3 kg of CH_4 (or 63 kg of CO_2-equivalent) per ton of charcoal produced.

The best fit obtained in this experiment was very similar to that reported in the Project Design Document (PDD) of the project activity entitled "Mitigation of Methane Emissions in the Charcoal Production of Plantar, Brazil", version 6a (05 July 2007) (Figure 16). In that experiment, the best-fit model was established as y = -3.4037x + 147, with a coefficient of determination (R2) of 0.6965.

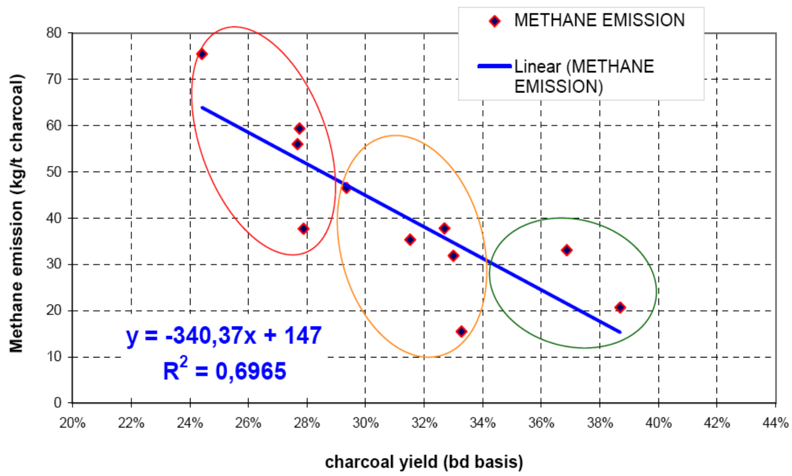

Figure 16. Correlation between methane emissions and charcoal yield reported in PDD "Mitigation of Methane Emissions in the Charcoal Production of Plantar, Brazil", version 6a (05 July 2007)

Project emissions in the transportation of reducing agents to the industrial facility ($RAT_{Vehicle, PJ, y}$) will be accounted as per Option 2 (Project emissions from transport based on distance traveled by vehicles) of AM0082/Version 01, Annex 2, Item A.2.2, using the formulae below, in a similar fashion to the emissions due to transportation of biomass to carbonization sites:

(19) $$RAT_{Vehicle,PJ,y} = N_{v,PJ,y} \times AVD_{i,PJ,y} \times EF_{v,km,CO_2,PJ,y}$$

Where:

$RAT_{Vehicle,PJ,y}$ = CO_2 emissions within the project boundary due to fossil fuel combustion from vehicles used to transport reducing agent(s) to iron ore reduction facility during year *y* of the project scenario (tCO_2/year);
$N_{RAT, PJ, Y}$ = Number of round trips (to and from) per type *v* of vehicle in project activity in the year *y;*
$AVD_{RAT, PJ, Y}$ = Average round trip distance (to and from) between the reducing agent type *v* production site (s) and the iron ore reduction site of the project activity during the year *y* (km);
$EF_{v,km,CO2,y}$ = CO_2 emission factor for type v of vehicle during the year *y* (tCO_2/km).

Project process emissions ($IRE_{PJ,y}$)

The process emissions from the use of reducing agent in the new iron ore reduction process are calculated using the steps outlined below:

a. Calculation of project process emissions

(20) $$IRE_{PJ,y} = \left(P_{PJ,y} \times EF_{Ind,PJ,y}\right) - \left(P_{PJ,y} \times Cc_{HM,PJ,y} \times 44/12\right)$$

Where:
$IRE_{PJ, y}$ = Project process emissions in the iron ore reduction facility in year y (tCO_2e);
$P_{PJ, y}$ = Hot metal production in year y (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);
$Cc_{HM, PJ, y}$ = 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).

b. Calculation of the project emission factor

(21) $$EF_{Ind,PJ,y} = \sum_i \frac{\left(\%C \cdot RA_{PJ,i}\right)}{100} \cdot \frac{44}{12}$$

Where:
$EF_{Ind, PJ, y}$ = Emission factor of one tonne of hot metal production under the project scenario (tCO_2e/ t of hot metal).
$\%C_i$ = Carbon content of the reducing agent i, in percent.
$RA_{PJ\ i}$ = Renewable reducing agent type i (i.e. renewable charcoal) requirement to produce one tonne of hot metal in the project scenario (tonne of reducing agent/ tonne of hot metal);
44/12 = Conversion factor from carbon to CO_2e (dimensionless).

Since the reducing agent employed in the project scenario (i.e. charcoal) is originated from renewable wood produced in dedicated plantations, its fossil carbon content (%C_i) is null. Hence, applying this value to the calculations of project process emissions results in $\mathbf{IRE_{PJ,y} = 0}$.

Leakage

The leakage assessment includes procedures to evaluate the change in emissions associated with the primary carbon extraction activity (eucalypt plantations establishment) outside the project boundary. This change happens due to the displacement of economic activities such as harvest of fuel wood for meeting domestic energy needs and use of lands as pastures for grazing/fodder collection.

As explained above, there are two types of plantation areas: reformed and newly established. The reformed plantations have been established back in 80's (Timeline CAF 2000), and since them have been only reformed. Therefore, no displacement of economic activities will happen due to the proposed project activity. The new plantations will be established on the degraded pastures of Zona da Mata region. According to the requirements of the PPF project (PPF Manual), only pasture lands are eligible for reforestation activities (condition evidenced by land eligibility study according the UNFCCC rules, (ID 8). Another condition of this program is that no more than 50% of the farm's area can be reforested, i.e. the farmer will continue grazing and/or agricultural activities on another half of the property.

Due to the above reasons, it can be concluded that no leakage in form of displacement of economic activities will occur due to implementation of the proposed project activity.

<u>Emission Reductions (ER y)</u>

Emission reductions are calculated as following:

(22) $$ER = BE_y - PE_y - LE_y - MAX\left(0, RAE_{BL,y} - RAE_{PJ,y}\right)$$

Where:

ERy = Emission reductions in year *y* (tCO_2e/yr);

BEy = Baseline emissions in year *y* (tCO_2e/yr);

PEy = Project emissions in year *y* (tCO_2e/yr);

LEy = Leakage emissions in year *y* (tCO_2e/yr);

$RAE_{BL,y}$ = Baseline upstream emissions in the reducing agent supply in year *y* (tCO_2e/yr);

$RAE_{PJ,y}$ = Project upstream emissions associated with production of reducing agents and transport in year y in the project scenario (tCO_2e/yr).

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	$RA_{BL,i}$
Data unit:	t coal coke / t hot metal
Description:	Quantity of coal coke necessary to produce one tonne of hot metal

Source of data used:	PP historical data
Value applied:	0.517
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value of the quantity of coal coke necessary to produce one tonne of hot metal was adopted from the engineering and historical data of the technology used by a compatible blast furnace of ArcelorMittal located in the municipality of João Monlevade.
Any comment:	Applied in the equation (3)

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 used:	Project participant historical data [44]
Value applied:	89
Justification of the choice of data or description of measurement methods and procedures actually applied :	The carbon content of the reducing agent used in the baseline scenario, the coal coke, was determined through measurements of this raw material in the pig iron reduction facilities of ArcelorMittal and it is applied conservatively in this section as being 89% of the coal coke weight.
Any comment:	Applied in the equation (7)

Data / Parameter:	$EF_{CO2e, coal coke, y}$
Data unit:	tCO2e / t coal coke
Description:	Emission factor to produce one tonne of coal coke in the iron ore reduction system baseline scenario
Source of data used:	Table 3 of Annex 1 of AM0082 version 01
Value applied:	0.4026
Justification of the choice of data or description of measurement methods and procedures actually applied :	As there is no operational data available, according to the methodology applied, a default value of Emission Factor shall be applied. For conservativeness, the option “flared” was chosen and used (EF = 0.4026 tCO2e / t coal coke).
Any comment:	Applied in equation (3)

Data / Parameter:	**$EF_{VF, BL}$**
Data unit:	tCO_2/liter
Description:	Emission factor for vehicle type *v* with fuel type *f* in the baseline scenario
Source of data used:	The calculation of the CO_2 emission emission factor of diesel oil (2.575 kg CO_2/l) was based on data from the National Energetic Balance, 2010 (*Balanço Energético Nacional – BEN, 2010*)[26] (net

[26] BEN, 2010. Table VIII.9 \| Specific Mass and Heating Values, accessed 04/11/2010, <https://ben.epe.gov.br/downloads/Relatorio_Final_BEN_2010.pdf>.

	calorific value, 10.100 kcal/kg; and specific mass, 840 kg/m^3) and from IPCC 2006 (Volume 2, Chapter 1, Table 1.4 - Default CO_2 emission factor for combustion) (CO_2 emission factor for diesel combustion, 72,600 kg CO_2/TJ).
Value applied:	0.002575
Justification of the choice of data or description of measurement methods and procedures actually applied :	National official information and IPCC default values were used in the calculation of this parameter, since values provided by fuel supplier in invoices and measurements by project participants were not available.
Any comment:	Applied in the equation (4)

Data / Parameter:	$\boldsymbol{n_{VF,BL,y}}$
Data unit:	-
Description:	Number of vehicles of type *v* with fuel type *f* in year *y* in the baseline scenario
Source of data used:	Defined ex-ante as described below.
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Fuel consumption is expressed as the quantity of fuel consumed ($\mathbf{FC_{VF,BL,y}}$) per tonne cargo x km transported. Hence, for the application of $\mathbf{FC_{VF,BL,y}}$ in equation 5 the value assumed for $\boldsymbol{n_{VF,BL,y}}$ must be 1, meaning that all the yearly load is hypotheticaly transported in 1 trip.
Any comment:	Applied in the equation (5)

Data / Parameter:	$\mathbf{k_{VF,\ BL,\ y}}$
Data unit:	km/year
Description:	Kilometers traveled by each of vehicle type *v* with fuel type *f* in the baseline scenario
Source of data used:	Ferrovia Centro-Atlântica (accessed 22/10/2010, <http://www.fcasa.com.br/wp-content/uploads/2010/02/mapacompleto.pdf>). Distance between the project plant to the coking facility: 626 km – calculated using “Minas Gerais’ Railroald” shapefile (source: *Centro de Sensoriamento Remoto*/Remote Sensing Center /CSR of the *Instituto Brasileiro de Meio Ambiente*/Brazilian Environment Institute/IBAMA, accessed 22/10/2010, <http://siscom.ibama.gov.br/shapes/>), using the GPS TrackMaker software.
Value applied:	626
Justification of the choice of data or description of measurement methods and procedures actually applied :	This corresponds to the shortest railroad distance from the site where the baseline reducing agent would be produced and the iron ore reduction facility.
Any comment:	Applied in the equation (5)

Data / Parameter:	$\mathbf{e_{VF,BL,y}}$
Data unit:	liters/km
Description:	Average fuel consumption of vehicle type *v* with fuel type *f* in the baseline scenario
Source of data used:	Calculated ex-post as described below.
Value applied:	627.57
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on the Brazilian Land Transportation Agency (ANTT), the historical train fuel consumption of the Concessionaries that control the rail flow between Vitória/ES and Juiz de Fora/MG is 0.00337 litres of diesel per tku ($l.t^{-1}.km^{-1}$). Considering the estimated yearly pig iron production (360,000 t pig iron/year) and the factor $RA_{BL,\ i}$ (0.517 t coke/t pig iron), the total yearly amount of coke to be transported in the baseline corresponds to 186,120 t. Hence, in order to transport the totality of coke to be consumed in one year in the baseline scenario, diesel consumption in the baseline scenario would correspond to 627.57 l/km.
Any comment:	Applied in the equation (5)

Data / Parameter:	$\mathbf{FC_{VF,\ BL,\ y}}$
Data unit:	Consumption of fuel type *f* of vehicle type *v* in the baseline scenario
Description:	Liters/year
Source of data used:	Calculated ex-post as described below.
Value applied:	785,722
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as per equation 04.
Any comment:	Applied in the equation (4)

Data / Parameter:	$\boldsymbol{v_{BL}}$
Data unit:	-
Description:	Vehicle type in the baseline scenario
Source of data used:	Project participant data
Value applied:	Train
Justification of the choice of data or description of measurement methods and procedures actually applied :	Most conservative option for coal coke transportation in the baseline scenario.
Any comment:	Applied in the equation (4) and (5)

Data / Parameter:	$\boldsymbol{f_{BL}}$
Data unit:	-
Description:	Fuel type in the baseline scenario
Source of data used:	Project participant data
Value applied:	Diesel

Justification of the choice of data or description of measurement methods and procedures actually applied :	Applicable fuel.
Any comment:	Applied in the equation (4) and (5)

Data / Parameter:	$\mathbf{EF_{CO2,i,y}}$
Data unit:	tCO_2/TJ
Description:	Average CO_2 emission factor of fuel type i in year y
Source of data used:	National Energetic Balance of Brazil (BEN) 2009
Value applied:	72.6
Justification of the choice of data or description of measurement methods and procedures actually applied :	Most recent national official data available.
Any comment:	Applied in the equation (13)

Data / Parameter:	$\mathbf{NCV_{DIESEL}}$
Data unit:	TJ / liter
Description:	Average net calorific value of diesel
Source of data used:	Official data – National Energetic Balance 2009 (Table VIII.9, page 216)
Value applied:	0.00003546 TJ/liter
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value published is 10,100 kcal/kg. Also it gives the fuel specific mass as being 840 kg/m^3 or 0,840 kg/liter. The conversion factor from kcal to kJ is 4,18. Based on the above data it was calculated the NCV from the fuel used (diesel) to express it in the unit of TJ/liter, in order to facilitate its application in the ERs' calculation.
Any comment:	Applied in the equation (13)

Data / Parameter:	$\mathbf{COEF_{i,y}}$
Data unit:	tCO_2/liter
Description:	CO_2 emission coefficient of diesel
Source of data used:	Calculated ex-ante as described below.
Value applied:	0.002575
Justification of the choice of data or description of measurement methods and procedures actually applied :	The following formulae is applied for the parameter calculation: $COEF_{i,y} = NCV_{i,y} \bullet EF_{CO2,i,y}$ $0.002575 = 0.00003546 \bullet 72.6$

Any comment:	Results from the application of equation (13)

Data / Parameter:	$EF_{v,km,CO_2,PJ,y}$
Data unit:	$kgCO_2/km$
Description:	CO_2 emission factor for type v of vehicle during the year *y*
Source of data used:	Brazilian GHG Protocol
Value applied:	1.12
Justification of the choice of data or description of measurement methods and procedures actually applied :	Country specific data. v = truck.
Any comment:	Applied in the equation (14) and (19)

Data / Parameter:	**EF_1**
Data unit:	tonne-N_2O-N /t-N input
Description:	Emission Factor for emissions from N inputs
Source of data used:	IPCC 2006 Guidelines
Value applied:	0.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	The A/R tool "Estimation of direct nitrous oxide emission from nitrogen fertilization" version 01, states this value has to be used in case no country specific value is found.
Any comment:	Applied in the equation (15)

Data / Parameter:	**$Frac_{GASF}$**
Data unit:	-
Description:	Fraction that volatilizes as NH_3 and NO_X for synthetic fertilizers
Source of data used:	The A/R tool "Estimation of direct nitrous oxide emission from nitrogen fertilization" version 01
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Adopted as per A/R tool.
Any comment:	Applied in the equation (16).

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO2e/tCH4
Description:	Global warming potential for CH_4
Source of data used:	IPCC Guidelines 2006

Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	The most recent data available for the methane's Global Warming Potencial was applied.
Any comment:	Applied in the equation (17)

Data / Parameter:	**GWP $_{N2O}$**
Data unit:	$tCO2e/tN_2O$
Description:	Global warming potential for N_2O
Source of data used:	IPCC Guidelines 2006
Value applied:	310
Justification of the choice of data or description of measurement methods and procedures actually applied :	The most recent data available for the methane's Global Warming Potencial was applied.
Any comment:	Applied in the equation (15)

B.6.3. Ex-ante calculation of emission reductions:

All applicable formulae applicable to e-ante calculation of emission reductions are presented in section B.6.1. The following paragraphs, hence, enumerate and justify the values used in the ex-ante estimation of emission reductions not discussed in section B.6.1.

Since the proposed project is a greenfield project, for the <u>ex-ante estimation of baseline emissions from the production of reducing agents</u>, $P_{PJ, y}$ corresponds to the expected yearly hot metal production.

Table 13. Summary of parameters used in the ex-ante estimation of yearly baseline emissions from the production of reducing agents.

Parameter	Unit	Value
$P_{PJ, y}$	t	360,000
$EF_{CO2e, coal coke,,y}$	tCO_2e/ t of coal coke	0.4026
$RA_{BL, i}$	t coal coke / t hot metal	0.517
$RAP_{BL, coal coke, y}$	**tCO_2/yr**	**74,932**

Table 14. Summary of parameters used in the calculation of $RAT_{Vehicle, BL,y}$, and calculation results

Parameter	Unit	Value
$EF_{VF,BL}$	tCO_2/liter	0.2575
$FC_{VF,BL,y}$	litres/yr	785,722
$n_{VF,BL,y}$	-	1
$k_{VF,BL,y}$	km/yr	1,252
$e_{VF,BL,y}$	litres/km	627.57
$RAT_{Vehicle, BL,y}$	**tCO_2/yr**	**2,023**

For the estimation of project emissions from fuel consumption in the establishment of plantations, a conservative value of diesel consumption of 333.4 liters per hectare is adopted[27] is adopted due to the impossibility of controlling the fuel consumption of the sub-contracters operations. The default value of fuel combusted per hectare applied is 435% higher that average diesel consumption internally registered by the project entity, which historically was 76,53 liters/ha/year between 2006 and 2009. The default value will be multiplied by the area (in ha) harvested to produce iron ore.

In order to produce one ton of hot metal, in average 3 m^3 of charcoal is needed[28]. An averga conversion index between wood and charcoal is 2 m^3 of wood to 1 m^3 of charcoal[29]. For ex ante estimation, it will be considered that production of one ton of hot metal 6 m^3 would be needed, i.e. in order to produce 360,000 tones of hot metal 2,160,000.0 m^3 of wood is needed. Average annual increment of the project anetity's plantations is 38 m^3 per hectare per year (AMBioFlorestas FMP), which corresponds to production of 266 m^3 per hectare. Hence, in order to produce necessary quantity of wood an area of 8,120 hectares will be planted and harvested yearly. Therefore, approximately 2,707,308 litres of diesel will be consumed in the establishement of plantations yearly.

Table 15. Summary of parameters used in the ex-ante estimation of yearly project emissions in establishment of plantations.

Parameter	Unit	Value
$FC_{i,j,y}$	Liter/yr	2,707,308
$COEF_{i,y}$	tCO_2/liter	0.002575
$NCV_{i,y}$	TJ/liter	0.00003546
$EF_{CO2,i,y}$	tCO_2/TJ	72.6
$E_{FuelBurn,PJ,y}$	**tCO_2e/yr**	**6,970**

Ex-ante estimation of project emissions due to nitrogen fertilizer apllication used the parameters depicted in Table 16. According to general recommendations[30], eucalypt plantation need 350-400 kg of NPK 06-30-06 fertilizer (I) and more 150-200 kg of NPK 18-06-24 (II) applied per hectare.

Table 16. Summary of parameters used in the ex-ante estimation of yearly of project emissions due to nitrogen fertilizer apllication.

Parameter	Unit	Value
$M_{SFi,t}$	(tonnes / yr) / ha	Fertilizer I = 0.400 Fertilizer II and III = 0.200
$F_{SN,t}$	tN / yr	263
EF_1	tonne-N_2O-N /(t-N input)	0.01

[27] Moreira C. et al. *Avaliação energética de cultivo de eucalipto, com e sem composto de lixo urbano*. Accessed 18/11/2010, http://200.145.140.50/html/CD_REVISTA_ENERGIA_vol4/vol20n42005/artigos/Carlos%20Roberto%20Moreira.pdf.
[28] Braga, R.N.B et al. Aspectos tecnológicos relativos à preparação de carga e operação de alto-forno. Associação Brasileira de Metalurgia e Materiais, 1994.
[29] Fontes, A.A. Importância do carvão vegetal para a economia brasileira. Federal Univesity of Viçosa, Dept of Forest Engineering, accessed 18/11/2010, http://www.ciflorestas.com.br/download.php?tabela=documentos&id=87
[30] Crestana, M.; Moreira, R. Informações Tecnológicas. Plantio de Eucalipto, accessed 18/11/2010, http://www.infobibos.com/Artigos/2009_3/eucalipto/index.htm.

$Frac_{GASF}$	-	0.1
NC $_{SF, i}$	(gN/100 fertilizer)	Fertilizer I = 0.06 Fertilizer II and III = 0.18
GWP_{N2O}	tCO_2e / tN_2O	310
N_2O direct- Nt	**tCO_2/year**	**1,282**

For the ex-ante estimation of project emissions in the transport of biomass to the carbonization sites the following facts must be taken into account:

The biomass to be used in the proposed project activity is supplied from dedicated plantations established and maintained by the ArcelorMittal BioFlorestas. The plantations are located in various municipalities and the carbonization units are located in close vicinity of the plantations. The estimated average distance between the primary carbon source (plantations) and the site of production the reducing agents (carbonization sites) equals 18 km. Considering that average yearly harvested area (8,120.0 ha) and the average wood yield at harvest (266 m^3/ha), one estimated the total amount of wood to be transported to the carbonization facilities (2,160,000 m^3). Considering an estimated truckload capacity (35 m^3), the estimated total number of round trips per year is 61,714.

Table 17. Summary of parameters used in the ex-ante estimation of yearly project emissions in the transport of biomass to the corbonization sites.

Parameter	Unit	Value
N $_{PCE, PJ, y}$	(round trips)	61,714
AVD $_{PCE, PJ, y}$	km	36
$EF_{TRUCK,CO2, y}$	$kgCO_2$/km	1.12
EP $_{VEHICLE, PCE, PJ, Y}$	**tCO_2/year**	**2,488**

Ex-ante estimation of project CH_4 emissions in the carbonization process employed the parameters depicted in the Table below. P $_{PJ, y}$ consists in the expected yearly hot metal production during the project activity.

Table 18. Summary of parameters used in the ex-ante estimation of project CH_4 emissions in the carbonization process .

Parameter	Unit	Value
P $_{PJ, y}$	tonnes of hot metal	360,000
F $_{PJ, charcoal}$	t charcoal/t of hot metal	0.6
EF $_{CH4, charcoal, PJ, y}$	tCH_4/t of charcoal	0.04397
GWP $_{CH4}$	tCO_2e/tCH_4	21
Y $_{PJ}$	t charcoal / t wood (dry basis)	0.31
RAP $_{PJ, charcoal, y}$	**tCO_2/year**	**199,438**

For the ex-ante estimation of project emissions from fuel consumption in the establishment of plantations it is noteworthy that the longest distance between the carbonization units and the iron ore reduction facility (650 km) was employed. Hence, the round trip distance (AVD $_{PJ, y}$) used in ex ante calculations equaled 1,300 km. The annual charcoal consumption was estimated as 216,000 tons, considering 6:10 charcoal:hot metal ratio. Moreover, according to internal registries of the PP, transportation capacity of a charcoal truck is 23 t per trip. Hence, in order to transport the estimated quantity of charcoal, 9,391 roound-trips would be needed.

Table 19. Summary of parameters used in the ex-ante estimation of yearly of project emissions due to the transportation of charcoal to the iron ore reduction facility.

Parameter	Unit	Value
$N_{PJ, charcoal, y}$	(round trips)	9,391
$AVD_{PJ, y}$	km	1,300
$EF_{TRUCK,CO2, y}$ (IPCC2006, GHG P Brasil)	$kgCO_2$/km	1.12
$RAT_{Vehicle, PJ, y}$	**tCO_2/year**	**13,674**

Table 20. Summary of parameters used in the ex-ante estimation of yearly baseline process emissions.

Parameter	Unit	Value
$P_{PJ, y}$	Tonnes of hot metal	360,000
$EF_{Ind, BL}$	tCO_2e / t of hot metal	1.703
$Cc_{HM, BL, y}$	tCO_2e / t of hot metal	0
$\%C_{BL, y}$	Carbon % in the coke	89
$RA_{BL\ i}$	t reducing agent/ t of hot metal	0.517
$\%C_{HM, PJ, y}$	Carbon % in the hot metal	0
$IRE_{BL, y}$	**tCO_2/yr**	**607.372**

Baseline Emissions (tCO_2e/yr)

$$BE_Y = RAE_{BL,Y} + IRE_{BL,Y} = 76,955 + 607,372 = 684,326 \ tCO_2 / year$$

Project Emissions (tCO_2e/yr)

$$PE_Y = RAE_{PJ} + IRE_{PJ} = 223,852 + 0 = 223,852 \ tCO_2 / year$$

Emission Reductions (tCO2e/yr)

$$ER_Y = BE_Y - PE_Y = 684,326 - 223,852 = 460,474 \ tCO_2 / year$$

B.6.4 Summary of the ex-ante estimation of emission reductions:

Years	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
01/01/2013	223,852	684,326	0	460,474
2014	223,852	684,326	0	460,474
2015	223,852	684,326	0	460,474
2016	223,852	684,326	0	460,474
2017	223,852	684,326	0	460,474

2018	223,852	684,326	0	460,474
31/12/2019	223,852	684,326	0	460,474
Total (tonnes of CO_2e)	**1,566,964**	**4,790,282**	**0**	**3,223,318**

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**$P_{PJ,y}$**
Data unit:	Tonnes of hot metal
Description:	Hot metal production in the project scenario in year *y*
Source of data to be used:	Iron reduction facility monitored data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	360,000
Description of measurement methods and procedures to be applied:	The production is weighted daily and the data is aggregated monthly and/or annually as per Internal Procedure GEAMB PS 0002.
QA/QC procedures to be applied:	The equipments of measurement of this parameter will be calibrated following internal procedures not exceeding the manufacturer's recommendation. Following the version 01 of the methodology AM0082, the total iron ore reduction produced in the facility will be: - 100% measured by weight, recorded continuously and aggregated daily; - the accuracy of the equipment is < 5%; - the manufacture's recommendation is to calibrate annually (Internal Procedure GE LEI PO 0229);
Any comment:	Applied in the equations (3) and (16)

Data / Parameter:	**$FC_{i,j,y}$**
Data unit:	liters/year
Description:	Quantity of fuel type i combusted in process j during the year y
Source of data to be used:	Project participant monitored data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2.707.308
Description of measurement methods and procedures to be applied:	For both *ex ante* and *ex post* calculations a conservative value of diesel consumption of 333.4 liters per hectare is adopted[31] is adopted due to the impossibility of controlling the fuel consumption of the sub-contracters operations. The default value of fuel combusted per hectare applied is 435% higher that average diesel consumption internally registered by the project entity, which historically was 76,53 liters/ha/year between 2006-09. The default value will be multiplied by the area (in ha) harvested to produce iron ore.

[31] Moreira C. et al. *Avaliação energética de cultivo de eucalipto, com e sem composto de lixo urbano*. Accessed 18/11/2010, http://200.145.140.50/html/CD_REVISTA_ENERGIA_vol4/vol20n42005/artigos/Carlos%20Roberto%20Moreira.pdf.

QA/QC procedures to be applied:	Internal procedure GEAMB PS 0002 applied.
Any comment:	Applied in equation (12)

Data / Parameter:	$N_{PCE, PJ, y}$
Data unit:	-
Description:	Number of round trips (to and from) of the trucks in the project activity during the year *y* to transport biomass to the carbonization site(s)
Source of data to be used:	Calculated as described below
Value of data applied for the purpose of calculating expected emission reductions in section B.5	61,714
Description of measurement methods and procedures to be applied:	Ex ante: considering that 8,120.3 ha will be harvested per year and that the average volume harvested per year is 266 m^3/ha, the total of 2,160,000 m^3 will need to be transported per year. The loading capacity of the truck is 35 $m^{3.}$ Ex post: points of departure and arrival are monitored for each truck within the project boundary according to Supply Chain Procedures (PS S01 4.4.6 03). Each arrival of a truck from plantation site (departure) to CPU (destination) will be registered in the AM CarbonMonitor based on the Annex 2 of PS S01 4.4.6 03 "Wood Transportation Control". The registries of trucks from each destination multiplied by two will compose the number of round trips per year per destination.
QA/QC procedures to be applied:	Internal procedure GEAMB PS 0002 applied.
Any comment:	Applied in equation (14)

Data / Parameter:	$N_{RAT, PJ, y}$
Data unit:	-
Description:	Number of round trips (to and from) of the trucks in the project activity during the year *y* to transport charcoal from the reducing agent production site(s) to the iron ore reduction facility
Source of data to be used:	Calculated as described below
Value of data applied for the purpose of calculating expected emission reductions in section B.5	9,391
Description of measurement methods and procedures to be applied:	Ex ante: Considering that to produce 1,000 kg of hot metal approximately 600 kg of charcoal is needed ($RA_{PJ, Y}$), the annual value of charcoal needed in the project activity is 216,000 tons. Ex post: According to Item 5.3.6 of Supply Chain Procedures (PS S01 4.4.6 03), after the truck is loaded with charcoal at UPC where it was produced, it is being weighted and emitted an invoice. This invoice covers up transportation of the charcoal until the industrial facility. A specific internal procedure PPO

	S03 A02 008 provides the guidance on charcoal expedition. The number of invoices from each CPU multiplied by two reflects the number of round trips from each CPU.
QA/QC procedures to be applied:	
Any comment:	Applied in equation (18)

Data / Parameter:	**$AVD_{PCE, PJ, Y}$**
Data unit:	Km
Description:	Average round trip distance (to and from) between the plantation areas and the reducing agent production site(s) in the project scenario during the year *y*
Source of data to be used:	Project proponent data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	36
Description of measurement methods and procedures to be applied:	Ex ante: Calculated based on the longest distance as the most conservative value, according to internal data. Ex post: Distance between plantation site and CPU shall be chosen from matrix of distances provided in the Monitoring Plan and defined on official records and road maps data depending on the plantation site (point of departure).
QA/QC procedures to be applied:	Registry in the Annex 2 of PS S01 4.4.6 03 "Wood Transportation Control", for each truck. Internal procedure GEAMB PS 0002 also applied.
Any comment:	Applied in the equation (14)

Data / Parameter:	**$AVD_{RAT, PJ, Y}$**
Data unit:	Km
Description:	Average round trip distance (to and from) between the reducing agent production site(s) and the iron ore reduction system facility in the project scenario during the year *y*
Source of data to be used:	Project proponent data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1,300
Description of measurement methods and procedures to be applied:	Ex ante: Calculated based on the longest distance as the most conservative value, according to internal records. Ex post: Distance between CPUs and industrial facility shall be chosen from matrix of distances provided in the Monitoring Plan and defined on official records and road maps data, depending on the CPU site (point of departure).
QA/QC procedures to be applied:	Registry in the invoice.
Any comment:	Applied in the equation (17)

Data / Parameter:	**$F_{PJ, CHARCOAL}$**
Data unit:	Quantity of charcoal necessary to produce one tonne of hot metal in the project scenario
Description:	t charcoal / t of hot metal
Source of data to be used:	Monitoring project data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.6 Value applied based on historical data of the production facility.
Description of measurement methods and procedures to be applied:	The parameter will be monitored daily applying Standard Operational Procedures GEAMB PS 0002 and aggregated annually.
QA/QC procedures to be applied:	The equipments of measurement of this parameter will be calibrated following internal procedures not exceeding manufacturer recommendation.
Any comment:	Applied in the equation (16)

Data / Parameter:	**Y_{PJ}**
Data unit:	Tonne of charcoal / tonne of wood on dry basis
Description:	Carbonization Gravimetric yield
Source of data to be used:	Data monitored according to the methodology AM0041
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.31
Description of measurement methods and procedures to be applied:	Ex ante: weighted average value according to internal records. Ex post: Internal procedure GEAMB PS 0002 applied to calculate (on dry-basis) and cross-check the charcoal weight with the wood sweight used in the carbonization process.
QA/QC procedures to be applied:	Follow operational guidelines in the applicable research and work instructions with a step by step guide for calculations.
Any comment:	Applied in the equation (17)

Data / Parameter:	**$EF_{CH4, charcoal, PJ, Y}$**
Data unit:	tCH_4/t of charcoal
Description:	Emission Factor to produce one tonne of renewable charcoal identified in the project supply chain
Source of data to be used:	Data from the experimental protocol demonstrating the relationship between methane emissions and carbonization gravimetric yield.
Value of data applied for the purpose of	0.04397

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Calculation of methane emission factor of the project activity in accordance with the regression relationship: $EF_{CH4, charcoal, PJ,y} = f(Y_{PJ}) = (A – B) * Y_{PJ}$ y = -3.3262 * x+147.08
QA/QC procedures to be applied:	N/A
Any comment:	Applied in the equation (16)

Data / Parameter:	**$NC_{SF, i}$**
Data unit:	gN / 100g fertilizer
Description:	Nitrogen content of synthetic fertilizer type i applied
Source of data to be used:	Fertilizer producer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Fertilizer I – 6 gN/100g Fertilizer Fertilizer II and III – 8 gN/100g Fertilizer
Description of measurement methods and procedures to be applied:	Nitrogen content of applied fertilizer is based on manucfacture's information. The fertilizers applied are presented in the parameter "i" below.
QA/QC procedures to be applied:	Information will be cross-check with fertilizer purchase receipts.
Any comment:	Applied in the equation (15a)

Data / Parameter:	i
Data unit:	-
Description:	Number of synthetic fertilizer types
Source of data to be used:	Project Participant monitored data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	- Fertilizer I = NPK 06-30-12 Fertilizer II = 08-00-32 Fertilizer III = 08-00-32
Description of measurement methods and procedures to be applied:	Registry of applied fertilizer in the Forest Cadastre system.
QA/QC procedures to be applied:	Cross-check with fertilizers application data control.
Any comment:	Applied in the equation (15a)

Data / Parameter:	$M_{SFi,t}$
Data unit:	(tonnes/ha) /year
Description:	Mass of synthetic fertilizer type i applied
Source of data to be used:	Project participant monitored data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.180 from the fertilizer type I 0.270 from the fertilizer II and III
Description of measurement methods and procedures to be applied:	Ex ante: historic average of tonnes of fertilizer applied per hectare is used (based on internal records). Ex post: quantity of fertilizer applied per hectare per year at each plantation site will be registered in the Forest Cadastre system.
QA/QC procedures to be applied:	n/a
Any comment:	Applied in the equation (15a)

Data / Parameter:	A_{PJ}
Data unit:	Hectares (ha)
Description:	Dedicated planted area for biomass production in the year y
Source of data to be used:	Forest Inventory and Forest Cadastre systems of PP
Value of data applied for the purpose of calculating expected emission reductions in section B.5	8,120
Description of measurement methods and procedures to be applied:	Ex-ante: calculated based on historical data of biomass and charcoal productivite and in the blast furnace charcoal consumption to produce pig iron. Ex-post: Monitored by Forest Cadastre and Forest Inventory systems of the PP.
QA/QC procedures to be applied:	N/A
Any comment:	Applied indirectly in the project activity emissions of Nitrogen fertilizing.

B.7.2. Description of the monitoring plan:

The monitoring plan is built according to the requirements of the applied methodology that provides guidance on the type of data, periodicity of data collection, data archival, and quality control measures and supports the implementation of the monitoring plan to meet the requirements of verification and compliance with local regulation. The detailed monitoring plan of the proposed project activity is attached in Annex 4 of the PDD.

1. Monitoring of the baseline scenario

The baseline scenario will be monitored by applying the baseline emissions formulae to the total amount of pig iron produced by the project entity based in the project production of the new iron ore reduction system as per the specifics characteristics of the new investment decision undertaken by the project proponent.

To determine the baseline emissions factor it is used the percentage of carbon content obtained from public available information. The carbon contents of the reducing agents are determined before the start of the project activity and will then serve as a baseline reference during the crediting period. The emission factor is a result of the equation described in this PDD (Section B, Item B.6).

Since this methodology uses similar equations for determination of baseline and project emissions and considering that the carbon contents of the reducing agents are pre-defined for the crediting period and that the emissions of the baseline scenario are under the cap presented of 360,000 tonnes of hot metal produced the CO_2 emissions in the baseline scenario are not monitored, as per the proposed methodology.

2. Monitoring of project emissions parameters

The proposed project boundary encompasses two interdependent components of the iron ore reduction system: reducing agents supplies and industrial iron ore reduction facility. All the project emissions included in the project boundary are monitored as shown in the section B.7.1 and Table 6 below.

Table 21. Summary of project activity parameters monitored.

Phase of the project activity	Parameters monitored
Primary carbon extraction	• Planted and harvested area; • Use of fertilizers; • Fossil fuels combustion.
Primary carbon transportation	Distance from plantation sites to carbonization units (option 2): • Number of round trips per type of vehicle; • Average round trip distance from the planting areas to reducing agent production site; • Emission factor per type of vehicle.
Reducing agent production	• Gravimetric yield and additional parameters (according to the methodology AM0041, version 01)
Reducing agent transportation	Distance from carbonization units to the industrial facility (option 2): • Number of round trips per type of vehicle; • Average round trip distance from the reducing agent production site to the iron reduction facility; • Emission factor per type of vehicle.
Iron ore reduction process	At the entrance of the iron ore reduction facility:

	• Reducing agent consumption; • Reducing agent origin. At the end of the iron ore reduction process: • Hot metal amount produced in the iron ore reduction process; • Hot metal carbon content.

The carbon content of the pig iron produced with renewable charcoal will always be considered as zero leading to conservative results for project emissions and emissions reductions. Therefore it is excluded from the project emissions basic monitoring flow.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

Date of completion of the application of the baseline and monitoring methodology: 12/07/2011

Responsibles persons:

- Mr. Carlos Henrique Delpupo
- Ms. Natalia Pasishnyk
- Mr. Cláudio Souza Silva
- Mr. Leandro Salvático
- Mr. Breno Rates Azevedo
- Mr. Carlos Shiguematsu
- Mr. Florian Herzog

Responsible entity: Instituto Totum (this entity is a project participant).
Address: Av. Paulista, 37 - 10th floor, Paraíso, ZipCode: 01.311-902 - São Paulo/SP - Brazil.
Tel: +55 (11) 3372-9572.
E-mail: cdelpupo@institutototum.com.br
URL: http://www.institutototum.com.br

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

12/08/2005
This corresponds to date of the first major investment in the industrial facility as shown in the project lifetime chronology presented in the section B.5.

C.1.2. Expected operational lifetime of the project activity:

The minimum operational lifetime of the project activity is 20 years due to the fact that the blast furnaces operate at least this period of time without need of refurbishment/reformation (Parreira & Santos). In case of blast furnace of ArcelorMittal CST, it operates without any major reformation during the last 22 years (CST, 2006).

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

01/01/2013 or the date of the registration of the project activity, whichever occurs later.

C.2.1.2. Length of the first crediting period:

7 years and zero months.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

The PP is in compliance with all applicable laws and regulations and obtained all applicable licenses and since all conditions were obeyed.

The State Environmental Authority of Minas Gerais, the State Secretary of Environment (FEAM) issued the following Environmental Licenses allowing the project activity implementation:

- Preliminary License 045/05 (ID 3);
- Installation License 018/06 [(ID 4);
- Provisory Operation License 018/06 (ID 5);
- Operation License 0113/07 (ID 6).

The Minas Gerais State Forest Institute (IEF) issued a Certification of Registry to the PP as “Consumer of Products and Sub-products from the Forest, including charcoal, moinha, wood bricks and charcoal pellets” (ID 7).

An Environmental Impact Study - EIA (ID 1) and a Report of Environmental Impacts - RIMA (ID 2) were provided to the Brazilian environmental authorities, which issued the environmental licenses cited in the section above, and to the DOE, demonstrating that no significant negative environmental impacts are expected from the implementation of the project activity.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

No significant negative environmental impacts are expected from the implementation of the project activity.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

This process was conducted according to the rules stated in Resolution number 7 of the CIMGC, the Brazilian DNA, which was published on March 31st 2008.

The invitation letters were sent to all stakeholders between 22th and 26th March 2010, communicating the PP's intention of submitting a greenhouse gas emission reduction project to the national and international authorities in order to generate carbon credits in the international market.

The letters were addressed to the main representatives of the below mentioned entities and the acknowledgements of receipt [31] are available upon request and for validation purposes:

City Hall, Municipality Chamber and Environmental Secretary of the following cities:

- Abaeté;
- Antônio Dias;
- Bela Vista de Minas;
- Bom Despacho;
- Capelinha;
- Carbonita;
- Coronel Fabriciano;
- Diamantina;
- Dionísio;
- Dores do Iandaiá;
- Itabiara;
- Itamanbira;
- João Monlevade;
- Juiz de Fora;
- Marliéria;
- Martinho Campos;
- Minas Novas;
- Quartel Geral;
- Rio Piracicaba;
- São José do Goiabal;
- São Pedro dos Ferros;
- Senador Modestino Gonçalves;
- Turmalina;
- Veredinha;

- Procuradoria da República of Minas Gerais State;
- Legislative Chamber of Minas Gerais State;
- Minas Gerais Public Ministry;
- Federal Public Ministry;

- Minas Gerais State Secretary of Environment (FEAM);
- Environmental Ministry of Brazil;
- Minas Gerais State Forest Institute (IEF);
- Brazilian Institute for Environment and Natural Resources (IBAMA);
- Brazilian Forum of NGO and social movements for environment and development (FBOMS);
- Environmental National Council (CONAMA);
- Water National Agency (ANA);
- Federal University of Juiz de Fora (UFJF);
- Superintendências Regionais de Meio Ambiente e Desenvolvimento Sustentável (SUPRAMs)
  - Central;
  - do Jequitinhonha;
  - do alto do São Francisco;
  - do Leste Mineiro;
  - da Zona da Mata;
- The following Social-Environmental Associations:
  - Fundação Biodiversitas;
  - Associação Mineira de Defesa do Meio-Ambiente;
  - Associação Municipal de Apoio Comunitário (AMAC);
  - Associação pelo Meio Ambiente de Juiz de Fora.

E.2. Summary of the comments received:

The stakeholders who have sent comments are listed below, following their respective comments [31a]:

- Environmental Secretary of Capelinha <Congratulating the project implementation due to its objective of sustainability>;
- Environmental Secretary of São José do Goiabal <Congratulating the fossil switch due to environmental issues and the increase in the regional economy>;
- São Vicente de Minas City Hall <Invited the PP to participle in a Industrial Exposition>;
- Associação Municipal de Apoio Comunitário de Juiz de Fora <Congratulates the PP and emphasizes its social responsibility work toward sustaintability>;
- Carbonita City Hall <States that the Project activity improves the economic development and brings a higher level of life quality>;
- Associação pelo Meio Ambiente de Juiz de Fora <States that the project is interesting and positive. It is also commented that the institution wants to make partnerships with the PP to work with Environmental Education programs>;
- Minas Novas City Hall <Congratulates the PP due to the economic, social and environmental benefits of the project activity and demonstrates interest in having also industrial activities>;
- Miradouro Environmental Secretary <States that only a few farmers from Miradouro know about the forestation opportunity generated by the project activity and the marketing should be intensified>.

- Associação pelo Meio Ambiente de Juiz de Fora <States that the project is positive and interesting, and that the forests will lead to GHG emissions reduction, although they are monoculture. Nevertheless, highlights that ArcelorMittal should retake the early partnerships with the Association and effectively invest in Environmental Education projects>.
- Associação Municipal de Apoio Comunitário <Congratulates ArcelorMittal due to the project and to its commitment with education, health, culture and environmental in the communities where it is located. Highlights that the company is a potential great partnership in stimulating entrepreneurs' social responsability>.
- FEAM <Highlights the project's environmental, social and economic benefits and the fact that the project is in accord with Minas Gerais State's governmental expectations in Climate Change Policy.>.
- Republic Procuracy of Minas Gerais State <States that the correspondence was received and forwarded to Juiz de Fora's Environmental Prosecutor.>.
- São Vicente de Minas Municipal Chamber <States that the project is an interesting manner to promote the rural activities diversification and that the Chamber will try to make feasible an opportunity of project divulgation in the city.>.

E.3. Report on how due account was taken of any comments received:

The PP acknowledge the receipt of the comments and considered that they are very valuable for the ArcelorMittal to achieve its goals towards sustainable relations with all its local and global stakeholders, as stated in the published ArcelorMittal Sustaintability Report 2006 [40]. The marketing actions to include the local communities and reproduce a higher environmental conscience are among the PP's priorities.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding regarding the project activity implementation.

Annex 3

BASELINE INFORMATION

All the baseline information is presented in the sections B.4 and B.5 above.

Annex 4

MONITORING INFORMATION

Objective

The MP outlines the guidance on monitoring procedures, including the responsibilities of the personnel involved in the project activity, in order to assure transparent calculation of the project emissions within the project boundary. The project entity is expected to provide written and oral instructions to project personnel on the monitoring procedures. It should also provide training and knowledge management procedures required for implementing monitoring procedures.

All data collected within this monitoring plan must be archived electronically and kept for at least 2 years after the end of the last crediting period. All measurements conducted within this monitoring plan must be conducted with calibrated measurement equipment according to relevant industry standards.

Monitoring period

The project monitoring is expected to cover the total project period of 21 years from the date of project registry (ca. 2011) (first crediting period of 7 years with renewal up to two additional crediting periods). This MP provides guidelines and instructions on project implementation during the project period. The MP can be amended in response to changes that may occur in the project activity as long as such amendments are in line with the general monitoring process and rationale described in this plan and are approved by a DOE during verification.

Structure

The Monitoring Plan is organized in the following chapters:

– **Chapter 1**: overview on the organization of the project activity.
– **Chapter 2**: procedures for the monitoring of the baseline and project scenarios.
– **Chapter 3**: instructions on data collection, data storage, and information management.
– **Chapter 4**: instructions for project management, reporting, and quality assurance.

Chapter 1

1.1. Project boundary

The project boundary is comprised of the following components: (i) the geographic boundaries of the reducing agents production sites, i.e. the plantation areas and the carbonization units, (ii) the physical site of the blast furnace where the iron ore reduction process takes place and (iii) the transportation of the wood until the carbonization units and of the charcoal from the carbonization units until the blast furnace.

All these components are under control of the companies from PP's group ArcelorMittal (AM) as shown in the table below below.

Component	Project Emissions type	Entity responsible for project emissions monitoring
Dedicated plantations*: areas and forestry operations	Upstream	AM BioFloresta
Transportation of wood to CPUs	Upstream	AM BioFloresta
Charcoal production **	Upstream	AM BioFloresta
Transportation of charcoal to industrial facility	Upstream	AM BioFloresta and AM Juiz de Fora
Iron ore reduction	Process	AM Juiz de Fora

* Inclusion of plantations into the project boundary:

There are two groups of dedicated plantations that supply raw material for reducing agents: (a) *reformed* plantations that are established on the own areas of ArcelorMittal BioFloresta and (b) *newly established* plantations on the areas of forest farmers that produce wood in frames of ArcelorMittal BioFloresta PPF project (outgrowth).

(a) reformed plantations: these sites are all geographically identified, listed in Annex 5 and included into the project boundary on the moment of project validation.

(b) newly established plantations: these sites are being established in frames of the Forest Outgrowth Programme (PPF) of AM BioFloresta and are planned to be registered as a A/R CDM Programme of Activities. The sites that are already identified and included in the PPF, are listed in Annex 5. All new areas that will enter the project boundary, shall attend the following requirements:

1. Be legal participants of the PPF Programme;
2. Pass through the standard process of selection (including requirements for applicability conditions of the AM0082) and registration in the database of the PP; and
3. Be registered in the Carbon Monitor of the PP under their geographic coordinates.

On the moment when PPF is registered as a A/R CDM PoA, the group (b) as well as associated project emissions will be excluded form the boundary of this industrial project.

** Charcoal production units (CPUs)

All existing charcoal production units with the project boundary are listed in Annex 5.

New charcoal production units that will process wood from PPF areas don't exist on the moment. They will be included into the project boundary of this industrial project as soon as decision on their exact location will be taken by ArcelorMittal BioFloresta.

1.2. Baseline emissions

The GHG emissions attributable to the iron ore reduction system in the baseline scenario are calculated as per the expected hot metal production of this system. The carbon content of the baseline reduction agent

(coal coke) is fixed for the crediting period. The baseline emissions are calculated based on the production capacity of the new iron ore system and therefore are fixed and not monitored.

1.3. Project emissions

The amount of pig iron produced will be monitored and recorded. The origin of the reducing agent will be carefully monitored and recorded in the Carbon Monitor database (see Figure 1 below), as well as indicators such as establishment of plantations, production and transportation of the wood and the reducing agent, and pig iron production volume. Considering that the monitoring data forms the basis for estimating the CO2 emissions, the correct application of the prescribed operational procedures for monitoring and recording of data will be periodically verified by the internal audit personnel to ensure the integrity of data. The sources of data, periodicity of data collection, and data archival methods are outlined in below.

The carbon content of the pig iron produced with renewable charcoal **will always be considered zero** leading to conservative results for project emissions and emissions reductions. Therefore, it will be excluded from the project emissions basic monitoring flow, as per provisions of applied methodology - AM0082. As the project activity only uses renewable reducing agent, monitoring of non-renewable reducing agents will also be excluded.

The monitored parameters are aggregated into Carbon Monitor from internal registries that are fulfilled according to associated internal procedures as shown in the table below:

Table23. Monitored parameters and corresponding iternal operational procedures

Phase	Parameters monitored	Original internal registry and procedures	Data provided by
Primary carbon extraction	1). Planted area (ha/yr); 2). Use of fertilizers (t/yr); 3). Fossil Fuel combustion (l/yr)	1-2) Registry: Forest Cadastre 3) Fossil fuel combustion per hectare during the field operations (planting and harvesting) is based on historical registries of the PP. It is monitored applying this average value to the monitored areas.	AM BioFloresta
Primary carbon transportation	Distance from plantation sites to carbonization units: 1). Number of round trips per type of vehicle; 2). Average round trip distance from the planting areas to reducing agent production site facility; 3). Emission factor per type of vehicle.	1). Supply Chain Control, Wood Transportation Control. Procedure: PS S01 4.4.6 03. 2). Points of departure (plantations site) and arrival (CPU) are registered in Supply Chain Control (see below), according to procedure PS S01 4.4.6 03. In Carbon Monitor, these registries are applied to a matrix of predefined average distanced between predefined points. 3). Registry: Brazilian GHG Protocol and IPCC Guidelines.	1-2) AM BioFloresta 3) n/a
Reducing agent production	Parameters according to AM0041: 1). Charcoal produced by	1) Registry: System MES. Procedure: GAAFO 0001. 2) Form "Control of Wood	1) AM Juiz de Fora 2-4) AM BioFloresta 5-6) n/a

	CPU; 2). Wood weight used for carbonization; 3). Moisture of wood used; 4). Moisture of charcoal produced; 5). Weighted average gravimetric yield; 6). Methane emission factor.	Transportation" of Supply Chain Control, according to procedure PS S01 4.4.6 03. 3-4) Registry: R&D department of AM BioFloresta. Internal procedure illustrated below. 5). Registry: Carbon Monitor. Procedure: calculated using the parameters 1-4 and applying formulae of AM0041. 6). Registry: Carbon Monitor. Procedure: calculated using the parameters 1-4 and applying formulae of AM0041.	
Reducing agent transportation	Distance from carbonization units to the industrial facility: 1). Number of round trips per type of vehicle; 2). Average round trip distance from the reducing agent production site to the iron reduction facility; 3). Emission factor per type of vehicle.	1). The number of trucks arriving to the industrial facility from the CPUs is registered in the system MES. Procedure: GAAFO 0001 of AM Juiz de Fora. 2). Points of departure (CPU) and arrival (AMJF) are registered in the emitted invoice, according to procedure PS S01 PPO S03 A02 008 of the Supply Chain Control (PS S01 4.4.6 03) of AM BioFloresta. In Carbon Monitor, these registries are applied to matrix of predefined average distanced between predefined points (see below). 3). Registry: Brazilian GHG Protocol and IPCC Guidelines.	1) AM Juiz de Fora 2) AM BioFloresta and AM Juiz de Fora 3) n/a
Iron ore reduction process	1). Reducing agent consumption; 2). Reducing agent origin. 3). Hot metal amount produced in the iron ore reduction process.	1). Registry: internal system MES. Procedure GAAFO PO 0008. 2-3). Registry: Internal system MES. Procedure GAAFO NS 0001.	1) AM Juiz de Fora 2) AM BioFloresta and AM Juiz de Fora 3) AM Juiz de Fora

1.4. Internal registries of project emissions parameters

1.4.1. The Forest Cadastre is an internal databank of ArcelorMittal BioFloresta that contains all information on forestry operations, occurences and harvesting/transportation provided by regional supervisors. The Forest Cadastre makes part of the System of Forest Register, an "all-inclusive" database centralized in ArcelorMittal Headquarters in Belo Horizonte.

The Figure 17 below provides an overview of information types contained in Forest Cadastre databank of ArcelorMittal BioFloresta.

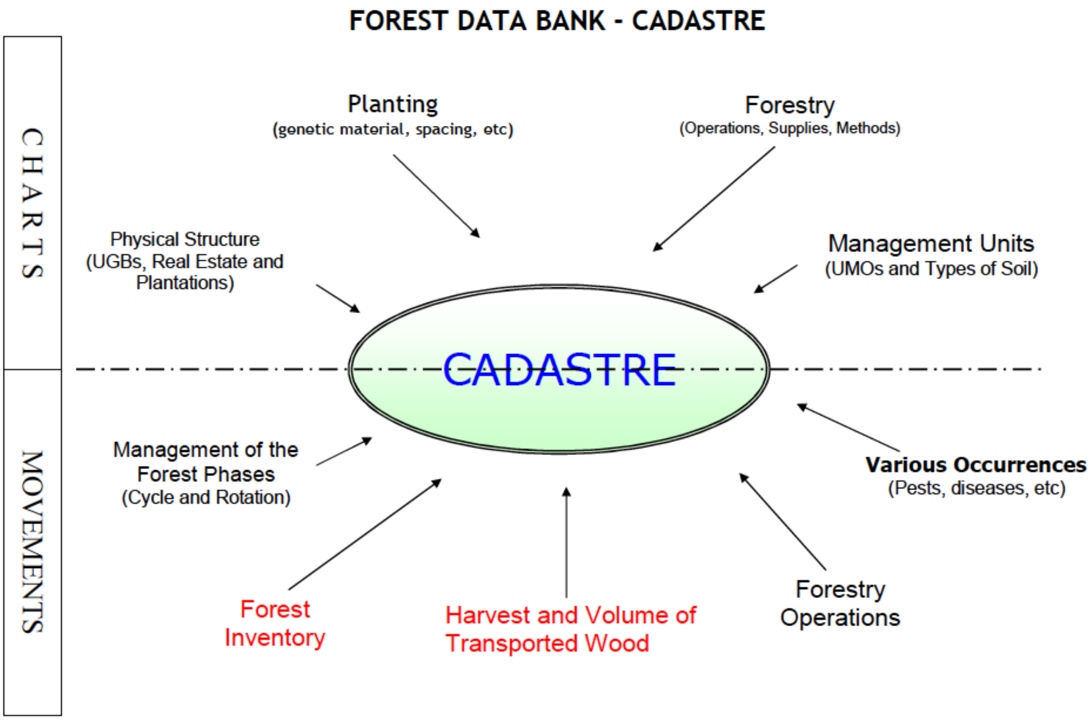

Figure 17. Information contained in Forest Cadastre databank of ArcelorMittal BioFloresta.

1.4.2. Supply Chain Control is conducted according to the provisions of procedure PS S01 4.4.6 03 (attached) based on FSC Standard for Chain of Custody Certification - FSC-STD-40-004 (Version 2-0).

Wood transportation is controlled through the forms "Wood Transportation Control" as shown on the figure below. This form is filled out when the wood is loaded for transportation in the departure point and upon arrival in the destination point (CPU).

ArcelorMittal Florestas

ArcelorMittal

PS S01 4.4.6 03 **Versão:** 01 **Data:** 17/01/2009	**PROCEDIMENTO DE SISTEMA**	**Sistema:** Gestão Integrada **Requisito:** Controle Operacional
Título: Controle de Cadeia de Custódia		

Anexo 2 - Controle de Transporte de Madeira

CADEIA DE CUSTÓDIA

Logística para assegurar o rastreamento da madeira para produção de carvão nas UPCs.

1 – Formulário para monitoramento da madeira transportada

Nº	Nº	CONTROLE DE TRANSPORTE DE MADEIRA	ArcelorMittal

Data / /	DADOS DO TRANSPORTADOR								
	Empresa: (1)			Placa Cavalo: (2)		Placa Carreta: (2)			
Empresa (16)	CARREGAMENTO								
	UGB: (3)		Talhão: (4)			Espécie: (5)			
Placa (17)	UPC: (6)			Plano de Corte: (7)					
	Data: / /		Hora: (8)		Assinatura: (9)				
Assinatura Motorista (18)	DESCARGA								
	CUBAGEM DA CARGA / ALTURAS (m) (10)								
	1º Lastro		2º Lastro		3º Lastro		4º Lastro		Nº Boxes (11)
	1		5		9		13		
	2		6		10		14		
	3		7		11		15		
	4		8		12		16		
	Média alturas (m): (10)		Volume (st): (12)		Data: / /				
	Largura (m): (10)		Peso liquido(t): (13)		Hora: (14)				
	Comprimento (m): '(10)				Assinatura: (15)				

Figure 18. Form "Control of Wood Transportation"

Items (3) and (6) stand for, respectively, planting site (departure point) and charcoal production unit (arrival point). Upon arrival of wood to the CPU, the registries are made in Carbon Monitor in order to monitor the number of round trips in the matrix of distances, as illustrated below:

Track (registry in the Form)	Distance (predefined, see Annex X)	Number of trucks (registry upon arrival on CPU)	Number of round trips per year	Distance per year
Departure $_{planting\_site\_1}$ --> Arrival $_{CPU\_1}$	D1 (km)	n_{CPU_1}	n_{CPU_1} x 2	= D1 x n_{CPU_1} x 2
Departure $_{planting\_site\_1}$ --> Arrival $_{CPU\_2}$	D2 (km)	n_{CPU_2}	n_{CPU_2} x 2	= D2 x n_{CPU_2} x 2
Departure $_{planting\_site\_2}$ --> Arrival $_{CPU\_1}$	D3 (km)	n_{CPU_1}	n_{CPU_1} x 2	= D3 x n_{CPU_1} x 2
Departure $_{planting\_site\_2}$ -->	D4 (km)	n_{CPU_2}	n_{CPU_2} x 2	= D4 x n_{CPU_2} x 2

Arrival $_{CPU\_2}$				
...	...	...	...	
Total				

As shown inFigure 19, these monitoring procedures allow for clear tracing of wood from the harvested area up to the iron-ore reduction facility. The project entity elaborates a Cutting Plan for the areas that are to be harvested during a defined period. A pre-harvesting forest inventory carried out by the project entity is used for industrial supply planning as well as resource planning of harvesting and transport equipment.

The data collected during this inventory are processed in the company information system in order to generate volumetric data for the cutting plan. It contains the properties and compartments (*Talhões*) to be harvested along with with collected round wood volume predictions.

The cutting plan is submitted to the State Forest Department (IEF) which analyzes the plan and eventually performs field verification visits in order to check physical evidence and reliability of the volume predications from inventory data.

In case of approval of the cutting plan, the IEF issues the harvesting and commercialization declaration (**DCC**) containing information about the quantity which is allowed to be harvested and processed to charcoal, the exact area (hectares) allowed to be harvested, exact information about the property containing the forest plantations (number and name of the land title), as well as the numbers of all talhões (forest compartments) permitted to be harvested.

When the loading process is completed and a truck is ready to leave the logyard, a timber transportation control form is filled out by the logyard responsible for every truckload. The form contains volumetric information of the transported timber, information of origin (talhão) as well as data of the truck and company.

Only with the DCC document and the timber transport control form the company transports timber from his properties to the Charcoal Production Unit (UPC).

Entering the UPC the truck is weighted on the company weightbridge and afterwards unloaded. All data from the timber transport control form are registered in the company database. One charcoal kiln is always used for the same DCC in order to guaranty chain of custody consistency. After the burning process, the produced charcoal is loaded on trucks and transported to the customer, which usually is the companies own iron ore producing unit.

For every truckload a fiscal invoice (nota fiscal) is issued. Without this invoice legal transportation of charcoal is not possible. The company information system database ensures that invoices will only be issued for the quantity of charcoal authorized by the forest department on the DCC.

If the complete charcoal volume of one DCC has been transported to the customer, a balance report will be submitted to the forest department for final verification.

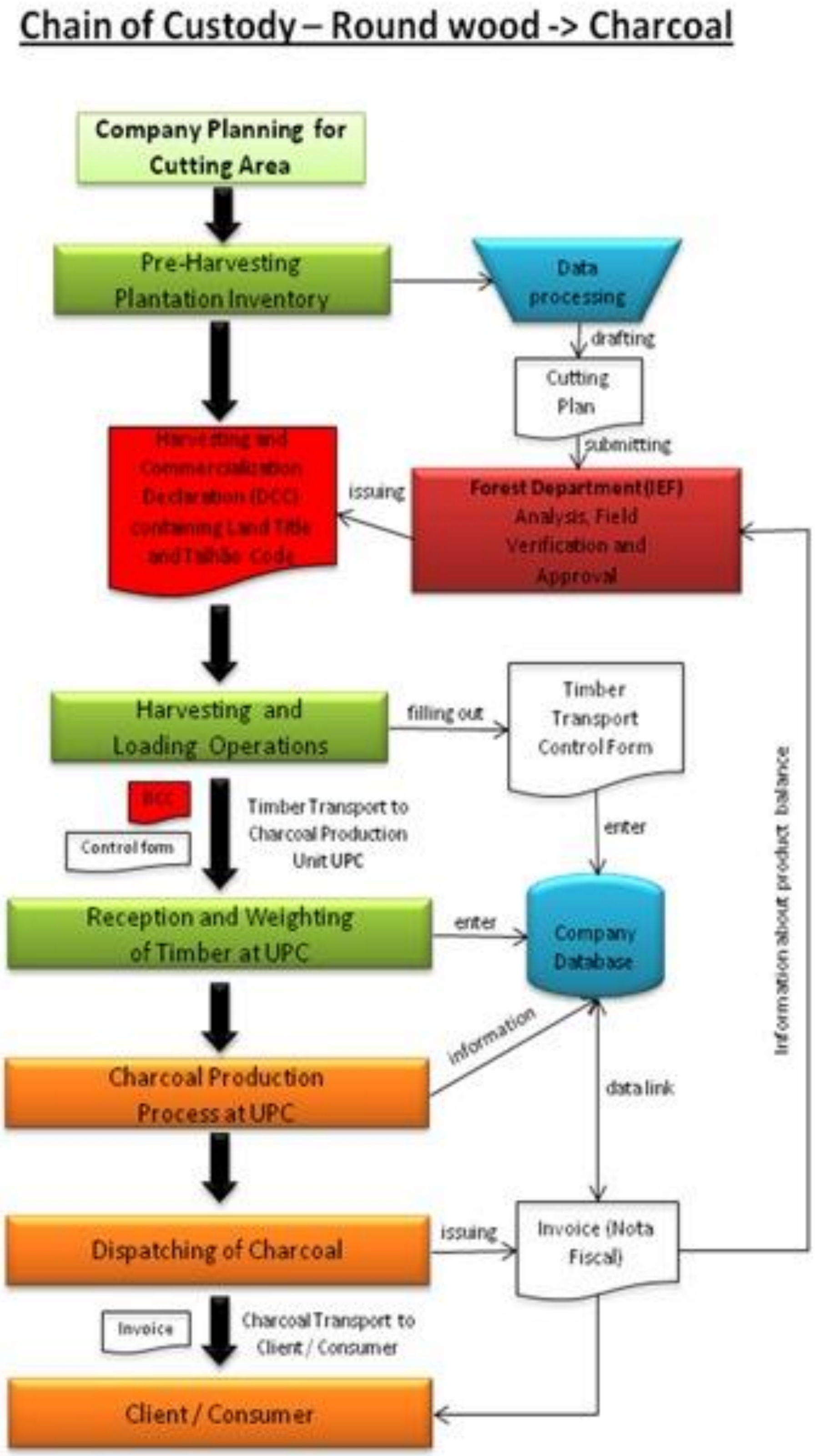

Figure 19. Tracking of wood from harvesting area to blast furnace

1.4.3. Procedures for determination of gravimetric yield

Production of reducing agent
The standard operational procedures developed to serve as uniform guidelines for the operations across all carbonization units shall be rigorously implemented. The following operations that influence the outcome of the project scenario should be carefully monitored as per the standard operational procedures.

1. Measurement of wood moisture
2. Weighing of wood used in carbonization
3. Measurement of charcoal moisture
4. Weighing of the charcoal produced
5. Calculation of the gravimetric yield (on a dry basis).

The above mentioned operational procedures of the project activity will be incorporated into the project entity's quality management system and registered as instructions to the staff. For the purpose of illustration, the operational procedures on the determination of wood moisture, gravimetric efficiency, and charcoal moisture are outlined below.

Determination of wood moisture:
- Execution period: minimum 60 days after harvesting.

- Operational procedure:
I. Get samples of diameters that represent diameter distribution of the plot;
II. Choose 70 pieces of wood in proportionately to the diameter classes;
III. Cut a 2 to 5cm thick disk from the middle of 1/3 of the length of each piece of wood;
IV. Weigh freshly cut wood disks. The disks should have no fissures, cracks or knots.
V. Identification of the disk with its weight and number.

- Sample drying
I. Set the oven at 103º (with variation around 2ºC);
II. Put the wood disks in the oven;
III. Dry until they reach constant weight, after three constant weighing processes;
IV. Weigh the disks and take note of the weight;
V. Calculate the moisture percentage, using the following formula:

$$\%U = \frac{\text{humid weight} - \text{dry weight}}{\text{Dry weight}} \times 100$$

Determination of charcoal moisture
- Execution period: minimum 48 hours after the charcoal is discharged on the patio.

- Operation procedure:
I. Get samples from different points of charcoal piles equivalent to 2kg;
II. Use same procedure until it reaches 200 liters;
III. Transfer the 200 liters sample to the sample divisor device table;
IV. Remove the diagonal portion for sending as sample for moisture determination;
V. Reduce the size of sample particles and grind them manually;
VI. Mix the ground portion;
VII. Remove 2kg from the ground portion;
VII. Put in waterproof plastic bags, seal with tape and label them;
VIII. Send to Research and Development Department.

- Sample's preparation

I. Sift in 1/2 and 3/8 sieve kit;
II. Remove sample from the part retained above 3/8 until it reaches 200gr;
III. Weigh on the scale with graduation lines of 0,01gr.

- Sample's drying
I. Adapt the oven at 100ºC (variation of around 5ºC);
II. Put the sample in the oven;
III. Dry samples until they reach constant weight after 3 constant weightings;
IV. Weigh the sample and write the weight;
V. Calculate the moisture percentage using the following formula:

$$\%H = \frac{\text{humid weight} - \text{dry weight}}{\text{dry weight}} \times 100$$

VI. Keep part of the sample for 01 week for counter proof.

Determination of gravimetric yield of carbonization units
- Wood: Weigh and measure all wood received at the Carbonization Unit
- Verification of the Wood Consumed by Carbonization: measure the stocks of wood in the carbonization unit (box + kilns), on the last day of each month;
- Calculate the volume of wood use:
Wood use = (initial stock + transport) –stock
- Convert the daily entry of wood in the carbonization unit from volume (m^3) to weight (tons) on dry basis.

Verification of the Produced Charcoal Mass:
- The charcoal volume and weight are verified upon delivery in the mill and packing unit;
- At the end of each month, the charcoal stocks are calculated and converted from volume to weight on dry basis;

The charcoal production is estimated using the following formula:
Production = final stock + reception at the mill or packing unit – initial stock

Gravimetric yield: weight of charcoal produced divided by wood used for charcoal production on dry basis.

$$\text{Gravimetric yield (\%)} = \frac{\text{charcoal weight}}{\text{wood weight}} \times 100$$

1.4.4. Control of transportation of charcoal to industrial facility

The trucks with charcoal are weighed at the industrial facility upon arrival. The internal procedure of AM Juiz de Fora GAAFO 0001 is applied and the results are inserted into the MES System, as shown on the figures below:

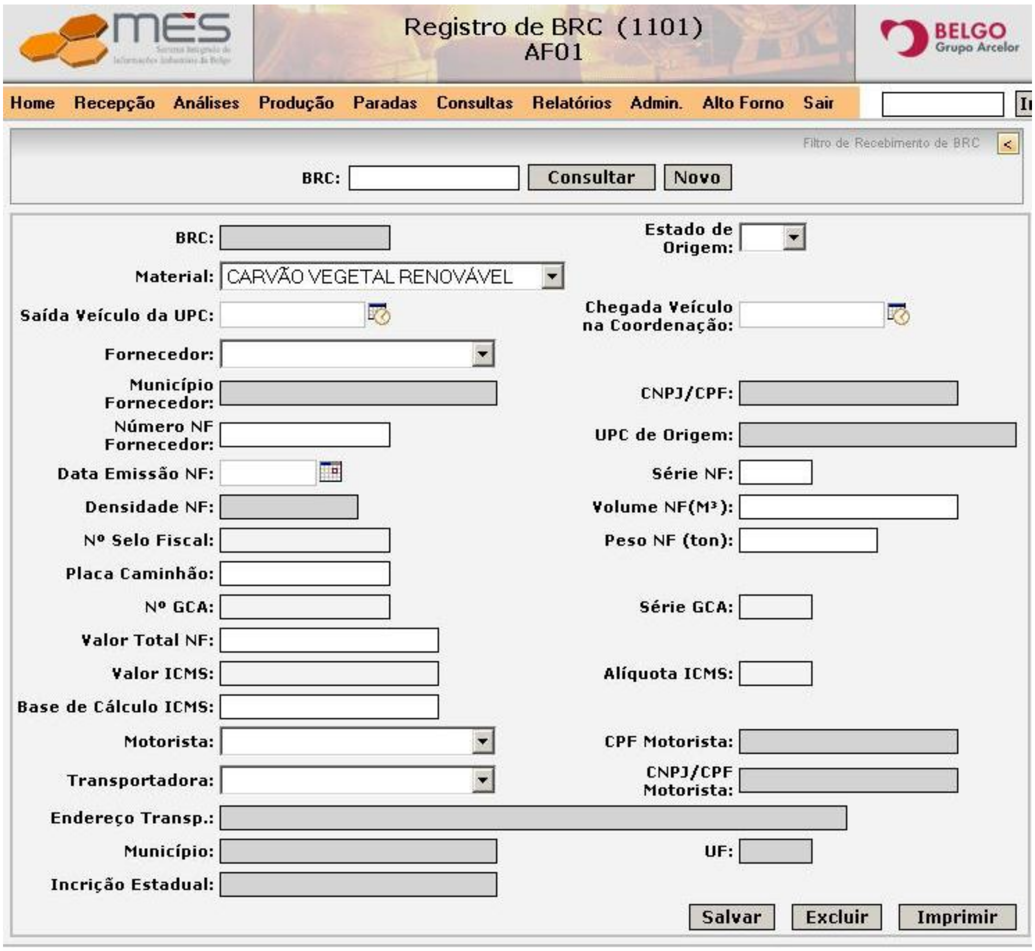

Figure 20. Registry of the arrival of the truck with charcoal: MES System.

Figure 21. Weight and departure points registries of delivered charcoal.

Consumption of charcoal and production of hot metal at industrial facility
Charcoal loaded into the blast furnaces is monitored according to the internal GAAFO PO 0008 and its weight is registered in the MES System.

Hot metal produced is monitored according to the internal procedure and registered in the MES System as shown on the figure below:

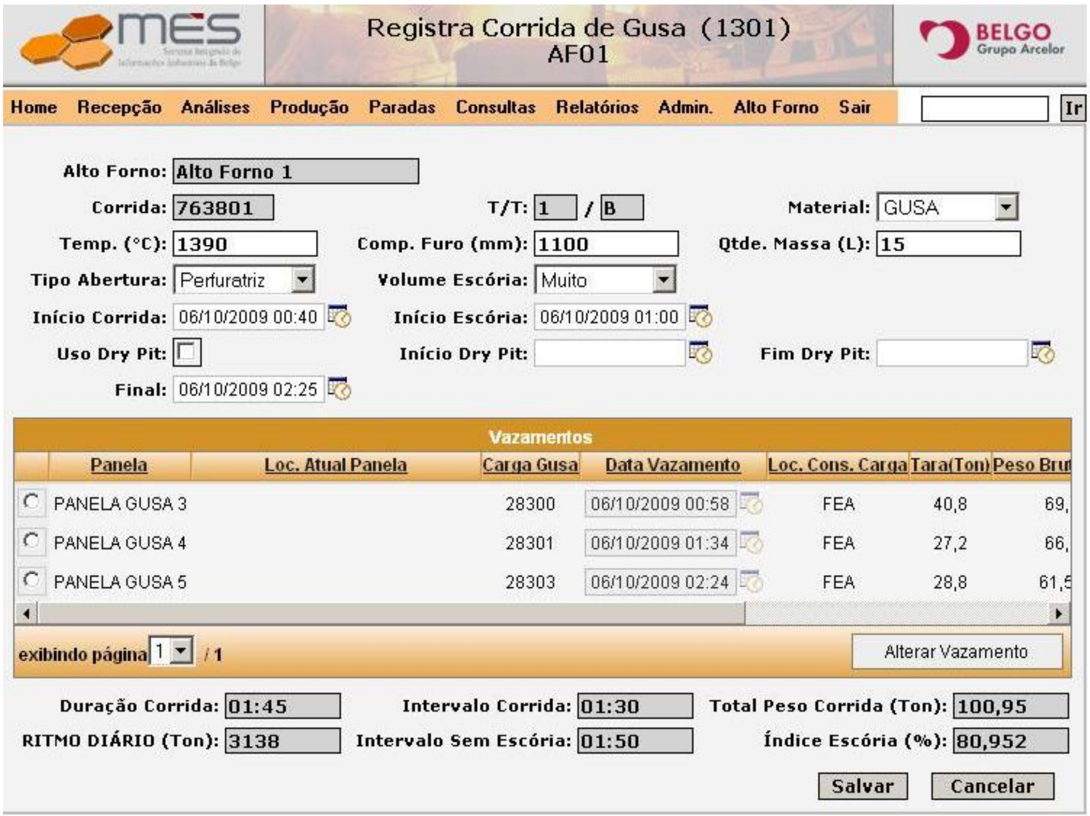

Figure 22. Batch registry of the iron ore production

Chapter 3

This section presents the guidelines for data collection in the project activity, including data storage policies that will be followed to support audit and verification. In case the project entity adopts different carbonization technologies, this monitoring plan will need to be updated accordingly.

Adhering to data and information management procedures shall ensure that in the event of change in personnel or for other reasons, the continuity of data management procedures is not affected. The methods followed to collect field data, and procedures used to ensure data entry, data quality, data storage and retrieval are the important elements of project information management.

Data collection
Collecting reliable field measurements is an important step in the quality assurance plan.
Standard procedures will be followed to collect reliable data to ensure the estimation of credible baseline and project emissions. To ensure continuity, the same procedures will be used during the project period and the personnel involved in carbonization activity will be trained in field data collection.

Data quality
During the monitoring process, data collected by the field personnel will be verified by the senior personnel overseeing the carbonization activity. The results of verification will be compared with the original data and errors, if any, are corrected. This random data checking and quality assurance procedures will be repeated at regular intervals. The project entity must implement procedures to ensure independent verification. Considering the differences in the electronic and paper based formats, there must be clarity in the terms defined and procedures followed. Particular attention will be paid to monitoring and measurement errors and mandatory data checks will be performed.

Data entry and storage
The project entity will make arrangements for data entry on the registry forms in paper and electronic formats and ensure transfer to the spreadsheet database at required intervals as outlined in the monitoring methodology. The data will be archived using acceptable standards and stored in compliance with the instructions of the project information management system: The project entity adopt both paper and electronic formats to ensure that the information is stored in multiple formats. All GHG related information collected will be aggregated into monthly and annual data and transferred to the ER calculation spreadsheet that accompanies the MP and the PDD.

The electronic data will be stored securely at multiple locations using monthly back-up procedures. Furthermore, the backed up data will also be stored on mobile media such as CD ROM or similar for easy retrieval.

Information management system
The project information management links the operations of the field data collection and spreadsheet database management and outlines responsibilities of staff involved in collecting field data and organizing spreadsheet database. The supervisory staff overseeing the field data and spreadsheet database must certify the data each month and provide necessary clarifications on the changes, if any in the data collected and processed during the month.

Chapter 4

Project Management
The project has a defined project management, with Mr. José Otavio Andrade Franco as a CDM Project Manager. ArcelorMittal BioFloresta and ArcelorMittal Juiz de Fora will define two CDM Project Manager Assistants (one from each company of the AM Group) that will be responsible for data supply from internal registries to Carbon Monitor system. The project management and quality assurance will be monitored at regular intervals and measures implemented to enhance the project effectiveness shall be submitted at the time of verification.

The project entity will prepare an annual report with information on project performance, emission reductions generated, experience in the implementation of the MP, compliance with social and environmental indicators, calculation methods, and information on the modifications to the MP.

The project entity must ensure that the required capacity and training is made available to its operational staff to enable them to undertake the tasks required under this MP. Staff training will be provided throughout the project period. The registries of training programs will be maintained and stored in the company's quality management system.

Quality assurance (QA) procedures

The company is certified according to ISO 14001, ISO 9001 and OSHAS 18001, and in 2005 it has been rewarded with the National Quality Award for excellence in management. In 2003 it became the first steelmaker in the world to be certified according to SA 8000 (Social Accountability). Registries of internal monitoring procedures outlines in this Monitoring Plan are subject to internal audit.

Verification of monitoring procedures

The verification of monitoring procedures and results is a requirement of CDM projects. The verification processes are intended to ensure that the project has achieved the emissions reductions as outlined in the project documents. The verification is expected to be undertaken in periodic intervals, e.g. annually.

The project entity ensures that the verification process is conducted as per schedule and will provide the necessary information to the DOE. The project entity shall prepare for the verification process with all relevant documents and shall instruct the project manager and relevant staff to provide written and oral information on the project activity.

Annex 5

LIST OF PLANTATION AREAS

Farm Name / Code	City	State	TOTAL Area (ha)	PLANTED Area (ha)
DIONÍSIO - H9	DIONÍSIO - MARLIÉRIA - SÃO J. GOIABAL	MG	21745.07	13470.58
S.P.DOS FERROS	SÃO PEDRO DOS FERROS	MG	8821.66	6071.31
VALENÇA - H9	DIONÍSIO	MG	2202.15	1385
BAR. ALEGRE - H9	SÃO JOSÉ DO GOIABAL	MG	116.67	66.6
L.SACRAM. - H9	SÃO JOSÉ DO GOIABAL	MG	56.14	33.82
SANTA CRUZ - H9	MARLIÉRIA	MG	444.93	302.45
BARATINHA - H12	ANTÔNIO DIAS - CEL FABRICIANO	MG	6739.65	4321.71
PIRAQUARA - AA	MARTINHO CAMPOS	MG	4671.9	3306
AB	MARTINHO CAMPOS	MG	2066.29	1473.67
AC	MARTINHO CAMPOS	MG	166.3	120.43
AD	MARTINHO CAMPOS	MG	575.45	411.56
AE	MARTINHO CAMPOS	MG	474.65	321.1
AF	MARTINHO CAMPOS	MG	477.5	315.4
AG	MARTINHO CAMPOS	MG	1628.73	1150.05
AH	MARTINHO CAMPOS	MG	153.37	109
AI	MARTINHO CAMPOS	MG	69.25	49.6
AJII	MARTINHO CAMPOS	MG	853.59	602.91
AL	MARTINHO CAMPOS	MG	735.3	470.15
AM	MARTINHO CAMPOS	MG	56	39,6
AN	MARTINHO CAMPOS	MG	63.4	31.65
AO	MARTINHO CAMPOS	MG	46.85	30.6
AP	MARTINHO CAMPOS	MG	151.3	106
BA	BOM DESPACHO	MG	9090.65	6711.74
BB	BOM DESPACHO	MG	620.6	462
BC	BOM DESPACHO	MG	711.5	490.9
BD	BOM DESPACHO	MG	313.59	211.73
BE	BOM DESPACHO	MG	290	207
BF	BOM DESPACHO	MG	81.3	57.3
CAI	ABAETÉ - D. INDAIÁ - Q. GERAL	MG	4616.01	3066.35
CC/CG	QUARTEL GERAL	MG	462.43	326
CF	QUARTEL GERAL	MG	386.39	179.82
CH	QUARTEL GERAL	MG	258.95	180.15
DA	ABAETÉ	MG	2396.8	1634.5
DC	ABAETÉ	MG	581.3	318.7
DDI	ABAETÉ	MG	846.79	578.69
DF	ABAETÉ	MG	234.85	169.6
DDII	ABAETÉ	MG	1157.86	884.7
AJI	ABAETÉ	MG	165.37	123.22

CAII	ABAETÉ	MG	113.9	81.8
CARBONITA - A	SEM. MOCESTINO GONÇALVES	MG	8919.18	4787.46
B	CARBONITA	MG	15038.21	9382.33
B ESTIVA	CARBONITA	MG	1889.4	1379
C	CARBONITA	MG	12728.82	8740.91
D	SEM. MODESTINO GONÇALVES	MG	1042.8	739.1
H	DIAMANTINA	MG	868.6	650
I	CARBONITA	MG	1075	740
PPF - MARTINHO CAMPOS				
Fazenda 'Tróia	Bom Despacho	MG	428	55.91
Fazenda Água Santa	Abaeté	MG	352.7	57.93
Fazenda Recanto do Beija-Flor	Martinho Campos	MG	88.6077	51.37
Fazenda Samambaia	Luz	MG	563.22	60.01
Fazenda São Domingos	Luz	MG	297	19.45
Fazenda São Francisco	Bom Despacho	MG	1096.9387	269.86
Fazenda Chapada e Porcos	Dores do indaiá	MG	119.8162	13.23
Fazenda São Leão	Dores do indaiá	MG	136.25	21.97
Fazenda Industão II	Pompéu	MG	252	68.29
Fazenda Riacho do Barro	Martinho Campos	MG	158.375	82
Fazenda Quartel de São João	Quartel Geral	MG	306.0367	62.96
Fazenda São Simão de Baixo	Abaeté	MG	229.1	119.94
Fazenda Parizinho	Quartel Geral	MG	434.5	55.29
Fazenda Onça	Quartel Geral	MG	63.5	27.38
Fazenda Mangueiras	Bom Despacho	MG	328.6094	17
Fazenda Colina Campos	Dores do indaiá	MG	100.7665	33.36
fazenda Cachoeira Bonita	Bom Despacho	MG	95	19.71
fazenda Ana Rosa	Cedro do Abaeté	MG	750	11.36
Santa Fé	Chiador/MG	MG	1285.64	37
Figueirão	Rio Preto/MG	MG	181.62	8.41
Café	Barroso/MG	MG	90	47.83
Caxinguele/Rinc	Lima Duarte/MG	MG	239.65	150
Santa Gertrudes	Mercês/MG	MG	102.9	18.72
Roda da Fortuna	Barroso/MG	MG	55.67	40
Cachoeira	Pedro Teixeira/MG	MG	308.00	8.62
Cachoeirinha	Juiz de Fora/MG	MG	358.99	34
Água Limpa	Eugenópolis/MG	MG	82.06	6.35
Boa Sorte	Santos Domunt/MG	MG	83	25
Sant'ana	Andrelândia/MG	MG	200	17
Morro Grande	São João Del Rei/MG	MG	75.99	30
São Mateus	Juiz de Fora/MG	MG	185.37	15
Salvador	Mercês/MG	MG	67.36	47.59
Casa de Pedra	Rio Preto/MG	MG	94.73	7

Santa Cruz	São Francisco do Glória/MG	MG	47.3	5
Tatú/Azeite	São João Del Rei/MG	MG	29.38	5
Rosaria	São João Del Rei/MG	MG	307.92	50.9
Capitinga	São Vicente de Minas/MG	MG	306.98	33.02
Asa Branca	Piau/MG	MG	145.4	14.4
São Jerônimo	Mar de Espanha/MG	MG	164.36	16.95
Vargem Alegre	Cataguases/MG	MG	157.6	25
das Aboboras	Andrelândia/MG	MG	177.01	6.08
Ipê	Andrelândia/MG	MG	117.3	9.15
Cachoeira	Lima Duarte/MG	MG	70.00	19
São Jorge	Simão Pereira/MG	MG	49.69	8.67
Cachoeira/Canta	Leopoldina/MG	MG	183.92	26.06
Colonia Major	Cataguases/MG	MG	71	21
Amparo	Rio Preto/MG	MG	58.65	4.8
Dois Corregos	Bom Jardim de Minas/MG	MG	102.12	8.1
Aquidauana	Juiz de Fora/MG	MG	192.57	13.8
N. S. do Carmo	Andrelândia/MG	MG	123.25	32.59
Souza	Andrelândia/MG	MG	136	42.5
São Lourenço	Eugenópolis/MG	MG	179.46	32
São Bento	Santa Bárbara Mte. Verde/MG	MG	128.26	40
Caxinguele/Rinc	Lima Duarte/MG	MG	239.65	75.67
Ponte Nova	Andrelândia/MG	MG	34.4	24.5
Palmeira	Mercês/MG	MG	19.81	11.58
São Lucas	São João Del Rei/MG	MG	59	10.73
Café	Barroso/MG	MG	36.23	25
Ouríves	Andrelândia/MG	MG	80	30
Sibipiruna	Andrelândia/MG	MG	178.67	10
Açude	Itutinga/MG	MG	125.31	56.5
Aliança	Andrelândia/MG	MG	460.62	12
São Luiz	São João Nepomuceno/MG	MG	143.22	7.38
Rodagem	Mar de Espanha/MG	MG	162.10	15
Lambarí Alegre	Miradouro/MG	MG	258.97	9
Goiaba	Andrelândia/MG	MG	322	50
Tereza D'Avila	Simão Pereira/MG	MG	242.05	14.42
São Sebastião	São João Nepomuceno/MG	MG	228.00	10
Bom Jardim	Barão de Monte Alto/MG	MG	76.84	5
São Luiz	São João Nepomuceno/MG	MG	136.2	7.66
Bela Vista	Tabuleiro/MG	MG	402	35.56
Pinhal	Lima Duarte/MG	MG	62.21	12.7
Veloso	Santana do Deserto/MG	MG	285.83	21.43
Andaime	Andrelândia/MG	MG	270.93	20.14
Santa Rosa	Andrelândia/MG	MG	322.28	30.23

Santo Antônio	Andrelândia/MG	MG	87.84	13.7
União	Mar de Espanha/MG	MG	166.10	13.5
Pouso Alegre	Lima Duarte/MG	MG	69.46	44.15
do Ribeirão	São João Nepomuceno/MG	MG	180	8.85
Baía	Juiz de Fora/MG	MG	148.83	13.92
Bela Itália	Coronel Pacheco/MG	MG	247.27	12.56
Carambi	Coronel Pacheco/MG	MG	283.01	18.67
Floresta	Coronel Pacheco/MG	MG	137.14	51.54
HD	Goianá/MG	MG	445.56	14.94
São Geraldo	Coronel Pacheco/MG	MG	159.2	38.72
Pica Pau	Goianá/MG	MG	156.14	51.92
Dois Irmãos	Leopoldina/MG	MG	484	18.56
Pedra Redonda	Barão de Monte Alto/MG	MG	210.38	41.88
Da Vargem	Lima Duarte/MG	MG	80.03	19.73
Pinhal	Lima Duarte/MG	MG	128.39	10
Da Lage	Juiz de Fora/MG	MG	211.75	15.8
Tatu	Barroso/MG	MG	74.11	30
Guará	Rio Preto/MG	MG	72.12	5.69
Sítio Aracajú	Chácara/MG	MG	142.87	5
Inhame	Itutinga/MG	MG	12.26	5
Serra	Santa Bárbara Mte. Verde/MG	MG	91.96	9.52
Floresta e Alia	Palma/MG	MG	180.22	33.35
Corrego Grande	Mar de Espanha/MG	MG	621.98	48.55
Santa Cruz	Antônio Prado/MG	MG	101.3	25.88
São Lourenço	Pirapitinga/MG	MG	184.73	10
Vargem Alegre	Laranjal/MG	MG	28.29	19.46
Dois Corregos	Bom Jardim de Minas/MG	MG	87.35	9.02
Arco Iris	Andrelândia/MG	MG	48.97	11
Bom Destino	Palma/MG	MG	82.79	8.95
Retiro	Santos Domunt/MG	MG	242.7	11.81
Santa Luzia	Barão de Monte Alto/MG	MG	756.35	20.4
São Manoel	Santa Bárbara Mte. Verde/MG	MG	185.12	16.63
Açude	Piedade do Rio Grande/MG	MG	25	22
Roseira	Liberdade/MG	MG	35.55	17.77
S. Bom Jardim	Mar de Espanha/MG	MG	166.10	14.78
Santa Cruz	São Francisco do Glória/MG	MG	53.11	20
Cachoeira	Juiz de Fora/MG	MG	332.91	46.19
Batatal	Santa Rita do Ibitipoca/MG	MG	23.1	10
Safira	Andrelândia/MG	MG	92.75	50.74
Galinheiro	Carrancas/MG	MG	198.28	60
Jacutinga	Lima Duarte/MG	MG	77.99	40
Nova Betel	Muriaé/MG	MG	175	13.09

Novo Mundo	Volta Grande/MG	MG	291.24	17
2 Corr. Caxambu	Bom Jardim de Minas/MG	MG	64	29.57
Bom Retiro	Juiz de Fora/MG	MG	219.23	13.52
Santa Delfina	Rio Preto/MG	MG	348.40	6.69
Do Carmo	Juiz de Fora/MG	MG	41.08	20.9
Bom Retiro	Bicas/MG	MG	192.44	13.65
Pedra Alta	Muriaé/MG	MG	351.01	60
Santa Luzia	Rio Novo/MG	MG	53.37	27.31
Rib. Pereiras	Andrelândia/MG	MG	25	10
Dr. Evaristo	Muriaé/MG	MG	40.89	10
das Pedras	São Vicente de Minas/MG	MG	199.95	20.89
Retiro Meio	Lima Duarte/MG	MG	49.01	37
Santa Rosa II	Lima Duarte/MG	MG	84.08	47.5
Santa Cuz	Leopoldina/MG	MG	685.92	29.06
Vale do Sol	Lima Duarte/MG	MG	55.72	42
São Geraldo-JF	Juiz de Fora/MG	MG	156.96	18.56
Capoeirão	Santa Rita do Ibitipoca/MG	MG	35.5	22.55
Caxinguele/Rinc	Lima Duarte/MG	MG	239.65	26.67
Santa Edvirges	Lima Duarte/MG	MG	97.25	8.39
José Ribeiro	Barroso/MG	MG	15.01	20
Camarote	Lima Duarte/MG	MG	268.14	7.78
S. Cachoeirinha	Lima Duarte/MG	MG	92.23	5
Arado	Andrelândia/MG	MG	60	11
São Vicente	Mar de Espanha/MG	MG	225.62	53
Uricana	Mar de Espanha/MG	MG	135.52	16.76
V. das Amoras	Andrelândia/MG	MG	78.46	5.8
Ipê	Mar de Espanha/MG	MG	166.18	16.76
Boa Fé	Santos Domunt/MG	MG	72.06	40.92
Campo Verde	Santana do Garambéu/MG	MG	48	25.55
Mata dos Penas	Muriaé/MG	MG	40.26	17.9
Doce	Rio Preto/MG	MG	42.61	4.81
Lava Pés	Rio Novo/MG	MG	34.82	5.04
São Jose	Santos Domunt/MG	MG	195.2	38.74
Sítio Cascata	Santana do Garambéu/MG	MG	118.31	6
Capivari	Aracitaba/MG	MG	216	15
Baraúna	Laranjal/MG	MG	49.51	24.22
São Miguel	Andrelândia/MG	MG	266.6	28
Jacarandá	Andrelândia/MG	MG	41.15	30
do Carmo	Juiz de Fora/MG	MG	289.28	52
Mato Dentro	Leopoldina/MG	MG	183.92	15
Vargem Alegre	Juiz de Fora/MG	MG	145.70	5
Fortaleza	Rio Pomba/MG	MG	262	40.64
Passa Cinco	Guarani/MG	MG	151.07	21.22

Santa Helena	Muriaé/MG	MG	145.17	27.69
Mato Virgem	Andrelândia/MG	MG	26.82	23
Sítio Água Bela	Carrancas/MG	MG	1059.96	80.15
Linha	Leopoldina/MG	MG	34.57	6.32
Sitio dos Ypes	Lima Duarte/MG	MG	240.5	10.14
da Serra	Lima Duarte/MG	MG	686.05	50
Cachoeirinha	Mar de Espanha/MG	MG	963.33	55.69
Caxinguelê	Lima Duarte/MG	MG	239.65	47.67
Paraíso	Juiz de Fora/MG	MG	432.50	14
São José	Andrelândia/MG	MG	51.02	25.93
Triqueda	Coronel Pacheco/MG	MG	479	16.86
Paraíso	Mar de Espanha/MG	MG	145.20	11.15
Amazonas	Santa Bárbara Mte. Verde/MG	MG	334.59	40
Tatú	São João Del Rei/MG	MG	130.64	50
Aldeia	Barão de Monte Alto/MG	MG	364.16	11
Canadá	Leopoldina/MG	MG	168.56	15
Laginha	Rochedo de Minas/MG	MG	243	17.09
Souza	Andrelândia/MG	MG	136	42.5
Barrinhas	Andrelândia/MG	MG	26.78	18.08
Águas Claras	Madre de Deus de Minas/MG	MG	55.09	7.95
Boa Esperança	Palma/MG	MG	26.13	10.5
Renascer	Juiz de Fora/MG	MG	312.52	24.2
Santa Rosa	Juiz de Fora/MG	MG	98.76	22.5
Nova Aurora	Muriaé/MG	MG	156.37	5
Liberdade	Goianá/MG	MG	918.19	30
Porteira Preta	Silverania/MG	MG	60	8.74
Boa vista	Eugenópolis/MG	MG	217.01	30.52
Celidônea	Palma/MG	MG	465.62	29.82
Espinho	Carrancas/MG	MG	57.99	20
Tatu ou Azeite	São João Del Rei/MG	MG	101.48	30
Triunfo II	Chácara/MG	MG	207.40	50

Annex 6

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