CGM Ceramic Voluntary Carbon Standard Project Description

19 November 2007

Date of the VCS PD: May 27th, 2009

Contents

1 Description of Project:

1.1 Project title

Gomes de Mattos Ceramic Fuel Switching Project
Version 05
PDD completed on May 27th, 2009.

1.2 Type/Category of the project

The voluntary project activity, although being applied at the voluntary market, encloses the following category of the simplified modalities and procedures, which is described in appendix B, for small scale type I CDM project activities.

- Category AMS-I.E: Switch from Non – Renewable Biomass for Thermal Applications by the User – Version 01 from February 01 of 2008 onwards.
- This project is not a grouped project

This category comprises small thermal appliances that displace the use of non-renewable biomass by introducing new renewable energy end-user technologies.

1.3 Estimated amount of emission reductions over the crediting period including project size:

The amount of emission reductions are greater than 5,000 tonnes of CO_2 equivalent and less than 1,000,000 tonnes of CO_2 equivalent, thus classifying as a project under the VCS 2007.1 size groups (micro project, project, mega project).

Table 1. Emission reductions estimate during the crediting period.

Year	**Annual estimate of emission reductions per ton of CO_2e**
May to December 2006	18,895
2007	28,342
2008	28,342
2009	28,342
2010	28,342
2011	28,342
2012	28,342
2013	28,342
2014	28,342
2015	28,342
January to April 2016	9,447
Total of estimate reductions (tonnes of CO_2e)	**283,420**
Number of years of the crediting period	**10**
Annual average of estimate reductions for the 10 year crediting period (tonnes of CO_2e)	**28,342**

1.4 A brief description of the project:

The accelerating destruction of forests around the world is being recognized as one of the main causes of climate change. Carbon emissions from deforestation far outstrip damage caused by planes and automobiles and factories.

One of the main reasons for deforestation is the demand for fuel. Ceramic companies are well known for their great demand of fuel to maintain their burning processes.

Therefore, the project activity in *Gomes de Mattos* Ceramic will indirectly contribute to minimize this problem in *Caatinga*[1] biome by displacing the use of native forests wood without sustainable forest management for thermal energy generation.

The project activity consists in a pioneer practice in the region of *Crato – Ceará*. The city of *Crato*, where the project activity takes place, is located in one of the prettiest regions of Brazilian northeast: the *Cariri* Valley[2], south of *Ceará* State. With a population of around 106,000 inhabitants[3], *Crato's* economy is based on the commercialization of agricultural products, however the city also commercializes industrial products, such as aluminum, footwear, ceramic devices and *aguardente.*

Figure 1.View of the Cariri Valley

According to SEBRAE[4], there are around 34 ceramic industries in the region of *Cariri* Valley and 10 located in the city of *Crato*.

The city faces a serious problem related to the environmental degradation due to the recent boom in the real state sector. Such occupation causes the devastation of gallery bush areas[5]. Therefore, the native wood from the gallery bushes can be employed in industrial processes.

The switching fuel project will reduce the greenhouse gases emissions, through substitution of native wood for wood from sustainable forest management plan, sawdust, Algaroba wood, residues form cashew tree and

[1] *The Caatinga biome has sufficiently diversified fauna and flora, being inserted in a region of approximately 800,000 km² in the northeast of Brazil. Nowadays, the uncontrolled deforestation is breaking up the firm land forest. Without necessary care, entire regions of fauna and old centers of species have the risk to be disappeared forever. Source: text adapted from: <http://www.ibge.gov.br/home/presidencia/noticias/noticia_visualiza.php?id_noticia=169> visited on : March 13th, 2009.*

[2] *The Cariri valley encompasses 33 municipalities.*

[3] *According to an IBGE (Brazilian Institute of Geography and Statistics) study realizedon2007.*

[4] *Brazilian Service of Support to Micro and Small Companies.*

[5] *Gallery bush is the vegetations in the rivers margin. Available at: http://pt.wikipedia.org/wiki/Crato_(Cear%C3%A1) visited on March 13th , 2009.*

babaçu coconut husk which may be replaced by elephant grass and municipal garden's residues, for thermal energy generation. This fuel exchange could only be feasible when considering the carbon credits incomes, since the adaptation of kilns to the new biomasses and the purchase of new equipments required considerable investments.

The main goal of this project activity is to minimize the negative impacts of the deforestation of the *Caatinga* biome by discouraging the exploitation of the area through limiting the interested parties in acquiring the proper legal documents for the commercialization of the native fire wood.

1.5 Project location including geographic and physical information allowing the unique identification and delineation of the specific extent of the project:

The project activity is located in the Municipality of *Crato* in the state of *Ceará* as indicated in Figure 2. The project site has the postal address:

- ***CGM* Ceramic**
  Address: *Rodovia CE* 55, Km 06, *Bairro Sítio Quebra*,
  Crato – State of *Ceará*
  Brasil
  Zip code: 63105-330
  The ceramic is located at the coordinates showed in the figure 2.

Figure 2[6].Geographic location of CGM ceramic: 7º10'36.50" S ; 39°24'49.23" W.

1.6 Duration of the project activity/crediting period:

The proposed project starts its switch fossil fuel in April of 2003 and the fuel switching was totally achieved by the end of April 2006.

- Project start date[7]: 01/April/2003
- Date of initiating project activity[8]: 01/May/2006
- Date of terminating the project[9]: 30/April/2016

VCS project crediting period: 10 years, twice renewable.

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[6] *Figure Source: Google earth visited on March 13th, 2009.*

[7] *Date on which the project began reducing or removing GHG emissions, i.e. when the project developer began employing renewable biomass.*

[8] *Date on which the project activity totally switched from non-renewable biomass to renewable biomass.*

[9] *Date on which the project activity completes 10 years of the first crediting period.*

1.7 Conditions prior to project initiation:

The use of native wood without sustainable management as fuel is a prevalent practice among the ceramics industries in Brazil. Wood from deforestation is delivered and utilized in the ceramic facilities and this non renewable biomass is offered with low prices.

Although firewood from deforested areas used has been for many decades as fuel in Brazil, it is impossible to define a start date on which this kind of non-renewable biomass began to be applied. Firewood used to be the most employed source of primary energy until the decade of 1970, when the petroleum started to supply the majority of Brazilian´s energy needs [10] . Moreover the Brazilian´s Energy and Mine Ministry has been monitoring every energetic sectors of Brazil since 1970, and firewood appears over the years monitored as a significant source of thermal energy for ceramic sector[11].

According to *Seye* (2003) [12] , in Brazil, the red ceramic devices are produced through an inefficient and traditional process using wood without forest management to generate thermal energy. In this industry segment the use of wood represents about 98% of the total fuel employed stimulating

Therefore, the employment of this fuel stimulates the increase in Brazilian deforestation rates. The baseline identified for this project activity is the employing of a total of 22,800 m3 of native wood per year to provide thermal energy to the ceramics' kilns.

The project activity focuses on the use of wood from sustainable forest management plan areas, sawdust, Algaroba wood, residues form cashew tree and *babaçu* coconut husk as renewable biomasses for energy supply. The entrepreneur aims to use municipal garden's residues and elephant grass in the future.

1.8 A description of how the project will achieve GHG emission reductions and/or removal enhancements:

The emission reductions will be achieved by displacing the use of wood from areas with no sustainable forest management to provide thermal energy in the ceramic companies. Therefore, the emissions launched during the combustion of wood were not compensated by the replanting. An opposite scenario occurs with the renewable biomasses employed in this project activity, which have carbon neutral cycle.

1.9 Project technologies, products, services and the expected level of activity:

Currently Gomes de Matos Ceramic uses two Hoffman[13] kilns and one *Câmara*[14] kiln constitutes the production line of *CGM* Ceramic.

The process for reducing water content in the ceramic devices is realized with the employment of two dryer plants that utilize the heat originated

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[10] *Brito, J.O. "Energetic use of Wood". Available at: <http://www.scielo.br/scielo.php?pid=S0103-40142007000100015&script=sci_arttext&tlng=ES> visited on: March 13 th, 2009*

[11] *Energy Research Company. National Energy Balance – energy consumption per sector. Available at <http://www.mme.gov.br/download.do?attachmentId=16555&download> visited on: March 13th, 2009*

[12] *Seye, Omar. Análise de ciclo de vida aplicada ao processo produtivo de cerâmica estrutural tendo como insumo energético capim elefante (Pennisetum Purpureum Schaum) / Omar Seye. Campinas, SP: [s.n.], 2003.*

[13] *"Hoffman" kilns have parallel chambers where the heat from one chamber is used in the next, therefore recycling the generated heat in the previous chambers.*

[14] *The "Câmara" is a kind of continuous kiln with chambers without chimney. It is usually employed to burn bricks*

in the kilns through an internal gas recirculation. A new dryer plant is predicted to be part of the dryer system until 2010.

CGM Kilns are responsible for burning ceramic bricks with 8 orifices, bricks with 6 orifices ,small flagstones and roof tiles.

Due to the fuel switch, the Ceramic had to acquire two mechanic burners to feed the Hoffman Kilns with the renewable biomasses.

CGM ceramic employs approximately 1,900 m3 of native wood was acquired in order to maintain the production of 1,478,000 ceramic devices per month, where 869,003 are bricks with 8 orifices, 343,103 are bricks with 6 orifices , 185,529 are small flagstones and 80,365 are roof tiles. Moreover, according with CGM database the average weight for bricks with 8 orifices is 2.2 Kg , for bricks with 6 orifices is 1.6 Kg, for flagstones is 2.2 Kg and 1 Kg for roof tiles. Thus, CGM ceramic is responsible for manufacturing 2,949 tonnes per month, what leads the kiln efficiency around 0.64 m3 of wood/tonnes of ceramic devices.

CGM Ceramic works with 3 kilns with 2 chambers each and in each chamber, 25,000 ceramic devices are burned per cycle. The native firewood consumption per chamber cycle is 32.13 m^3. The cycle is described below.

The burning cycle comprises 24 hours to load the chamber with ceramic devices, approximately 16 hours to burn, 24 hours cooling and 8 hours to remove the pieces from the kiln.

The overall characteristics of the production of *Gomes de Matos* Ceramic and its kilns are shown at table 2.

Table 2 Technical parameters of CGM kilns.

Technical Paramenters	**Hoffman 1**	**Hoffman 2**	**Câmara**
Consumption of firewood (m3 of Wood per ton of ceramic devices)	0.64	0.64	0.64
Features	Has parallel chambers where the heat from one chamber is used in the next.	Has parallel chambers where the heat from one chamber is used in the next.	Continuous kiln with chambers
Maximum Temperature	900°C	900°C	900°C
Average Production per burning cycle	50,000	50,000	50,000
Average ceramic devices per month	500,000	500,000	500,000
Average supposed capacity of each kiln (MW)	2	2	2
Hours of burning cycle	72	72	72
Burning cycles per month	10	10	10

The production described in table 2 can exhibit small variations each month, influenced by the ceramic market demand in the region, the average ceramic production of 1,478,000 ceramic devices per month.

The present project aims to use 100% of renewable biomass mainly native wood from sustainable management areas, Algaroba wood, residues from cashew trees. However, CGM utilizes small quantities of other biomasses such as *Babaçu* coconut Husk, wood from sustainable management areas (eucalyptus)and sawdust. The main biomasses providers are listed at the table below:

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Table 3 Renewable biomass providers.

Biomass	Provider	Percentage of total Biomass consumption
Amount of sawdust (tonnes)	F.Cardoso de Menezes (transportated by José luciona da silva)	0.8%
Amount of Renewable native wood (tonnes)	FAZ BOQUEIRÃO	32.6%
	SÍTIO CANA BRAVA	9.0%
	FAZ PAU D' ARCO	16.3%
Algaroba	Elisvaldo Gomes Cavalcante	22.2%
	Antonio Gonçalves de Holanda	4.3%
Eucalipto	fazenda taboquinha (transportated by justiniano da silva e antonio jose batista de soares)	2.7%
Amount of Residues from cashew tree (tonnes)	Augustinho dos Reis	1.1%
	Francisco José Rocha	10.0%
	Charles Teles Macedo	0.2%
Amount of Babaçu coconut husk (tonnes)	Flavio Apolinario dos Santos	0.5%
	Cicero ernandes de souza	2.7%

Before the project activity, the process was noticeably different; the wood was inserted in the kilns just by the employee and it was not necessary any logistic modification.

Due to the project activity, a set of adaptations were necessary, such as alterations to the kilns as well as the construction of a shed where the biomass must be stored so the ceramics can operate with the coconut husk and sawdust. Also, the ceramic had to take responsibility for two management plans, which demands time and a high investment from the enterprise. All of these changes were made counting on this project approval, and the incomes from carbon credits.

The main characteristic's changes of the project activity are described in the table below.

Table 4. Main overall characteristic's changes during the period utilizing non-renewable biomass (before the project activity) and the period utilizing renewable biomass (after the project activity).

Scenario	Non-renewable biomass	Renewable biomass

		Biomass	Native wood from management areas	Cashew wood	Sawdust	*Babaçu* Coconut husk	Algaroba wood	Eucalyptus Wood from forest management plan
Amount of biomass (per year)	22,800 (m^3)	tonnes	6,761	1,257	60	60	1,531	218
Production (units per year).	17,736,000	17,736,000						

1.10 Compliance with relevant local laws and regulations related to the project:

This project is in accordance to the CONAMA[15] Resolution, no. 237/97 which establishes that clay extraction activities and ceramic production must be supported by specific licenses, such as operational license, clay extraction license, environmental licenses and the permission of the environmental Secretary of *Ceará* (SEMACE[16]) which must run under the valid time.
The project is also in accordance to Federal Constitution, Article 20, which establishes the payment of a Financial Compensation by the Mineral Resources Exploitation. This financial compensation is annually performed to DNPM (National Department of Mineral Production)[17].

1.11 Identification of risks that may substantially affect the project's GHG emission reductions or removal enhancements:

- Price of the renewable biomasses
The thermal energy generation through the combustion of biomasses is an innovation in the ceramic industry. The future demand of this alternative fuel e.g. by other consumers is not easy to foresee. There is currently a great amount of these types of biomasses available locally, however, it is possible that the demand and the prices would increase as well. If this scenario occurs, the carbon credit income will make the continuous use of renewable biomasses feasible.

- Availability of the renewable biomasses
The current great amount of the biomasses available locally was already described herein, however if a non foreseeable reason affect the

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[15] *CONAMA (National Environmental Council), created in 1981 by Law 6.938/81, is the Brazilians' department responsible for deliberation and consultation of the whole national environmental policy and it is chaired by the Minister of Environment. Therefore, it is responsible for the establishment of standards and criteria relating to licensing of potentially polluting companies. More information is available at <http://www.mma.gov.br/port/conama/estr.cfm>. Visited on: March 13th, 2009.*

[16] *SEMACE is the Environment Secretary in the State of Ceará responsible to issue the environmental licenses according to CONAMA resolution 237/97. More information at: <www.semace.ce.gov.br> visited on: March 13th, 2009.*

[17] *The objectives of the National Department of Mineral Production are: to foster the planning and promotion of exploration and mining of mineral resources, to supervise geological and mineral exploration and the development of mineral technology, as well as to ensure, control and monitor the exercise of mining activities throughout the national territory, in accordance with the Mining Code, the Mineral Water Code and respective legislation and regulations that complement them. Source: <http://www.dnpm.gov.br/enportal/conteudo.asp?IDSecao=168&IDPagina=222> visited on: March 13th, 2009.*

availabity of the biomasses, the ceramic owner will search for other type of renewable biomasses, such as elephant grass and garden residues.

- Difficulty related to the abrupt change
The ceramic have used wood in its kilns throughout eleven years, the suddenly change claimed a lot of effort of each one in the ceramic, the main challenges is the reconfiguration of the internal logistic and the employees resistance to the new situation.

1.12 Demonstration to confirm that the project was not implemented to create GHG emissions primarily for the purpose of its subsequent removal or destruction.

The history of *CGM*'s activities using non-renewable biomasses since 1995 firstly fossil fuel and then native wood –what confirms that the project activity was not implemented to create GHG emissions for the purpose of its subsequent removal or destruction.

1.13 Demonstration that the project has not created another form of environmental credit (for example renewable energy certificates.

CGM's project is not creating any other form of environmental credit under any specific program. Social Carbon Methodology is being applied only as a Sustainability tool in association with VCS 2007.1 standard.

Social Carbon Methodology was developed by Ecológica Institute (www.ecologica.org.br). It was founded on the principle that transparent assessment and monitoring of the social and environmental performance of projects improves their long-term effectiveness. The methodology uses a set of analytical tools that assess the social, environmental and economic conditions of communities affected by the project, and demonstrates through continuous monitoring the project's contribution to sustainable development.

Please see letter attached from TÜVNord Cert GMB, which was responsible to validate and verify the projects.

1.14 Project rejected under other GHG programs (if applicable):

CGM's project has not been rejected to any formal GHG reduction or removal program. This project report was elaborated to make the project public and available to voluntary measures or other opportunities in the carbon market.

1.15 Project proponents roles and responsibilities, including contact information of the project proponent, other project participants:

<u>Project Proponent</u>

The project proponent contributed to the current report by assigning the following roles and responsibilities to:

Mr. *Ronaldo Sampaio Gomes de Matos*, Director and monitoring data responsible: Information and visit of the ceramic, detailed information on process and production lines, environmental challenges, technological challenges, research and development history, ceramic devices market challenges, detailed information and numbers on sales, how output data is handled, and how data is stored and kept by the *Cerâmica Gomes de Matos* office.

Other information on the project's proponent:
Address:
Rodovia CE 55, Km 06 - Bairro Sítio Quebra
Crato - Ceará, Brasil

Zip code: 63105-330
Ceramic phone number: +55 (88) 3521-6580
e-mail address : ceramicacgm@yahoo.com.br

Project Developer

Carbono Social Serviços Ambientais Ltda: Project participant, project idealizer and responsible to prepare the project report and accompany the proponent until the end of crediting period.

Cézar Braga Alves, Technical Analysts: Project Design Document writers, elaboration of GHGs Emissions' Inventory, direct contact between Carbono Social Serviços Ambientais Ltda. and the ceramic companies, and responsible for collecting the necessary information. Coordinated by:

Flávia Yumi Takeuchi, Technical Coordinator and Rafael Ribeiro Borgheresi, Technical Analyst.

Other information of the project developer contact:

Address: *Rua Borges Lagoa, 1065 – Conj. 144 – Vila Clementino*
Postal Code: 04038 032
São Paulo – São Paulo, Brazil

Phone number: +55 11 2649 0036

Web site: http://www.socialcarbon.com

Email: cezar@socialcarbon.com
flavia@socialcarbon.com
rafael@socialcarbon.com

1.16 Any information relevant for the eligibility of the project and quantification of emission reductions or removal enhancements, including legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and temporal information):

The project is eligible according to:

- Legislative: the project attends all legal requirements;
- Technical: alterations/adaptations required are technically feasible;
- Economic: High investments were necessary in order to make the project feasible ;
- Sectoral: incentive of good practices to the sector;
- Social: social carbon methodology will be applied which will improve long term sustainability. The culture of burning wood as fuel will be slowly mitigated;
- Environmental: the project attends all legal requirements and no environmental impacts are predicted;
- Geographic /site specific: the plant can be uniquely geographically identified with no barriers regarding logistic;
- Temporal information: the project will not double count the GHG emissions during the ten years renewable of the crediting period.

However there is no information relevant for its eligibility which is not already described in this VCS PD.

1.17 List of commercially sensitive information (if applicable):

None of the information exposed to the validator was withheld from the public version of the report.

2 VCS Methodology:

2.1 Title and reference of the VCS methodology applied to the project activity and explanation of methodology choices:

- ***Category AMS-I.E: Switch from Non-Renewable Biomass for Thermal Applications by the User*** *– Version 01 from February 01 of 2008 onwards.*

The amount of non-renewable biomass (B_y) will be determined according to the option "b" of the applied methodology once option "a" is designed for really small appliances like household stoves and does not fit for the kind of projects in question.

The project's emissions from the combustion of native wood are accounted in the same way as fossil fuel combustion, once it is not renewable and emits CO_2.

2.2 Justification of the choice of the methodology and why it is applicable to the project activity:

The methodology applied is Category AMS-I.E: Switch from Non – Renewable Biomass for Thermal Applications by the User – Version 01 from February 1st of 2008 onwards which is applicable for project activities that avoid greenhouse gas emissions by using renewable biomass in order to generate thermal energy.

This category comprises small thermal appliances that displace the use of non-renewable biomass by introducing new renewable energy end-user technologies. The end-user technology in the case of this project can be established as the project proponent, who utilizes the thermal energy generated by the new renewable energy technology.

There are no similar registered small-scale CDM project activities in the region of *Ceará* once *Carbono Social Serviços Ambientais Ltda.* has made a research and did not find any registered small-scale CDM Project activity in the region. The sources of registered small-scale CDM project activity consulted were the United Nations Framework Convention on Climate Change (UNFCC)[18] and Brazilian´s Technology and Science Ministry[19]. Therefore, the proposed project activity is not saving the non-renewable biomass accounted for by the other registered project activities.

The utilization of firewood from area without any kind of management cannot be considered a renewable source of biomass, since it does interfere in the carbon pools and increase the carbon emissions to the atmosphere, turning greenhouse effect even worse. Moreover, the native wood provided from areas without a reforestation management plan does not fit any of the options of UNFCCC definition of renewable biomass in Annex 18, EB 23.

Furthermore, firewood has been used for many centuries as fuel in Brazil[20]. Although, it is impossible to define a start date on which this kind of non-renewable biomass began to be applied, there are many

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[18] CDM activities registered by CDM Executive board are Available at: <http://cdm.unfccc.int/Projects/registered.html>. Visited on: September 06th, 2008.

[19] Brazilian´s Technology and Science Ministry is responsible for registry and approval of all CDM activities within Brazilian boundaries. CDM activities submitted to the Brazilian Inter-Ministerial Commission of CDM Activities are available at: <http://www.mct.gov.br/index.php/content/view/47952.html>. Visited on: September 06th, 2008.

[20] Uhlig, A. Lenha e carvão vegetal no Brasil: balance oferta-demanda e métodos para estimação de consumo, tese de doutorado, Universidade de São Paulo, São Paulo, 2008. 156 p. Available at: http://www.teses.usp.br/teses/disponiveis/86/86131/tde-14052008-113901/>. Visited on: December 12th, 2008

documents to prove that wood has been used for thermal energy generation before 1989 as requested in the applied methodology. Firewood used to be the most employed source of primary energy until the decade of 1970, when the petroleum started to supply the majority of Brazilian's energy needs [21]. Moreover the Brazilian's Energy and Mine Ministry has been monitoring every energetic sectors of Brazil since 1970, and firewood appears over the years monitored as a significant source of thermal energy for ceramic sector [22]. Especially in the ceramic sector, the use of firewood is visible non-renewable and unsustainable, involving negative environmental impacts associated [23]. This way, it can be concluded that non-renewable biomass has been used since 31 December 1989 or previously.

The *Babaçu* coconut husk and forest residues (sawdust) are agro-industries residues, so they are considered renewable according to option V of methodology definition of renewable biomass: "The biomass is the non-fossil fraction of an industrial or municipal waste".

The municipal garden's residues are considered renewable biomass according to option V of methodology definition of renewable biomass: "The biomass is the non-fossil fraction of an industrial or municipal waste". Since it's a municipal waste from the city of *Crato*, which is located in the ceramic region.

The cashew tree pruning is considered renewable according to option II, as soon as it fits all the assumptions below:
"The biomass is woody biomass and originates from croplands and/or grasslands where:
(a) The land area remains cropland and/or grasslands or is reverted to forest; and
(b) Sustainable management practices are undertaken on these land areas to ensure in particular that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and
(c) Any national or regional forestry, agriculture and nature conservation regulations are complied with."
Residues from cashew trees fits all the three options above since just residues from the croplands area are utilized, i.e. the area remains a cropland with the use of the biomass. Moreover, the areas where the cashew trees fallows sustainable management practices, according to is cultivation and harvest techniques, where the pruning of cashew trees is necessary in order to allow an appropriate formation of the tree and maintaining favorable conditions for the next harvest period[24]. This way, in cashew cultivation must be cut undesirable branches of the cashew trees.
Besides, Brazilian's production presents the tendency of increasing so far, carried by the new technologies utilized and the higher national and international demand of cashew nuts[25]. This way, the Brazilian sources of residues from cashew trees will increase following the Brazilian production, due the fact that cashew cultivation requests it.

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[21] *Brito, J.O."Energetic use of Wood". Available at: <http://www.scielo.br/scielo.php?pid=S0103-40142007000100015&script=sci_arttext&tlng=ES>. Visited on: September 06th, 2008.*

[22] *National Energy Balance- energy consumption per sector. Available at: <https://ben.epe.gov.br/BEN2007_Capitulo3.aspx> Visited on: September 06th, 2008.*

[23] *Uhlig, A. Lenha e carvão vegetal no Brasil: balance oferta-demanda e métodos para estimação de consumo, tese de doutorado, Universidade de São Paulo, São paulo, 2008. 156 p. Available at: <http://www.teses.usp.br/teses/disponiveis/86/86131/tde-14052008-113901/>. Visited on: December 12th, 2008*

[24] *According with "Manual de Aplicação de sistemas descentralizados de Geração de Energia elétrica para projetos de Eletrificação rural" Available at: <http://www.cepel.br/~per/download/rer/rt-789-00.pdf> visited on: March 13th, 2009*

[25] *Checked at: <http://www.nordesterural.com.br/nordesterural/matLerdest.asp?newsId=2219> visited on: March 13th, 2009*

The *Algaroba* wood *(Prosopis juliflora),* is considered renewable according to option IV: "The biomass is a biomass residue and the use of that biomass residue in the project activity does not involve a decrease of carbon pools, in particular dead wood, litter or soil organic carbon, on the land areas where the biomass residues are originating from".
The utilization of *Prosopis juliflora* is in according with option IV since it is considered a biomass residue due its competitive characteristics. A research made by EMBRAPA[26], which encompass States from northeast region of Brazil, affirmed that *Algaroba* is characterized as an invasive exotic plant due to its fast expansion, which causes many environmental impacts[27].

The elephant grass is considered renewable according to option III, as soon as it fit all the applied methodology assumptions:
"The biomass is non-woody biomass and originates from croplands and/or grasslands where:
(a) The land area remains cropland and/or grasslands or is reverted to forest; and
(b) Sustainable management practices are undertaken on these land areas to ensure in particular that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and
(c) Any national or regional forestry, agriculture and nature conservation regulations are complied with."
Currently, elephant grass has been acquiring national importance as biomass to generate thermal energy due to its high productiveness and easy adaptation in almost all climate and soil Brazilian conditions[28]. In case of utilizing elephant grass it will be cultivated in pasture or degraded areas, in which there is no vegetation to be deforested. Therefore, this practice will not generate competing use of biomass and it will not deforest a vegetated area.

The wood provided from sustainable management areas (both kinds are considered renewable biomasses according to option I, as long as it fits these options conditions stated below:
"The biomass is originating from land areas that are forests where:
(a) The land area remains a forest; and
(b) Sustainable management practices are undertaken on these land areas to ensure, in
particular, that the level of carbon stocks on these land areas does not systematically
decrease over time (carbon stocks may temporarily decrease due to harvesting); and
(c) Any national or regional forestry and nature conservation regulations are complied with."
The areas where these kind of biomasses are provided from management areas as stated in section 1.9. These areas follow the *Ceará´s* law which claims the sustainability rules for such activity[29]. Besides, it provides evidences that the sustainable management plans utilized from the project

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[26] *EMBRAPA is the Brazilian Agricultural Research Corporation's which its mission is to provide feasible solutions for the sustainable development of Brazilian agribusiness through knowledge and technology generation and transfer.*

[27] *Araujo, J. L. P., Correia, R. C., Araujo, E. P., Lima, P. C. F. Cadeia Produtiva da Algaroba no Pólo de Produção da Bacia do Submédio São Francisco. EMBRAPA. Petrolina –PE – Brazil.*

[28] *According to EMBRAPA (Brazilian Agricultural Research Corporation's). Source: <http://www.mwglobal.org/ipsbrasil.net/nota.php?idnews=3292>. Visited on: September 06th, 2008.*

[29] *According to SEMACE (normative instruction number 001/2003 from August 15th of 2003.) Available at: <http://www.semace.ce.gov.br/biblioteca/legislacao/conteudo_legislacao.asp?cd=315>. VisitedonMarch 04th, 2009.*

activity are undertaken and the level of carbon stocks will not decrease over time as required in the referenced option of the applied methodology.

Moreover, the project activity will annually generate less than 45 MWThermal.

2.3 Identifying GHG sources, sinks and reservoirs for the baseline scenario and for the project:

According to the applied methodology, the project boundary is the physical, geographical area of the use of biomass or the renewable energy, thus, the ceramic limits.

In the baseline, there is use of non-renewable biomass to burn ceramic devices in the ceramics' kilns. This practice is responsible to discharge in the atmosphere the carbon that was stored inside of the wood (well-known by a carbon sink).

Table 5. Gases included in the project boundary and brief explanation

	Gas	Source	Included?	Justification/ Explanation
Baseline	CO_2	Emission from the combustion of non-renewable fuel	Yes	The major source of emissions in the baseline
	CH_4	-	No	Deforestation rates will probably decay Excluded for simplification. This is conservative.
	N_2O	-	No	Possibly emissions from wood burning will be excluded for simplification. This is conservative.
Project Activity	CO_2	-	No	Excluded for simplification. This emission source is assumed to be very small.
	CH_4	-	No	Excluded for simplification. This emission source is assumed to be very small.
	N_2O	-	No	Excluded for simplification. This emission source is assumed to be very small.

2.4 Description of how the baseline scenario is identified and description of the identified baseline scenario:

Observing table below, the common fuels employed and therefore, the baseline candidates are: natural gas, charcoal, wood, other recuperations, diesel oil, fuel oil, liquefied petroleum gas, others from petroleum, piped gas, electricity and others non-specified.

Table 6. Distribution of fuel employed on the ceramic sector in Brazil

BRAZILIAN ENERGY BALANCE 2007 – CERAMIC SECTOR EVALUATION			
	Unit: 10^3 Tone of oil equivalent		
FUEL	**2004**	**2005**	**2006**
Natural Gas	767	831	901
Charcoal	52	70	42
Wood	**1,611**	**1,710**	**1,762**
Other recuperations	35	36	32
Diesel Oil	8	9	8
Fuel Oil	295	268	285
Liquified Petroleum Gas	134	148	151
Others from Petroleum	51	71	76
Piped gás	0	0	0
Electricity	262	270	276
Others non specified	0	0	0

(Brazilian Energy Balance, Available at: <http://www.mme.gov.br/download.do?attachmentId=16555&download> visited on January 05th, 2009)

The most probably scenario in the absence of native wood would be the use of fuel oil, which is not viable considering its higher prices when compared with firewood. Even tough, fuel oil presents a higher Net Calorific Value when compared with firewood; the costs with fuel oil are higher because of its expensive prices. Fuel oil presents an average price of 0,895R$/Kg and the firewood presents an average price of 35R$/m³. These values lead us to conclude that the price of oil fuel is of 0.000090587 R$/Kcal as long as the price of wood is 0.000014648R$/Kcal[30] utilizing the Net Calorific Value for both fuels. Therefore, the costs with the employment of fuel oil is about six times higher than the employment of firewood and adding the fact of the fuel oil required much more technology to be inserted, the conclusion is that the use of fuel oil is not attractive, at all.

Another plausible baseline scenario would be the use of Natural Gas. Although there is distribution/gas pipe in the region[31], the inconstant distribution of natural gas, as 40% of the natural gas consumed in Brazil proceeds from Bolivia[32] made the project developers not to trust in this fuel, therefore excluding this possibility.

The baseline is identified as the amount of non-renewable wood displaced with the fuel switch. The overall characteristics of the ceramic production are used to obtain the real amount of non-renewable biomass used in the baseline scenario.
Without the project activity, according to historical experience of CGM Ceramic, would be utilized approximately 0.64 m³ of wood to burn a thousand of ceramic devices and to maintain the ceramic furnace. Therefore, an amount of around 1,900 m³ of wood was required to maintain the average ceramic production of 2,949 tonnes of ceramic devices per month. The efficiency of the kiln is around 0.64³ of wood per tonne of ceramic devices, which presents a lower efficiency when compared with the value of Hoffman consumption found on literature which is between 0.5 and

[30] *According to data values and facts from "Estudo Comparativo da Queima de Óleo BPF e de Lenha em Caldeiras". Comparation made between wood from eucalyptus and fuel oil.Also the NCV of oil fuel itulized was 9880Kcal/Kg as stated in the source applied. Available at: <http://www.abcm.org.br/xi_creem/resumos/TE/CRE04-TE01.pdf>. Visited on: September 06th, 2008.*

[31] *Source: <http://www.ctgas.com.br/template02.asp?parametro=2547>. Visited on September 06th, 2008.*

[32] *Source: <http://ecen.com/eee51/eee51p/gn_bolivia.htm>. Visited on May 05th, 2009.*

0.9 m^3 of wood per thousand of pieces[33]. That occurs since CGM used to employ wood in their dryers as well and because of the lower efficiency of CGM's kilns.

2.5 Description of how the emissions of GHG by source in baseline scenario are reduced below those that would have occurred in the absence of the project activity (assessment and demonstration of additionality):

The methodology applied is Category AMS-I.E: Switch from Non – Renewable Biomass for Thermal Applications by the User – Version 01 which is applicable for project activities that avoid greenhouse gas emissions by using renewable biomass in order to generate thermal energy.

Furthermore, the project activity will annually generate less than 45 MWthermal.

As stated before CGM Ceramic is responsible for employing 1900 m3 of wood in order to manufacture 1,478,000 ceramic devices per month, where 869,003 are bricks with 8 orifices, 343,103 are bricks with 6 orifices , 185,529 are small flagstones and 80,365 are roof tiles. Moreover, according with CGM database the average weight for bricks with 8 orifices is 2.2 Kg , for bricks with 6 orifices is 1.6 Kg, for flagstones is 2.2 Kg and 1 Kg for roof tiles. Thus, CGM ceramic is responsible for manufacturing 2,949 tonnes per month, what leads the kiln efficiency around 0.64 m3 of wood/tonnes of ceramic devices.

To demonstrate that the project is additional it will be used the test 1 of section 5.8 of the Voluntary Carbon Standard – Specification for the project-level quantification, monitoring and reporting as well as validation and verification of greenhouse gas emission reductions or removals.

Test 1 – The project test

Step 1: Regulatory Surplus
The project is not mandated by any enforced law, statute or other regulatory framework in federal, State and Municipal levels in the survey performed.

Step 2: Implementation Barriers
The project shall face at least one distinct barrier compared with barriers faced by alternative projects.

- **Technological and technical barrier**

In the small project activity, the ceramic found some technological barriers. The machineries needed some adjustments in order to use the new biomasses, fuels that are uncommonly employed for the initial propose of the machines. With the use of mechanic burners, the employees do not have near contact to kiln entrances. In addition to the alterations in the machineries, the kilns sustained some adaptations due to the new fuel implemented and to work in accordance with the mechanic burners, the adaptations include:

- Kiln entrances needed to be reduced;

- Ash-pit of the furnace had to be closed;

Furthermore, the fuel substitution represented some weeks more to get adapted to the burn with the new biomasses, and get the final product with the same quality than in the baseline scenario. Thus, *CGM* Ceramic had to find the best procedure to handle with the new biomass, which is far

[33] *Source: TAPIA, R. E. C. et al.* ***Manual para a indústria de cerâmica vermelha****. Rio de Janeiro: SEBRAE/RJ, 2005. (Série Uso Eficiente de Energia).*

different when compared with the use of wood. Another technological barrier is related to the difficult of the elaboration of the Sustainable Forest Management Plan for the areas that supply renewable wood to the Ceramic. The elaboration of these plans requires an intensive study involving the correct species to be planted, the cutting tree periods, the amount allowed to be cut, etc, demonstrating the real need of technical information and specialized professionals to execute these procedures.

- **Financial barrier**

New equipments were acquired such as 2 mechanic burners, pyrometers, thermocouples, computers for control, cables, switchers and plugs. Besides the initial investment with mechanic burners, there are costs related to its maintenance and electrical energy for equipment operation.

A new storage shed of approximately 300 m^2 has been constructed in order to store the new biomass volume, mainly the sawdust and the *babaçu* coconut husk. These biomasses are stored in order to overcome scarcity and rainy period.

When the new production techniques have been introduced in the ceramic plant, there was an adaptation period and a testing period. For the adaptation of the kilns a still period of a burning cycle for each kiln had to be considered. Also the testing period of approximately three months, required in order to identify the correct burning curve, lead to waste of considerable amount of biomass (average 25%) in each burning cycle. All this resulted in prejudice for the company financial Profit and Loss balance.

The ceramic owner had to deal with high investments in order to elaborate a sustainable management plan with native species. The ceramic also had to withstand with the acquisition of a piece of land in order to implement the management plan[34]. Even with the reforested areas completely providing wood to the ceramics, the management of these areas requires constant amounts of money for the maintenance of their activities.

Due to all the above mentioned reasons the ceramic industry had to deal with higher production costs. That made the ceramic responsible think about stopping the fuel switching project.

The demonstrations of the main costs after and before the project activity can be checked in the tables of costs below.

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Table 7. Investments before and after the project activity

Investment				
Equipament Aquisition	Non-renewable biomass		Renewable biomass	
Costs with equipment acquisition (including freight)	---------	BRL	R$ 343,354.48	BRL
Loss of revenues - period for adaptation of the kiln for biomass	---------	BRL	R$ 31,500.00	BRL
Waste of biomass in the testing period	---------	BRL	R$ 16,565.77	BRL
Waste of products	---------	BRL	R$	BRL

[34] *The investments really occurred in order to implement the sustainable management plan, however, the ceramic was not able to show the invoices to the validation team until the conclusion of this Project Description. For this reason, it was not considered in the table of financial costs.*

in the testing period (3 months)			46,557.00	
New biomass storage shed	---------	BRL	R$ 149,115.00	BRL
Total Invested	**0**	**BRL**	**R$ 587,092.25**	**BRL**

The income from the commercialization of the carbon credits is essential to maintain the fuel switch, as this change needs more resources than previously to maintain operations. This disparity obviously puts *Gomes de Mattos* Ceramic in a less competitive position when compared to its competitors which are mostly using wood. The consequences of this commercial disadvantage would make the fuel switching and the continued use of the needed machinery unfeasible without the existence of the carbon markets.

- **Institutional Barriers**

Since the kilns were adapted to burn the new biomass, and there was a lack of qualified work force to manage these new equipments, it was necessary to submit some workers to training and capacitating courses.

The new biomass presented a larger volume, which in turn was required to be stored under a shed, thus changing the established logistic system of the ceramic. The shed, moreover, contributes keeping the biomass dry, increasing the burning efficiency.

- **Risks of the project**

The use of wood from areas without sustainable forest management is a traditional and well-known process, the fact of which presented a risk to the owner of *CGM* ceramic with the implementation of the fuel switching project, since the introduction of a previously unknown type of fuel and machines added a significant amount of insecurity to the production process.

After the project implementation the main barrier was the maintenance costs, which are higher than the ceramics which still use non-renewable biomasses.

It must be re-emphasized that there is no direct subsidy or support from government for this project. Without the income from the commercialization of the carbon credits, the fuel switch at *Gomes de Mattos* Ceramic would not be feasible or attractive to the project developer.

- **Barrier due to the price of the biomass**

The thermal energy generation through the combustion of biomasses is an innovation in the ceramic industry. The future demand of this alternative fuel e.g. by other consumers is not easy to foresee. Although there is currently a great amount of these types of biomasses available locally, it is a possible that the demand and the prices would increase as well. If the price of the biomass increases, in the other hand, the products cannot increase, once it would not have competitive prices in relation to other ceramics which did not made the fuel switch.

Step 3: Common Practice

According to the GHG Protocol for Project Accounting, common practice analysis shall be carried out following:

1. Define the product or service provided by the project activity.

The product of the project activity are ceramic bricks with 8 orifices, bricks with 6 orifices ,small flagstones and roof tiles.

2. Identify possible types of baseline candidates.

Observing table below, the common fuels employed and therefore, the baseline candidates are: natural gas, charcoal, wood, other recuperations, diesel oil, fuel oil, liquefied petroleum gas, others from petroleum, piped gas, electricity and others non-specified. Other possible baseline candidate would be the use of renewable biomass without the carbon credits support.

Table 8. Percentage of fuel employed on the ceramic sector in Brazil

BRAZILIAN ENERGY BALANCE 2007 – CERAMIC SECTOR EVALUATION			
FUEL	**2004**	**2005**	**2006**
Natural Gas	24%	24%	26%
Charcoal	2%	2%	1%
Wood	50%	50%	50%
Other recuperations	1%	1%	1%
Diesel Oil	0%	0%	0%
Fuel Oil	9%	8%	8%
Liquified Petroleum Gas	4%	4%	4%
Others from Petroleum	2%	2%	2%
Piped gás	0%	0%	0%
Electricity	8%	8%	8%
Others non specified	0%	0%	0%

(Brazilian Energy Balance, source: http://www.mme.gov.br visited on: January 05th, 2009)

3. Define and justify the geographic area and the temporal range used to identify baseline candidates.

Brazil was identified as the geographic area of the baseline candidates because Energy Research Company[35] from Mines and Energy Ministry of Brazil is the most representative and reliable source of information about the ceramic sector and its fuel employed.

Therefore, data from table above were provided by a reliable source and it was considered 3 years of its historical data, including the most recent available data and the period when CGM Ceramic did its fuel switch.

4. Define and justify any other criteria used to identify baseline candidates.

The other types of criteria used to identify baseline candidates were the common practice, the costs of fuel and the local availability of technology and fuel.

The criteria common practice was used to identify baseline candidates because if a kind of fuel has already been employed with success in the ceramic sector it is an obvious baseline candidate.

Besides, the fuel cost was criteria once if a kind of fuel has high costs it will discourage the scenario of investing in this type of fuel, for example.

Equally important, the local availability of technology and fuel were pieces of criteria because the lack of technology and fuel in the region excludes them as baseline candidates. An example may be the lack of natural gas distribution in some regions.

There are legal requirements constraints regarding the use of non renewable biomass as exposed in Decree N.5,975 of November 30th, 2006. However, it is not enforced namely due to the lack of police. The

[35] *Energy Research Company is a national entity which intended to provide services and researches to subsidize the energy sector planning, in areas as electric Power; oil, natural gas and their derivatives; coal; wood; renewable energy sources and energy efficiency; among others.*

consumption of non renewable biomass by the ceramic industry was related by several authors (NERI, 2003[36]; ALBUQUERQUE et al, 2006[37]; BRASIL, 2001[38]; VIANA, 2006[39]; CARDOSO, 2008[40]). This have also been observed in other industries as in the production of steel (BRASIL, 2005[41]), which has a much better structure and internal organization when compared with the ceramic industry, that is usually a small and familiar enterprise. BRASIL (2001) suggests that it is important to stimulate the miner sector, especially who are respecting the environment. The incomes from carbon credits can be this incentive which would contribute to avoid the consumption of non renewable biomass illegally. Therefore laws and regulations will not be considered to constraint the geographical area and temporal range of the final list of the baseline candidates.

The project activity implementation without the carbon credits incomes is a criteria once there was biomass availability.

5. Identify a final list of baseline candidates.

Table 9 provides the percentage of the level of penetration of each fuel utilized in the ceramic sector during the average of the three last years available (2004, 2005, and 2006). Baseline candidates are the use of:

a) Wood: The fuel most used, which would be the scenario of highest GHG emissions, once its emission factor is the highest according to IPCC 2006[42].

b) Natural gas: it is restricted by the inconstant distribution, its high costs[43] and lack of availability[44]. The risk of lack of offering and higher costs when compared with other fuels discourages the scenario of investing in this type of fuel even in local with piped gas. The distribution of gas is preferentially performed to thermal power plants, increasing the risk of blackout of natural gas.

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*[36] NERI, J.T. Energia Limpa, Sustentável ou de Subsistência? **Cerâmica Industrial**, Rio Grande do Norte;V,8, n.1,35 -6,2003.*

*[37] ALBUQUERQUE, J.L.B. et al. Águia-cinzenta (Harpyhaliaetus coronatus) e o Gavião-real-falso (Morphnus guianensis) em Santa Catarina e Rio Grande do Sul: prioridades e desafios para sua conservação. **Revista Brasileira de Ornitologia**, v.14, n.4, p. 411 - 415, dez. 2006. Available at: <http://www.ararajuba.org.br/sbo/ararajuba/artigos/Volume144/ara144not3.pdf>. Access at: September 10th, 2008.*

*[38] BRASIL. Ministério de Ciências e Tecnologias. **Levantamento da Situação e das Carências Tecnológicas dos Minerais Industriais Brasileiros**: com enfoque na mineração de: Argila para cerâmica, Barita, Bentonita, Caulim para carga, Talco / Agalmatolito e Vermiculita. Brasília, 2001. Available at: < http://www.cgee.org.br/prospeccao/doc_arq/prod/registro/pdf/regdoc710.pdf>. Access at: September 10th, 2008.*

*[39] VIANNA, F.M.A. **Participação Pública em Programas Ambientais: Um Estudo em Área Suscetível a Desertificação no Estado do Rio Grande do Norte.** 2006, 109f. Dissertação (Mestrado em Engenharia de Produção) - Universidade Federal do Rio Grande do Norte, Natal, 2006. Available at: <http://www.pep.ufrn.br/publicacoes.php?enviou=1>. Access on September 10th, 2008.*

*[40] CARDOSO, C.F.R. **Panorama do Setor Florestal: o que tem sido feito na esfera do Governo Federal,** Rio de Janeiro, 03 Set. 2008. Report presented in 1° SEMINÁRIO DE MADEIRA ENERGÉTICA, 2008.*

[41] BRASIL. Diagnóstico do Setor Siderúrgico nos Estados do Pará e do Maranhão. Brasília: Ministério do Meio Ambiente, 2005. 76 p.

[42] Source: IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Source: <http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf>. Page 2.18. Table 2.3. visited on 13th March, 2009.

[43] Source: <http://www.dep.fem.unicamp.br/boletim/BE31/artigo.htm> visited on 13th March, 2009.

[44] Source: <http://www.gasnet.com.br/novo_entrevistas.asp?cod=145> visited on 13th March, 2009.

c) Fuel oil: This fuel is more expensive than wood, however it can be a more plausible of substitute of wood than natural gas. The risks involving natural gas distribution are so considerable that PETROBRÁS[45] was offering subsidy to the consumption of fuel oil in spite of natural gas in the State of São Paulo.

d) Renewable biomass: despite the high biomass availability, the main problems concerning the use of renewable biomass are related to the high investments, technological and institutional barrier, mainly the risk of changing for a biomass not consolidated as fuel for ceramic industries[46].

6. Identify baseline candidates that are representative of common practice (for the project-specific baseline procedure).

In Brazil, the red ceramic devices are generally produced through an inefficient and traditional process using wood without forest management to generate thermal energy technologies[47]. In this industry segment the use of wood represents about 98% of the total fuel employed stimulating the increase in Brazilian deforestation and desertification rates. It happens because wood without forest management is offered with lower prices than wood from areas with forest management[48].Furthermore, using non-renewable wood is a simple procedure and well known by the kiln operators.

The native forest without any kind of sustainable management has always been a source of firewood, which seemed inexhaustible, due to the amount generated in the expansion of the agriculture frontier bringing forward environmental impacts, with regard to the degradation of soil, change in the regime of rainfall and consequent desertification[49].

The ceramic industry sector has practically not evolved compared to the past, mainly due to the simplified techniques of manufacture. Moreover, the major equipments (chiefly kilns) of the production process were not improved significantly. Most of these companies still use non-renewable wood in their kilns and the drying process occurs naturally, without the utilization of energy. On the other hand, the influence of the market by improvements in this sector is very insignificant[50].

Thus, the common practice is the use of wood and its non-renewable fraction, which is the fuel most employed and with less risk associated.

The acquiring of new equipment and the overall costs of the fuel switch represented a risk to the project proponent since the baseline practice was already established and well-known by the laborers. The operators did

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45 PETROBRÁS performs in oil and oil by product exploration, production, refining, marketing, and transportation, both in Brazil and abroad. More information available on <http://www2.petrobras.com.br/ingles/ads/ads_Petrobras.html>. Visited on September 06th, 2008.

46 The use of renewable biomass was not included in table 08 which shows the fuel most employed in the ceramic sector according to Brazilian Energy Balance.

47 ABREU, Y. V.; GUERRA, S. M. G. Indústria de Cerâmica no Brasil e o Meio Ambiente. Chile: IV Congreso Nacional de Energía, 2000. Available at: <http://www.nuca.ie.ufrj.br/bgn/bv/abreu2.htm>. Visited on November, 20th 2008.

48 Seye, Omar. Análise de ciclo de vida aplicada ao processo produtivo de cerâmica estrutural tendo como insumo energético capim elefante (Pennisetum Purpureum Schaum) / Omar Seye. Campinas, SP: [s.n.], 2003.

49 UHLIG, A. Lenha e carvão vegetal no Brasil: balance oferta-demanda e métodos para estimação de consumo, tese de doutorado, Universidade de São Paulo, São paulo, 2008. 156 p. Available at: http://www.teses.usp.br/teses/disponiveis/86/86131/tde-14052008-113901/ >. Visited on December, 12th 2008

50 PAULETTI, M. C. Modelo para Introdução de Nova Tecnologia em Agrupamentos de Micro e Pequenas Empresas: Estudo de Caso das indústrias de Cerâmica Vermelha no Vale do Rio Tijucas. 2001. Available at: < http://www.spg.sc.gov.br/menu/desenv_economico/camara_apls/estudos/Trabalhos_sobre_economia_catarinense/Ceramica_estrutural/2001_Tecnologia_ceram_verm_vale_tijucas_dissertacao.pdf >. Visited on November 20th, 2008.

not have the knowledge of the ideal amount of renewable biomass that is necessary to use in order to achieve the temperature of about 900°C to cook its ceramic pieces, to acquire the final product with the same quality and to maintain the optimal process as they did when using the native wood without sustainable management. As a result of the fuel switch, an extensive training course was required for the staff in order to clarify new measures linked to the new technology in order to sustain the quality of the final product.

Thus, the project activity is not a common practice.

Impact of project approval

Presently, the ceramic industrial segment of *Ceará* state comprises mostly small industrial units that still use the most diverse technological models, and the grand majority of them, use native firewood from the *Caatinga* biome as fuel. These industries have some technological restrictions in the areas of energy exploitation and the efficiency of the machinery, but the project's approval can dramatically improve the development of this sector. In *Crato*, there are around 10 ceramic industries, which make *CGM*'s visibility and qualitative effect as a role model.

Moreover, measures should be taken to preserve *Caatinga* biome and the project activity represents an example that can be followed by other activities.

The project activity contributes to the reduction of the greenhouse gas (GHG) emissions by diminishing deforestation of the *Caatinga* biome. Rich in natural resources, *Caatinga* is one of the most threatened ecosystems of the planet. In addition, its high calorific power is the main cause of its degradation. In a region where the scarcity of rivers implies lesser access to the electric energy, the firewood and charcoal correspond of 30% of the used energy matrix in the industries of the region, which intensifies the local deforestation.

In the last years, the deforestation verified rated an annual average of approximately 5,000 km^2 within the boundaries of the *Caatinga* biome.[51]

Table 10 shows the approximate area of all the biomes in Brazil, and the area occupied by the *Caatinga* is highlighted.

Table 9 . Brazilian biomes in decreasing order of importance

Brazilian Biomes	**Approximate Area (km^2)**	**Area of the biome / Total Brazilian Area (%)**
Amazonian biome	4,196,943	49.29
Cerrado biome	2,036,448	23.92
Mata Atlântica biome	1,110,182	13.04
***Caatinga* biome**	**844,453**	**9.92**
Pampa biome	176,496	2.07
Pantanal biome	150,355	1.76
Total Brazilian Area	**8,514,877**	**100**

(Source: http://www.ibge.gov.br/home/presidencia/noticias/noticia_visualiza.php?id_noticia=169&id_pagina=1) *visited on 13th March , 2009*

[51] *Source: <http://www.ongacema.org.br/meioambiente/caatinga.html> visited on March 13th, 2009.*

3 Monitoring:

3.1 Title and reference of the VCS methodology (which includes the monitoring requirements) applied to the project activity and explanation of methodology choices:

- ***Category AMS-I.E: Switch from Non – Renewable Biomass for Thermal Applications by the User –*** *Version 01 from February 01 of 2008 onwards.*

The methodology applied is Category AMS-I.E: Switch from Non – Renewable Biomass for Thermal Application by the User – Version 01 from February 01 of 2008 onwards which is applicable for project activities that avoid greenhouse gas emissions by using renewable biomass in order to generate thermal energy.

The project activity will generate less than the limits of 45 MWthermal for Type I small scale project activities.

Source data used in this report is based on real outputs from *CGM* Ceramic. This section will focus on information management related to production.

3.2 Monitoring, including estimation, modelling, measurement or calculation approaches:

The monitoring will be done with the aim of determine the most approximate quantity of wood without sustainable management that, in the absence of the project, would be used in the ceramics' kilns and consequently the amount of GHG that would be emitted in tonnes of CO_2e.

Table 10. Data reported in monitoring estimation

Parameters	Description	Units	Origin	Frequency
$Q_{renbiomass}$	Amount of renewable biomass	tonnes	Measured by the project proponent	Monthly
Origin of renewable biomass	Renewable origin of the biomass	Not Applicabl e	Controlled by the project proponent	Annually
PR_y	Production of ceramic pieces	Tonnes	Controlled by the project proponent.	Monthly
Renewable Biomass Surplus	Amount of renewable biomass available	Tonnes or m^3	Monitored by articles and database	Annually
Leakage of Non-Renewable Biomass	Leakage resulted from the non-renewable biomasses	tCO_2e	Monitored by articles and database	Annually
$EF_{projected\ fossil\ fuel}$	CO_2 Emission factor of residual fuel oil	tCO_2/TJ	IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Source: http://www.ipcc-nggip.iges.or.jp/pu	Not monitored

			blic/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf. Page 2.18. Table 2.3.	
$\mathbf{NCV_{biomass}}$	Net Calorific Value of non-renewable biomass	TJ/ton of Wood	Bibliography	Not monitored
$\boldsymbol{\rho_{biomass}}$	Specific gravity of non-renewable biomass	ton/ m³	Bibliography	Not monitored
$\boldsymbol{f_{NRB,y}}$	Fraction of biomass (wood) used in the absence of the project activity established as non- renewable biomass using survey methods	Percentage	Data from project proponent and bibliography	Annually
$\mathbf{BF_y}$	Consumption of non-renewable biomass per thousand of ceramic devices produced	tonnes/ thousand of ceramic devices	Data from project proponent	Not monitored

In the monitoring plan, the amount of non-renewable biomass ($\mathbf{B_y}$) will be determined using the option 'b' of the applied methodology:

$$\mathbf{B_y} = \frac{HG_{p,y}}{\eta_{old} \times NCV_{biomass}}$$

As stated before, the *CGM* ceramic employed around 1,900 m³ of native wood without sustainable management per month producing 2,949 tonnes ofceramic devices. This information leads to the number of 0.64 m³ of native wood to produce a tonne of ceramic devices.

The quantity of native wood that would be used in the ceramics will be calculated through the multiplication of the ceramics' monthly production in tonnes by the consumption of the kiln, as the following example for *CGM* Ceramic:

By = (Monthly production(tonnes)) x Kiln Consumption ($\mathbf{BF_y}$) x Fraction of non-renewable biomass

By = 2,949 (tonnes) x 0.64 m³ of wood/tonnes of ceramic devices x 0.967 x 0.880 ton/m3 x 12 months

By = 19,272 tonnes of native wood/year

The responsible to monitor data provided in table 11 will be Mr. *Ronaldo Gomes de Matos.* Internal audit will guarantee data quality.

3.3 Data and parameters monitored / selecting relevant GHG sources, sinks and reservoirs for monitoring or estimating GHG emissions and removals:

Monitored Parameters

<table>
<tr><td>Data / Parameter:</td><td>$Q_{renbiomass}$</td></tr>
<tr><td>Data unit:</td><td>Tonnes per month</td></tr>
<tr><td>Description:</td><td>Amount of renewable biomass</td></tr>
<tr><td>Source of data to be used:</td><td>Measured by the project developer</td></tr>
<tr><td>Value of data</td><td>Predicted to:
<table>
<tr><th>Biomass</th><th>Native wood from management areas</th><th>Cashew wood</th><th>Sawdust</th><th>Babaçu Coconut husk</th><th>Algaroba wood</th><th>Eucalyptus Wood from forest management plan</th></tr>
<tr><td>tonnes</td><td>563</td><td>105</td><td>5</td><td>5</td><td>128</td><td>18</td></tr>
</table>
</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>The amount of biomasses will be monitored in accordance to the weight described in the receipts from the providers. The values in the receipts may be described in m³, therefore it is necessary the conversion to tonnes through the specific gravity of each biomass. The specific gravity values of the renewable biomasses utilized in this project is:
<table>
<tr><th>Biomass</th><th>Native wood from reforested areas</th><th>Residues from Cashew trees</th><th>Sawdust</th><th>Babaçu Coconut husk</th><th>Algaroba wood</th><th>Eucalyptus wood from forest management plan</th></tr>
<tr><td>Specific gravity (tonnes/ m³)</td><td>0.88</td><td>0.42</td><td>0.245</td><td>1.085</td><td>0.756</td><td>0.49</td></tr>
</table>
The sources of these data are:

Sawdust:
Masses and Dead Loads of Concrete and Other Materials-http://www.cca.org.nz/pdf/Masses.pdf

Residues from cashew trees:
LORENZI, H. Árvores Brasileiras: Manual de Identificação e Cultivo de Plantas Arbóreas Nativas do Brasil, vol.1. 4.ed. Nova Odessa, SP: Instituto Plantarum, 2002.

Native wood from management areas:
The same applied in ρbiomass

Babaçu coconut husk:
<http://www.ipef.br/publicacoes/scientia/nr34/cap04.pdf> visited on March 13th, 2009.

Algaroba wood:
The value applied is an average among all species founded in the source:
<http://www.cnpf.embrapa.br/publica/boletim/boletarqv/bolet45/pag-99_106.pdf>
visited on March 13th , 2009.

Wood from forest management areas (eucalyptus):
The value applied is an average among all species founded in the source:
<http://www.ipef.br/publicacoes/scientia/nr23/cap08.pdf>
</td></tr>
</table>

	visited on March 13th , 2009.
QA/QC procedures to be applied:	The ceramic has a spreadsheet of the quantity of biomass acquired. It will be rechecked according to the receipts of purchase.
Any comment:	

Data / Parameter:	**PRy (Ceramic devices)**
Data unit:	Unity of ceramic devices or tonnes of ceramic devices.
Description:	Production of ceramic pieces
Source of data to be used:	Controlled by the project developer.
Value of data	1,478,000 units per month or 2,949 tonnes per month
Description of measurement methods and procedures to be applied:	The amount was acquired by counting the total production of one year. The measurement will be done by an internal control sheet monitored by the project proponent, which will be filled daily. The production is a representative sample to ensure that all appliances are still in operation
QA/QC procedures to be applied:	The ceramics have an internal control of the quantity of pieces produced. It will be rechecked according to the biomass employed and the kiln consumption of renewable biomass.
Any comment:	

Data / Parameter:	**Origin of renewable biomass.**
Data unit:	Not Applicable
Description:	Renewable origin of the biomass
Source of data to be used:	Controlled by the project developer.
Value of data	renewable biomass
Description of measurement methods and procedures to be applied:	The guarantee of acquiring renewable wood will be achieved by invoices from the providers. The origin of the cashew tree pruning will be evidenced with a declaration from the provider that the sustainable plan had been followed. As stated in the section 2.2, the biomasses (Algaroba wood, *babaçu* coconut husk, Elephant grass and Sawdust) are considered renewable as fulfilling the options described in the methodology applied.
QA/QC procedures to be applied :	The biomass will be considered as renewable if it is according to the definition given by Methodology AMS-I.E: Switch from Non - Renewable Biomass for Thermal Application by the User - Version 01 from February 01 of 2008 onwards.
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

Data / Parameter:	**Leakage of non-renewable biomass.**
Data unit:	tCO_2e
Description:	Leakage resulted from the non-renewable biomass
Source of data to be used:	Monitored
Value of data	0
Description of measurement methods and procedures to be applied:	The three sources of leakages predicted in the applied methodology will be monitored. Scientific articles, official statistical data, regional and national surveys will be provided in order to ensure that there is no leakage from non-renewable biomass (or to estimate the leakage).
QA/QC procedures to be applied :	Data available regarding the ceramic industries fuel consumption will be utilized to monitor the leakage.
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

<table>
<tr><th>Data / Parameter:</th><th>Renewable biomass surplus</th></tr>
<tr><td>Data unit:</td><td>ton or m^3</td></tr>
<tr><td>Description:</td><td>Amount of renewable biomass available</td></tr>
<tr><td>Source of data to be used:</td><td>Monitored</td></tr>
<tr><td>Value of data</td><td>
<table>
<tr><th>Harvest</th><th>07/08</th></tr>
<tr><td>Forest Residues (sawdust) in m^3</td><td>10,775.38</td></tr>
<tr><td>Babaçu coconut husk (tonnes)</td><td>4,756</td></tr>
<tr><td>Wood from management areas(m^3)</td><td>4,595,695</td></tr>
<tr><td>Residues from cashew trees (tonnes)</td><td>196,625</td></tr>
<tr><td>Algaroba wood (m^3)</td><td>2,500,000</td></tr>
<tr><td>Municipal garden's residues</td><td>Not measured</td></tr>
<tr><td>Elephant Grass</td><td>Not measured</td></tr>
</table>
Detailed information in section 4.1 – Leakage.</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>It will be used to calculate the leakage of renewable biomass. The sources of leakages predicted in methodology applied will be monitored. The measurement of the leakage will be based in national and international articles and database every monitoring period. The sources will provide information about the biomass availability in the project activity’s region.</td></tr>
<tr><td>QA/QC procedures to be applied :</td><td>Data available regarding the ceramic industry fuel consumption will be employed to monitor the leakage.</td></tr>
<tr><td>Any comment:</td><td>Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.</td></tr>
</table>

Data / Parameter:	$f_{NRB,y}$
Data unit:	*Fraction of biomass or (percentage)*
Description:	Fraction of biomass (wood) used in the absence *of the project activity in year y.*
Source of data used:	Survey methods.
Value of applied:	96.7%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Before the project activity, wood from areas without forest management was offered with low prices and high viability to the ceramics owner. *Thus, the totality of fuel employed in the baseline scenario is from non-renewable origin. However, considering that 0.11% of* Caatinga *biome has sustainable forest management plan, the fraction of non-renewable biomass is 99.89%. Also it was add the amount of wood saved by similar projects that are being developed by Carbono Social Serviços Ambientais Ltda. with the same methodology in the region. It was measured the amount of 6,242,408 m3 of wood in 10 years, representing around 0.04% of total Caatinga area.* Despite of the fact all the biomasses utilized in this project activity being renewable, CGM ceramic was not able to provide evidences in order to prove all the licences of the farm were the Eucalyptus wood is originated from. Thus, it will be discounted in this parameter, and will be monitored for its measurement as well. The average percentage of Eucalyptus consumptions is 2.7% of the total biomass consumption.

	Hence, the Fraction of non-renewable biomass applied in a conservative way is 96.7 %. Source: <http://www.cnip.org.br/planos_manejo.html>. Visited on March 04th, 2009.
QA/QC procedures to be applied :	The monitoring of this parameter will be based in national and international articles and database every monitoring period. The sources will provide information about the sustainable use of *Caatinga* biome. Wood saved from projects with same biome and applied methodology developed by *Carbono Social Serviços Ambientais Ltda* was considered in this fraction. CDM or VCS registered projects will also be included in this fraction if placed in the same region and methodology. Moreover the amount of non-renewable biomass applied in the project activity will be monitored monthly and will be considered in the value of Fnrb parameter.
Any comment:	It will be employed in order to estimate the amount of non renewable biomass.

Fixed parameters

Data / Parameter:	**EFprojected_fossil fuel**
Data unit:	tCO_2/TJ
Description:	CO_2 Emission factor of residual fuel oil
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Source: <http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf>. Page 2.18. Table 2.3. visited on march 13th, 2009.
Value applied:	77.4 tCO_2/TJ
Justification of the choice of data or description of measurement methods and procedures actually applied:	In the baseline scenario, the probable fossil fuel that would be consumed in the absence of native wood without sustainable forest management would be the heavy oil. This fuel is more expensive than wood, however it can be a more plausible of substitute of wood than natural gas due to risks involving natural gas distribution.
Any comment:	Applicable for stationary combustion in the manufacturing industries and construction. The fossil fuel likely to be used by similar consumers is taken the IPCC default value of residual fossil fuel. Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits income for this project activity, whichever occurs later.

Data / Parameter:	**NCV biomass**
Data unit:	TJ/ton of wood
Description:	Net Calorific Value
Source of data to be used:	National data
Value of data applied for the purpose of calculating expected emission reductions	0.019
Description of measurement methods and procedures to be applied:	This value will provide the energy generated by the amount of wood that would be used in the absence of the project. The species used to calculate the average value are typical trees of *Caatinga* Biome that are usually utilized as fuel in the ceramic industries of the region. Sources: - Poder Calorífico da Madeira e de Resíduos Lignocelulósicos. Available at

	<http://www.renabio.org.br/arquivos/p_poder_lignocelulosicos_11107.pdf> visited in March 13th, 2009. - Estrutura anatômica da madeira e qualidade do carvão de Mimosa tenuiflora (Willd.) Poir . Available at: <http://www.scielo.br/pdf/rarv/v30n2/a18v30n2.pdf> visited in March 13th, 2009.
Any comment:	IPCC default values shall be used only when country or project specific data are not available or difficult to obtain, according to "Guidance on IPCC default values" (Extract of the report of the twenty-fifth meeting of the Executive Board, paragraph 59).

Data / Parameter:	**ρ biomass**
Data unit:	ton/ *m³*
Description:	Specific gravity
Source of data to be used:	National data
Value of data applied for the purpose of calculating expected emission reductions	0.88 ton/m³. Value average checked at: -IPCC: Intergovernmental Panel on Climate Change. Orientácion del IPCC sobre las buenas prácticas para UTCUTS - chapter3 - Table 3A.1.9-2 - LORENZI, H. Árvores Brasileiras: Manual de Identificação e Cultivo de Plantas Arbóreas Nativas do Brasil, vol.1. 4.ed. Nova Odessa, SP: Instituto Plantarum, 2002. - *Estrutura anatômica da madeira e qualidade do carvão de Mimosa tenuiflora (Willd)*. Available at <http://www.scielo.br/pdf/rarv/v30n2/a18v30n2.pdf> visited in March 13th, 2009. - Poder Calorífico da Madeira e de Resíduos Lignocelulósicos. Available at: <http://www.renabio.org.br/arquivos/p_poder_lignocelulosicos_11107.pdf> visited in March 13th, 2009. -<http://www.ibama.gov.br/lpf/madeira/caracteristicas.php?ID=195&caracteristica=139> visited on March 13th, 2009.
Justification of the choice of data or description of measurement methods and procedures actually applied:	The amount of wood used in the baseline was measured in volume units. This datum will be used for the unit conversion.
Any comment:	The species used to calculate de average value are typical trees of *Caatinga* Biome and usually utilized as fuel in the ceramic industries of the region.

Data / Parameter:	**BFy**
Data unit:	m3 of wood per tonnes of ceramic devices.
Description:	Consumption of non-renewable biomass per thousand of ceramic devices
Source of data used:	Historical data from project proponent
Value of data	0.64 m3 of wood per tonnes of ceramic devices.

Justification of the choice of data or description of measurement methods and procedures actually applied :	The value was acquired through the average consumption and production of ceramic devices during the years when the ceramic used to consume non sustainable wood. This value is in accordance with the data acquired in other ceramics that employ the same type of kilns. The value is employed to calculate the real amount of wood displaced to maintain the ceramic production in the baseline scenario.
Any comment:	The efficiency of the kiln is around 1.29m^3 of wood per thousand of ceramic devices, which presents a lower efficiency when compared with the value of Hoffman consumption found on literature which is between 0.5 and 0.9 m^3 of wood per thousand of pieces. That occurs since CGM used to employ wood in their dryers as well and because of the lower efficiency of CGM's kilns. Source with TAPIAS, 2000[52].

3.4 Description of the monitoring plan

The party responsible for implementing the monitoring plan shall be the owner of the company *Cerâmica Gomes de Mattos*. The project proponent will also be responsible for developing the forms and registration formats for data collection and further classification. Data monitored will be kept during the crediting period and 2 years after. For this purpose, the authority for the registration, monitoring, measurements and reporting is Mr. Ronaldo Gomes de Matos. All the monitored parameters will be checked annually as requested in the methodology Category AMS-I.E: Switch from Non - Renewable Biomass for Thermal Application by the User - Version 01 from February 01 of 2008 onwards.

The management structure will rely on the local technicians with a periodical operation schedule during the project. The technical team will manage the monitoring, the quality control and quality assessment procedures.

The party will also implement a social carbon monitoring plan through the social carbon methodology, which was developed by *Instituto Ecológica* Palmas focused on a sustainable development and better social conditions to the communities where it is implemented.

4 GHG Emission Reductions:

4.1 Explanation of methodological choice:

Methodology AMS-I.E: Switch from Non - Renewable Biomass for Thermal Application by the User - Version 01 from February 01 of 2008 onwards, which comprises project activities that avoid greenhouse gas emissions by using renewable biomass in order to generate thermal energy. The project's emissions from the combustion of native wood are accounted in the same way as fossil fuel combustion, once it is not renewable and emits CO_2.

The project activity will generate less than the limit of 45 MWthermal for Type I small scale project activities.

Baseline

$$ER_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected\_fossilfuel} \quad \text{(Equation 01)}$$

Where:

ER_y: Emission reductions during the year y in tCO_2e

B_y: Quantity of biomass that is substituted or displaced in tonnes

$f_{NRB,y}$: Fraction of non-renewable biomass (wood) used in the absence of the project activity in year y

$NCV_{biomass}$: Net calorific value of non-renewable biomass in TJ/ton

$EF_{projected\ fossil\ fuel}$: Emission factor for the projected fossil fuel consumption in the baseline in tCO_2e/TJ[53].

B_y is determined using the following option:

Calculated from the thermal energy generated in the project activity as:

$$B_y = \frac{HG_{p,y}}{\eta_{old} \times NCV_{biomass}} \quad \text{(Equation 02)}$$

Where:

$HG_{p,y}$: Quantity of thermal energy generated by the renewable energy in the project in year y in TJ.

η_{old} : Efficiency of the system being replaced

$$HG_{p,y} = SGE \times PR_y \quad \text{(Equation 03)}$$

Where:

SGE: Specific energy which has to be generated in the process to produce a certain amount of ceramic devices in TJ/thousand of ceramic device.

PR_y: Amount of product produced in year y in tonnes of ceramic devices

$$\eta_{old} = \frac{SGE}{SFE} \quad \text{(Equation 04)}$$

[53] *The fossil fuel likely to be used by similar consumers is taken the IPCC default value of residual fossil fuel.*

Where:

SFE: Specific fuel energy needed for the process to produce a certain amount of ceramic devices in TJ/ thousand of ceramic device

$$\mathbf{SFE} = \mathbf{BF_y} \times \mathbf{NCV_{biomass}} \qquad \text{(Equation 05)}$$

Where:

BF_y: Amount of native firewood needed to produce a certain amount of product in tonnes/tonnes of ceramic devices

Using the Equations 3, 4 and 5 in the Equation 2, it results to:

$$\mathbf{B_y} = \mathbf{PR_y} \times \mathbf{BF_y} \qquad \text{(Equation 06)}$$

As shown in the calculations above, the ηold is not required to calculate the Emission Reductions, thus it was excluded from the By calculation.

Leakage (LE)

The Category AMS – I.E: Switch from Non – Renewable Biomass for Thermal Application by the User – Version 01 from February 01 of 2008 onwards predicts the following possible three sources of leakage:

A) *If the project activity includes substitution of non-renewable biomass by renewable biomass, leakage in the production of renewable biomass must be considered.*

The leakage from biomass projects, like this project activity, was estimated according to the "General guidance on leakage in biomass project activities" (attachment C of appendix B) of Indicative Simplified Baseline and Monitoring Methodologies for Selected Small-Scale CDM Project Activity Categories, which identifies different emission sources based on the type of biomass considered (described in the table 12).

Table 11. Sources of leakage according to the type of the biomass.

Biomass Type	Activity/ Source	Shift of pre project activities	Emissions from biomass generation/ cultivation	Competing use of biomass
Biomass from forests	Existing forests	–	–	X
	New forests	X	X	–
Biomass from croplands or grasslands (woody or non-woody)	In the absence of the project the land would be used as cropland / wetland.	X	X	–
	In the absence of the project the land will be abandoned	–	X	–

Biomass residues or waste	Biomass residues or wastes are collected and use.	-	-	X

Observing table 12, the possible sources of leakage of the present project activity is the competing use of wood from management areas, Algaroba wood, residues from cashew trees, *Babaçu* coconut husk, garden's residues, elephant grass and sawdust. All of these biomasses have enough availability as showed below demonstrating the lack of leakage for each biomass.

***Algaroba* wood**

According to Silva (2007)[54], *Algaroba*[55] (*Prosopis juliflora* (Sw.) D.C.) is a tropical tree legume fairly common in the semi-arid region of Brazil, which thrives in dry environments where other plants would hardly survive.

At the beginning of 40's, this specie was introduced in the Northeast region of Brazil with the aim of providing food to animals and to be utilized for reforestation actions. However, currently, due to its competitive skills, *Algaroba* spreads through several regions of Brazilian semi-arid areas[56].

A research made by EMBRAPA[57], which encompass the States nothest region, affirmed that *Algaroba* is characterized as an invasive exotic plant due to its fast expansion, which causes many environmental impacts[58]. Besides, Algaroba presents a considerable capacity of regeneration and dispersal[59], which means that the plant does not die, it sprouts again stead.

The research's author reported that wood from *Algaroba* exploration is mainly commercialized as fuel for industries of vegetable oil, leather, ceramic and bakeries. On the other hand, *Algaroba* wood is not sold for stake[60], pegs and poles uses.

The factors which contribute most to the expansion of *Algaroba* uses, as firewood in these industries sectors, were its wide availability in the region and its legal release extraction from IBAMA[61]. This way, in order to control the decrease of biologic diversity in *Caatinga* biome, which has

[54] *Silva, C. G. M, Melo Filho, A. B., Pires, E. F., Stamford M. Physicochemical and microbiological characterization of mesquite flour (Prosopis juliflora (Sw.) DC). Ciênc. Tecnol. Aliment., Campinas, 27(4): 733-736, out.-dez. 2007.*

[55] *Algaroba may also be known as mesquite.*

[56] *EMBRAPA, Projeto vai definir manejo para evitar invasão da Algaroba no ambiente semi-árido. Avaliable at: <http://www.embrapa.gov.br/imprensa/noticias/2002/agosto/bn.2004-11-25.4648301041/>. Visited on December 14th, 2008.*

[57] *EMBRAPA is the Brazilian Agricultural Research Corporation's which its mission is to provide feasible solutions for the sustainable development of Brazilian agribusiness through knowledge and technology generation and transfer.*

[58] *Araujo, J. L. P., Correia, R. C., Araujo, E. P., Lima, P. C. F. Cadeia Produtiva da Algaroba no Pólo de Produção da Bacia do Submédio São Francisco. EMBRAPA. Petrolina -PE - Brazil.*

[59] *EMBRAPA, Projeto vai definir manejo para evitar invasão da Algaroba no ambiente semi-árido. Avaliable at: <http://www.embrapa.gov.br/imprensa/noticias/2002/agosto/bn.2004-11-25.4648301041/>. Visited on December 14th, 2008.*

[60] *Heavy pole to which cattle is tied.*

[61] *IBAMA (Brazilian Institute for Environment and the Renewable Natural Resource) is the environmental agency of Brazil affiliated with Ministry of Environment. The main missions of IBAMA are: Environmental Protection, Environmental Licensing, Environmental Quality and Sustainable Use of Forest Management and Animal Resources. More information about IBAMA is available at: <www.ibama.gov.br >.*

been occasioned from *Algaroba's* genre invasion, the government started to stimulate the *Algaroba* exploration in order to avoid it´s noxious effects[62]

Furthermore, this research showed that *Algaroba* is not used as a unique source of fuel for thermal energy generation in these industries sectors, e.g. corresponding only for 30% of the fuel's source in bakeries of the region studied.

The same research estimated that in the Northeast semi-arid region there were about 500 hundreds hectares spread through every type of its region land. Moreover, according to EMBRAPA (1992) [63] , wood's production by *Algaroba* is at least 5 m³/ha/year, i.e. the production in the project's region is about 2,500 thousands of m³ per year, what represents less than 0.08% of the total amount of *Algaroba* used by *CGM* Ceramic per year[64]

Therefore, this kind of fuel does not encompass any type of leakage since there is current a great amount of these renewable biomasses available locally as described before.

Forest Residues

Forest Residues are also a probable fuel to be used for the ceramic devices burning. The production of wood generates a large amount of residues, which can be reused to generate thermal energy. As can be observed in the figure 3, the potential of energy generation in the state of *Ceará* is plentiful, which means that there is an enormous availability of this kind of fuel to be employed in the project activity. This way, this biomass does not have potential to generate leakage emissions due to its high availability.

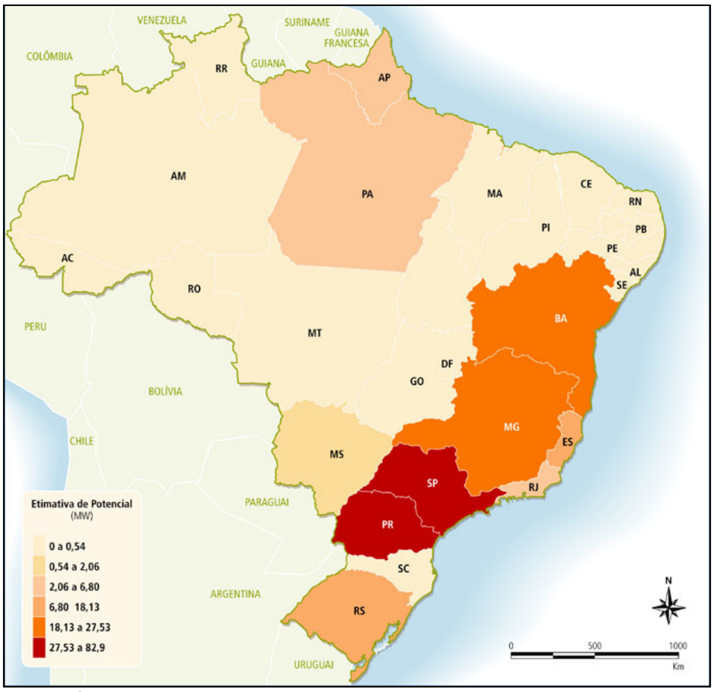

Figure 3. Forest Residues Potential for Energy Generation[65]

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[62] *Algaroba extraction is authorized in the state of Ceará, and it may be checked at normative instruction number 08 from 24/08/2004, developed by SEMACE.*

[63] *EMBRAPA, Comunicado Técnico N°, Nov/92, p.1-2. Available at: <http://www.cpatsa.embrapa.br/public_eletronica/downloads/COT51.pdf>. Visited on December 14th, 2008.*

[64] *CGM Ceramic consumes approximately 2,025 m³ of Algaroba wood per year.*

[65] *Source: CENTRO NACIONAL DE REFERÊNCIA EM BIOMASSA – CENBIO. Panorama do potencial de biomassa no Brasil. Brasília; Dupligráfica, 2003. 80 p.*

Considering that around 22% of the wood produced will generate sawdust[66]. The production of wood in the state of *Ceará* was of 48,979 m^3[67] in 2007, thus, will generate 10,775.38 m^3 of sawdust.

The project activity will employ approximately 60 tonnes per year, thus 244 m^3 of woodchips/sawdust per year which represents 2.27% of the total of these residues generated in the State of *Pará*.

This way, this renewable biomass does not have potential to generate leakage emissions due to its high availability.

Cashew tree wood

Since *CGM* Ceramic utilizes wood residues from cashew trees, it is important to analyze the cashew scenario within Brazilian borders. The cashews cultivation is extremely important to Brazilian economy, where it is responsible for generate 150 million dollars per year. The cashew production is important especially in the northeast region, representing about 95% of Brazilian´s cashew production. Besides, cashew production is responsible for generating job opportunities for 35,000 fieldworkers, 15,000 in the manufacturing process and 200,000 indirect job opportunities[68]. The Brazilian production achieved 143,000 tonnes of cashew-nuts in 2005 spread in an area of 650,000 Hectares[68].Moreover, Brazilian´s production presents the tendency of increasing so far, carried by the new technologies utilized and the higher national and international demand of cashew nuts[69]. This way, the Brazilian sources of residues from cashew trees will increase following the Brazilian production, due the fact that cashew cultivation request continuous cut of cashew trees. The cut of cashew trees is necessary in order to allow an appropriate formation of the tree and maintaining favorable conditions for the next harvest time. This way, in cashew cultivation must be cut undesirable branches of the cashew trees[70]. Moreover, dry branches on the ground compound a considerable amount of residues from cashew trees cultivation.

There is no estimated amount of residues from cashew trees, however its abundant availability is well-known all over the country. Besides, in order to destine the great amount of residues from cashew trees, the Brazilian´s government allowed the utilization of this residue as firewood[71].
According to "*Plantio do Caju*" cashew trees cultivation presents a density of 121 units of trees per hectare[72], and the production of firewood residues from each tree is 2.5 kg per year[73]. The cultivation of cashew is

[66] BRITO EO. Estimativa da produção de Resíduos na Indústria Brasileira de Serraria e Laminação de Madeira. Rev. da Madeira. v.4. n.26. 1995, pp. 34-39.

[67] According to IBGE(Geographic and Statistic Brazilian Institute) available from: <http://www.ibge.gov.br/estadosat/temas.php?sigla=ce&tema=extracaovegetal2007>

[68] According with EMBRAPA (Brazilian Agricultural Research Corporation's Available at :<http://sistemasdeproducao.cnptia.embrapa.br/FontesHTML/Caju/CultivodoCajueiro/index.htm> visited on March 13th, 2009.

[69]Checked at: <http://www.nordesterural.com.br/nordesterural/matLerdest.asp?newsId=2219>. Accessed on March 04th, 2009.

[70]According to EMBRAPA(Brazilian Agricultural Research Corporation's). Available at: http://sistemasdeproducao.cnptia.embrapa.br/FontesHTML/Caju/CultivodoCajueiro/tratosculturais.htm> visited on March 13th, 2009

[71] Source: <http://tribunadonorte.com.br/motoresrn/noticias.php?id=83885>. Visited on May 06th, 2009.

[72]According to "Resposta Técnica" from CETEC (Technologic Center of Minas Gerais) considering a space of 10 meters from each tree. Available at: <http://sbrtv1.ibict.br/upload/sbrt4555.pdf?PHPSESSID=76a9111889defa6787039ca56b380c58> visited on March 13th, 2009
[73]According to "Manual de Aplicação de sistemas descentralizados de Geração de Energia elétrica para projetos de Eletrificação rural" Available at: <http://www.cepel.br/~per/download/rer/rt-789-00.pdf> visited on March 13th, 2009.

located in an area of 650,000 hectares[68]. This way, the Brazilian production of residues from cashew trees is around 196,625 tonnes per year. Therefore, the *CGM´*s consumption of residues from cashew trees (1,257 tonnes per year) represents around 0.6 % of the total production of residues from cashew trees. Thus, the amount of residues from cashew trees necessary to provide thermal energy in *CGM´*s kilns represents a non-representative quantity of this kind of biomass, which avoids the possibility of leakage.

***Babaçu* Coconut Husk**

Babaçu coconut is a fruit provinient from *Babaçu palm* which is a Brazilian's native species. *Babaçu* Palm is an important specie in Brazilian economy and culture where it occupies nine states mainly in north and northeast region [74]. *Babaçu* coconut husk may have different employments such as manufacturing of vegetal oil, food, or source of biomasses energy supply. For these reasons *babaçu* coconut shows a high and continuous production. According to IBGE the Brazilian's *babaçu* coconut almond reaches the number of 358 tonnes during 2007 just in *Ceará* state[75]. Besides, the almond derived from *babaçu* coconut represents just 7% of its total weight the other 93% of *babaçu* coconut represent its husk[76] which is utilized as fuel in this present project. These facts lead to conclude that the production of *babaçu* coconut husk is 4,756 tonnes per year. The proposed project activity will employ 60 tonnes of *babaçu* coconut husk per year, that means 1.3% of the total production in *Ceará* states. Also the ceramic may utilize *babaçu* coconut husk from other states in the region such as *Maranhão* which has an annual production of 108,745 tonnes of almond from *babaçu* coconut[77]. For all these reasons the utilization of this biomass represents a non-representative quantity of these kind of biomass when compared with it production. Thus, there is no leakage for such biomass.

Wood from management areas

Ceará state presents a production of 4,595,695 m^3 of fire wood[78], being one of the largest productions among Brazilian's states. The present project intends to utilize around 8,131 m^3 of wood from management areas per year. In this way, the project will utilize 0.2% of the total biomass availability in *Ceará* state. Thus, the amount of fire wood from management areas necessary to provide thermal energy in *CGM´*s kilns represents a non-representative quantity of this kind of biomass, which avoids the possibility of leakage.

Elephant grass

This biomass is from grassland in abandoned areas, therefore the leakage that would be applicable is the shift of pre project activity and emissions from biomass generation/cultivation. Currently, elephant grass

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[74] *According to "Carvão de babaçu como fonte termica para sistema de refrigeração por absorção no estado do Maranhão" Available at: <http://libdigi.unicamp.br/document/?code=vtls000348640 > visited on March 03rd, 2009.*

[75] *According to IBGE(Geographic and Statistic Brazilian Institute) available from: <http://www.ibge.gov.br/estadosat/temas.php?sigla=ce&tema=extracaovegetal2007> visited on March 13th, 2009.*

[76] *According to "Carvão de babaçu como fonte termica para sistema de refrigeração por absorção no estado do Maranhão" Available at: <http://libdigi.unicamp.br/document/?code=vtls000348640 > visited on March 03rd of 2009.*

[77] *According to IBGE (Geographic and Statistic Brazilian Institute) available from: <http://www.ibge.gov.br/estadosat/temas.php?sigla=ce&tema=extracaovegetal2007> visited on March 13th, 2009.*

[78] *According to IBGE(Geographic and Statistic Brazilian Institute) available from: <http://www.ibge.gov.br/estadosat/temas.php?sigla=ce&tema=extracaovegetal2007> visited on March 13th, 2009.*

has been acquiring national importance as biomass[79] to generate thermal energy due to its high productiveness and easy adaptation in almost all climate and soil Brazilian conditions; it also dismisses the use of fertilizers (NPK)[80]. In case of employing this kind of biomass, the project proponent will cultivate, by himself, elephant grass in pasture or degraded areas, in which there is no vegetation to be deforested. Therefore, this practice will not generate competing use of biomass and it will not deforest a vegetated area, i.e. this leakage will not exist.

Garden's residues

Urban gardens residues are very usual residue over Brazilian's countries where around 70% of the amount of this kind of biomass is left in open dumps or landfills. This way the urban garden residue does not have any kind of utilization turning out in an residue which may originate problems such as high costs for its correct disposal or treatment or result in negative environmental effects when not disposed correctly[81].
For all this reasons the utilization of Urban gardens residues as fuel turn out be a considerable destination for these kind of residue, and would provide an abundant source of renewable biomass if utilized in the proposed project activity

B) Leakage relating to the non-renewable biomass shall be assessed from ex-post surveys of users and areas from where biomass is sourced.

The following potential sources of this type of leakage were identified:

– Use/diversion of non-renewable biomass saved under the project activity by non-project households/users who previously used renewable energy sources. If this leakage assessment quantifies an increase in the use of non-renewable biomass used by the non-project households/users attributable to the project activity then baseline is adjusted to account for the quantified leakage.

– Use of non-renewable biomass saved under the project activity to justify the baseline of other project activities can also be potential source of leakage. If this leakage assessment quantifies a portion of non-renewable biomass saved under the project activity that is used as the baseline of other project activity then baseline is adjusted to account for the quantified leakage.

– Increase in the use of non-renewable biomass outside the project boundary to create non-renewable biomass baselines can also be potential source of leakage. If this leakage assessment quantifies an increase in use of non-renewable biomass outside the project boundary then baseline is adjusted to account for the quantified leakage.

To ensure that the project activity will not cause the type of leakage described in item B, *Carbono Social Serviços Ambientais LTDA.* will make a research with ceramics located in the region with the purpose of checking the fuel employed in the kilns, and it is expected that the carbon credits incomes will stimulate the use of renewable biomass to other ceramics presenting a huge possibilities for sustainable development in the region. Therefore, the sources of leakages mentioned above will probably not be applicable as it is predicted that:

- The project activity will not displace the use of renewable biomass of a non-project user, due to the likely decrease in the use of non-renewable biomass in the region;
- The non-renewable biomass employed which would be employed in this project activity will not being saved for other project activity, since other ceramics was already consuming native wood (common practice).

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[79] Source: <www.mwglobal.org/ipsbrasil.net/nota.php?idnews=3292> visited on March 13th, 2009.
[80] Source: <www.cnpgl.embrapa.br/nova/informacoes/pastprod/textos/17Instrucao.pdf> visited on March 13th, 2009.

[81] Souce: <http://cenbio.iee.usp.br/download/documentos/notatecnica_ix.pdf> visited on March 13th, 2009.

It will occur a decrease in using non-renewable biomass, especially due to the incentive of carbon credits.

Therefore, it can be concluded that the wood which was avoided by the present project activity is not being used by other ceramists.

Initially the project developer consumed wood from the nearby areas, however, as time went by, this resource became scarce and the distance from wood suppliers was gradually increasing. This fact shows how this impact of baseline activities is prominent and how the project activities can reduce deforestation.

C) If the equipment is transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered.

The leakage is not applicable for this project activity, as there is no transference of equipment, in spite of new equipments had to be acquired.

Due to all the explanations described above, the present project activity does not encompass any type of leakage.

4.2 Quantifying GHG emissions and/or removals for the baseline scenario:

The applied methodology does not predict project emissions; therefore, the baseline emissions are equivalent to emission reductions, which is demonstrated below.

$$ER_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected\_fossil\ fuel}$$

By,total = 35,388 tonnes of ceramic devices per year x 0.64 *m³* of wood/tonnes of ceramic devices x 0.88 tonnes of wood/*m³* = 19,930 **tonnes of wood**

ERy, total = 19,930 tonnes of wood x 0.967 x 0.019 TJ/ton x 77.4 tCO_2/TJ = **28,342 tCO_2e**

By, total considers all the biomass that is dismissed. Thus, there is no need to calculate By,savings in the baseline emission in the estimative, it will be calculated only in the monitoring.

Table 12. Emission reductions without considering the leakage.

Year	Baseline Emission Reductions (tonnes CO_2e)
May to December-2006	18,895
2007	28,342
2008	28,342
2009	28,342
2010	28,342
2011	28,342
2012	28,342
2013	28,342
2014	28,342
2015	28,342
January to April-2016	9,447
Total of estimate reductions	283,420

(tonnes of CO2eq)	
Number of years of the crediting period	10
Annual average of estimate reductions for the 10 year crediting period (tonnes of CO_2e)	28,342

4.3 Quantifying GHG emissions and/or removals for the project:

The applied methodology does not predict project emissions and leakage was considered to be zero.

4.4 Quantifying GHG emission reductions and removal enhancements for the GHG project:

Total Emission Reductions

Table 13. Estimation of emission reductions.

Year	Baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Emissions Reductions (tCO_2e)
May to December - 2006	18,895	0	18,895
2007	28,342	0	28,342
2008	28,342	0	28,342
2009	28,342	0	28,342
2010	28,342	0	28,342
2011	28,342	0	28,342
2012	28,342	0	28,342
2013	28,342	0	28,342
2014	28,342	0	28,342
2015	28,342	0	28,342
January to April - 2016	9,447	0	9,447
Total	**283,420**	**0**	**283,420**
Annual Average	**28,342**	**0**	**28,342**

5 Environmental Impact:

As can be observed in table 14, the only negative impact identified is that the project activity will generate ashes due to the burning of the biomass, but this impact will be mitigated by incorporating the ashes into the clay used as thermal insulator in the kilns entrance.

The burning of the new biomasses also emits particulate material and CO_2, as well as when using wood. However, the emission reductions of GHG will improve since they are renewable biomasses.

This way the project does not cause any additional negative impacts as all generated energy is a result of the best and unique exploitation of the natural resources available. On the contrary, the Project will improve the local environmental conditions by establishing proper treatment for the renewable biomasses and also by contributing to the reduction of the deforestation rate.

Table 14. Summary of the environmental impacts.

Environmental	Environmental Impact	Classification
Soil	Improvement of soil conditions because of the vegetation conservation	Positive
Air	Production of ash	Negative
Climate	GHG emission reduction	Positive
Water/hydric resources	Preservation of ground water quality	Positive
Water/hydric resources	Preservation of the water cycle renewal	Positive
Energy	No more use of a polluting residues as fuel for energy production	Positive
Fauna	Biodiversity preservation	Positive
Flora	Biodiversity preservation	Positive

Environmental Laws related to the plant activities

The National Environmental Policy (PNMA), instituted by the Brazilian Law 6.938/81, has the purpose of preservation, improvement and recovery of the environmental quality, with the intention to assure conditions for the social-economic development and the protection of human dignity in the country. The PNMA establishes that the construction, installation, amplification and operation of any enterprise or activity which may exploit natural resources, and are considered potentially pollutant, or capable of degrading the environment, will be possible only if they obtain a previous environmental permission, according to the Brazilian Constitution of 1988. One of the tools settled by the PNMA, in order to monitor and study the potential impacts generated by these kinds of enterprises, is the Environmental Impact Assessment (EIA).

An EIA was not required due to the project activity.

6 Stakeholders comments:

The main stakeholders considered in this project are the local government, the ceramic sector association and the employees. It was sent a letter to those stakeholders informing about the project. In the ceramic's facilities, the letter was fastened in the employees' board which is a visible place with high circulation of employees. The letter is available during 7 days and the outcomes are waited for a period of 7 days after the letter has been sent.
No outcomes were received until the end of the VCS PD elaboration.

7 Schedule:

- Project start date: 01/April/2006
- Crediting period start date: 01/May/2006
- First Verification Report predicted to 20/April/2009
- Date of terminating the project: 30/April/2016
- VCS project crediting period: 10 years renewable
- Monitoring and reporting frequency: from 6 to 12 months, since the beginning of the crediting period.

8 Ownership:

8.1 Proof of Title:

Ceramic’s article of incorporation and the contract between Carbono Social Serviços Ambientais Ltda. – project developer – and *Cerâmica Gomes de Matos* will proof the title, demonstrating the rights to the GHG emissions reductions and the ownership of the project. These proofs of title will be checked by DOE and are in power of *Gomes de Matos* Ceramic and available to consultation.

8.2 Projects that reduce GHG emissions from activities that participate in an emissions trading program (if applicable):

Not applicable.