

KITAMBAR SWITCHING FUEL PROJECT



Document Prepared By Sustainable Carbon – Projetos Ambientais Ltda

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

This project activity was developed by Carbono Social Serviços Ambientais LTDA. (Social Carbon Company), which has changed its company name to Sustainable Carbon – Projetos Ambientais LTDA.

The project activity is the project of *Kitambar Ceramic*, which is a red ceramic company located in Caruaru municipality, in the State of *Pernambuco*, in the northeast of Brazil. The ceramic company produces bricks and roof tiles, destined mainly for the regional market in *Pernambuco*.

The objective of this project activity in the ceramic is to stop using non-renewable native wood, which is a non-renewable fuel, and completely substitute it with renewable biomasses to feed their kilns. These measures can minimize the environmental impacts related to the native wood deforestation and consumption.

This fuel switching project is reducing the greenhouse gas (GHG) emissions through the substitution of native wood for renewable biomasses to generate thermal energy. It was concluded that this is feasible when considering the income derived from commercializing the resulting carbon credits. This move was originally unattractive due to the high investment costs of the adaptation of machineries to the new biomass and other barriers. In opposition to the identified baseline, the project activity generates thermal energy without causing deforestation and uses abundant renewable biomass.

Kitambar Ceramic Company utilized eight “Round Kiln” during all this monitoring period (2014 to 2015). Each one can produce 42,000 devices per cycle. During the last monitoring period, Kitambar Ceramic factory started using new equipments - a wood shredder and a dosing machine which makes the right dosage of biomass. These equipments improve the efficiency of the factory at the same time that they reduce the physical efforts made by the employees. These equipments were purchased on 13/07/2011, but only became operational during the last monitoring period.

The emission reductions due to the switching of non-renewable fuel (non-renewable wood) to renewable biomasses were equal to **43,944 tCO₂e** during the monitoring period from 01-June-2014 to 31-March-2015.

1.2 Sectoral Scope and Project Type

The project is associated to the following scope, as per UNFCCC definitions:

1 - Energy industries (renewable - / non-renewable sources);

This is not an AFOLU project. This is not a grouped project.

1.3 Project Proponent

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

Organization name	Cerâmica <i>Kitambar</i> Artefatos de Cerâmica Ltda
Contact person	<i>Mr. Antônio Marcos Tavares Barbosa</i> and <i>Mr. Severino Francisco Torres</i>
Title	<i>Mr. Antônio Marcos Tavares Barbosa</i>, Director and owner: Information about the ceramics, detailed information on process and production lines, environmental challenges, technological challenges, research and development history, ceramics devices market challenges. <i>Mr. Severino Francisco Torres</i>, Quality Controller, responsible for monitoring data: General data and information on inputs and outputs of the ceramic industry, detailed information on the acquisition of renewable biomasses and how this data is kept by the controller's office.
Address	Rodovia BR 232, Km 136, Distrito Industrial Caruaru - <i>Pernambuco</i> – Brazil Postal code: 55.000-000
Telephone	Ceramic phone number: +55 (81) 3722-7777
website	http://www.kitambar.com.br

As the project authorized contact, Sustainable Carbon was given the responsibility of preparing the present project report and to accompany the proponents until the end of the crediting period.

Organization name	Sustainable Carbon – Projetos Ambientais Ltda
Role in the project	Project developer, Project participant and Project idealizer.
Contact person	Beatriz Rovere Dênis Gonçalves dos Santos Larissa Tega da Fonseca Marcelo Hector Sabbagh Haddad Mariana Fieri Thiago de Ávila Othero Victor Oliveira Moller Iago Paniza S. Rangel

Title	Beatriz Rovere: Technical analyst Dênis Gonçalves dos Santos: Technical analyst Larissa Tega da Fonseca: Technical coordinator Marcelo Hector Sabbagh Haddad: Technical coordinator Mariana Fieri: Technical coordinator Thiago de Ávila Othero: Technical coordinator Victor Oliveira Moller: Technical analyst Iago Paniza S. Rangel: Technical analyst
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1.4 Other Entities Involved in the Project

No other entity is involved in this project activity.

1.5 Project Start Date

According to version 02 of the VCS PD¹, project start date was defined as 01-December-2006. On this date, the project began reducing or removing GHG emissions, i.e. the ceramic started using renewable biomass as fuel.

1.6 Project Crediting Period

The crediting period for this project started on 01-January-2007 and ends on 31-December-2016.

VCS project crediting period: 10 years, two times renewable.

1.7 Project Location

According to the applied methodology, the project boundaries for the project are the physical, geographical areas of the renewable energy generation, thus, the ceramic limits. Kitambar ceramic is located in Brazil, in the State of Pernambuco, which is indicated in Figure 01. The project site has the following postal address:

¹ Document available at: < https://mer.markit.com/br-reg/public/project.jsp?project_id=100000000000032>. Last on: 16/03/2015.

Kitambar Ceramic

Rodovia BR 232, Km 136, Distrito Industrial

Caruaru - Pernambuco – Brazil

Postal code: 55.000-000

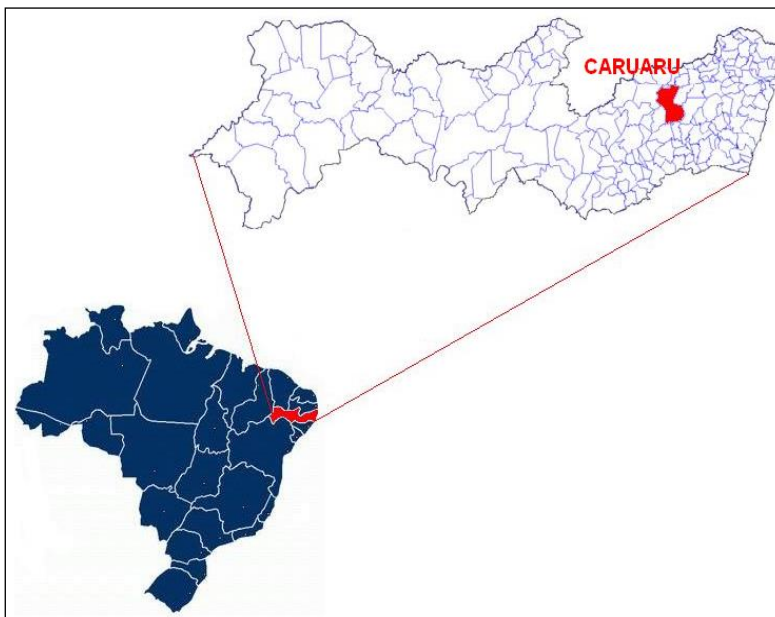


Figure 1. Geographic location of the city of the project activity that has the following coordinates in Pernambuco State: Caruaru: 8° 16' 58" S and 35° 58' 33" W.

1.8 Title and Reference of Methodology

The project applies a small scale methodology approved under the Clean Development Mechanism, as follows:

Category AMS-I.E.: Switch from Non-Renewable Biomass for Thermal Applications by the User – Version 01, valid from 01/02/2008 to 08/04/2010². This category comprises small thermal appliances that displace the use of non-renewable biomass by introducing new renewable energy end-user technologies.

1.9 Other Programs

- Emission Trading Programs and Other Binding Limits: The project activity is not included in an emission trading program or any other mechanism that includes GHG allowance trading.

² This version of the methodology is available at:

<http://cdm.unfccc.int/UserManagement/FileStorage/CDM_AMSP4VBBO5G54RXDE9KQ6FJWMGHZLHFA5>. Last visit on: 16/03/2015.

- Other Forms of Environmental Credit: The project activity is not creating any other form of environmental credit under any specific program.
- Participation under Other GHG Programs: The project activity is not registered under any other GHG program.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The VCS PD was validated by the Designated Operational Entity TÜV Nord Cert GmbH and this present monitoring report will be verified by the group RINA *Brasil*.

The project has been fully operational since the starting date of the crediting period. This means the ceramic is operating using exclusively renewable biomass, thus mitigating their baseline emissions.

As described on the VCS PD version 02, the production process at *Kitambar Ceramic* encompasses eight “Round kilns” in order to burn the fuel and fire the ceramic units, which are mainly used in the construction sector. The “Round kilns” at *Kitambar Ceramic* have capacity for approximately 42,000 ceramic units per burning cycle, depending on the kind of the products that are fired, and approximately 28 burning cycles are done per month. The drying process occurs in a semi-continuous dryer which reuses the heat provided by the kilns to dry the ceramic units. In case no heat is being provided by the kilns, there is a separated furnace supplied only with renewable biomass.

Table 1. Emission reductions verified in the last monitored periods

Emission Reduction (tCO ₂ e)		
1 st Monitoring Period	January to December of 2007	40,627
	January to September of 2008	33,122
Total in the 1 st Monitoring Period		73,749
2 nd Monitoring Period	October to December of 2008	10,203
	January to November of 2009	36,988
Total in the 2 nd Monitoring Period		47,191
3 rd Monitoring Period	December of 2009	3,801
	January to December of 2010	47,039
	January to December of 2011	47,025
	January to February of 2012	8,02
Total in the monitoring 3 rd Monitoring Period		105,885
4 th Monitoring	March to December of 2012	38,429

Period	January to December 2013	47,002
	January to May of 2014	20,209
Total in the monitoring 4 th Monitoring Period		105,660

As renewable biomasses, *Kitambar* Ceramic employs *Algaroba* wood, forest residues (sawdust and MDF) and Native Wood from forest management areas.

During the 3rd period, from 01-December-2009, to 29-February-2012, verified by Bureau Veritas Certification Brazil, the ceramic factory utilized Coconut Husk as renewable biomass. However, since the 4th monitoring period, the ceramic factory has been utilizing native wood from forest management areas as renewable biomass instead of coconut husk. An analysis (regarding the 4th monitoring period) was made to ensure that this situation does not impact in the project additionality.

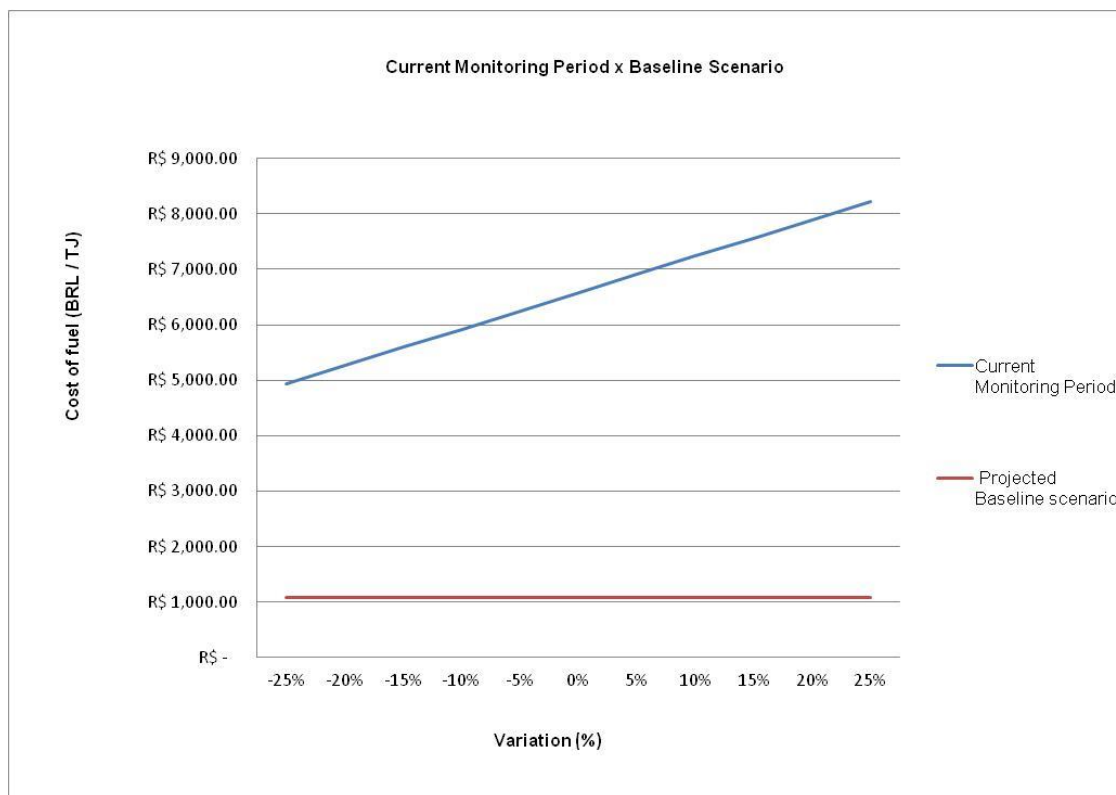
Through this analysis, the cost per energy generated by the new biomass was higher than the cost per energy generated in the baseline scenario. Figure 2 below summarizes the comparison between these scenarios, and the impact in the project's additionality.

The cost of non-renewable wood was updated utilizing a conservative correction factor applied to the cost of the non-renewable biomass in 2006, in order to account for general price increases due to inflation. The annual rate of increase applied on the current monitoring period was 6.50%³.

Figure 2 below shows that the non-renewable biomass is financially more attractive than using renewable biomass. With the project activity's implementation, the fuel spending has increased, as can be verified at the Figure below. Comparing the cost per energy generated, *Kitambar* ceramic industry spent with renewable biomass BRL 6,577.97 per TJ generated during the analyzed monitoring period, against BRL 1,078.89 per TJ that would be expected for the projected baseline scenario in 2014, considering a conservative correction of 6.50% annually. The operation with renewable biomass appears to be less financially attractive since it is more expensive than the non-renewable wood.

³ It was considered an annual increase of 6.5% once it was the highest inflation rate evidenced between 2004 and 2013. Available at: <<http://www.portalbrasil.net/ipca.htm>>. Last visited on June, 10 th 2015.

Figure 2. Cost of renewable biomass per energy generated at the baseline scenario and at the last monitoring period



2.2 Deviations

2.2.1 Methodology Deviations

There were no methodology deviations during this monitoring period.

2.2.2 Project Description Deviations

The registered VCS PD version 02 establishes that the project proponent (meaning the ceramic owner) would measure the amount of renewable biomasses used (parameter $Q_{renbiomass}$). However, during the entire monitored period, this parameter was monitored through all the receipts and invoices of biomass received by the ceramic industries. This means the amount of renewable biomass is controlled by the ceramics owners, by storing receipts and invoices. In this monitoring period a new measure system for the parameter $Q_{renbiomass}$ was implemented, based weight in tones. More information about the weight measure system in the table $Q_{renbiomass}$ (section 3.2) of the monitoring period.

Moreover, the registered VCS PD version 02 did not consider the conversion factor from stereo meter (m^3 stereo) to cubic meter (m^3) for the amount of renewable biomass that arrives in volume units (parameter $Q_{renbiomass}$). Therefore, in this Monitoring Report, the values presented in the table

$Q_{renbiomass}$ of the VCS PD (section 3.3) for Algaroba wood and native wood from management areas were corrected, according to the conversion factors presented in the section 3.2 of this Monitoring Report, table $Q_{renbiomass}$.

In the last monitoring period, the ceramic factory started using native wood from forest management areas as renewable biomass. The native wood from forest management areas is a biomass composed of firewood that is produced in existing areas of native forest where sustainable management techniques are applied. These techniques aim to ensure sustainable exploitation of wood, ensuring the conservation of areas and carbon stocks. This biomass is considered renewable according option I from CDM definition of renewable biomass (Annex 18 of the 23rd Report from the Executive Board), as soon as it fits all the assumptions below:

The biomass is originating from land areas that are forest 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.

According to the IBAMA Normative Instruction N° 112 from August 21st, 2006, the entrepreneur who uses raw material from native forests is obliged to use the DOF (Forest Origin Documents) to control the origin, transport, and storage of forest products and by-products. Therefore, to use firewood obtained from native forests in a sustainable manner, it is necessary to use the DOF, which is required by national law. This requirement it is not enforced namely due to the lack of control, and constitutes the baseline scenario, as described in Section B.5. During the project, however, all firewood used will have DOF, thus demonstrating that it is sustainable.

Furthermore, the other renewable biomasses likely to be used by the project, such as algaroba wood and forest residues, do not require documents for residues, since they do not fall under the forest by-products definition of IBAMA Normative Instruction N° 112/06.

The forest management in the Caatinga biome is one of the main options to ensure the sustainable biomass production for energy use, as well as for other basic needs of the populations and productive activities in the Northeast of Brazil. Due to the semi-arid climate of the Caatinga biome, the vegetation is composed of medium and small size trees, shrubs; with many cactuses and thorny Bromeliaceae in the driest sites. The dominant physiognomy is a dry and low forest. Most plants lose their leaves during the long dry season, giving the Caatinga a meager aspect. However, its primary productivity is very high during the rainy season, when vigorous plant growth offers a wide variety of forage, flowers, fruits and wood.

The sustainable forest management plan can be organized into three stages: firstly, the division of the property in exploitable areas and areas of permanent preservation that are inaccessible to exploitation. The second stage is the planning of roads that connect the area with the primary

roads. In the third stage, the allocated area is divided for exploration in blocks in order to sustain forest exploitation annually⁴.

In the Caatinga biome, the forest management is based on a monocyclic system, with an estimated rotation of 12 to 15 years. The exploration is done by clear cutting in annual plots. The cut is made near the tree's base in order to allow its regeneration by sprouts. When recovered, i.e. after 12 to 15 years, the vegetation reaches similar diversity levels. By this system, the estimated production of a forest management plan is about 40.5 m³ / ha. The estimated annual productivity (also known as mean annual increment) of managed forest is about 3 m³ / ha / year, so at the end of 12 to 15 years, the previously exploited 40.5 m³ have already recovered, closing the cycle⁵. The area in the Caatinga biome with sustainable forest management plans more than doubled between 2005 to 2010, showing a trend toward consolidation of forest management as an alternative for sustainable use in the biome, particularly in a region that has high dependence on forest biomass for energy generation⁶. The use of forest management doesn't affect the applicability of the project, according the methodology AMS-IE, as this is made for projects that use renewable biomass, including woody biomass. The availability of this biomass on the project region is assessed on Section 4.3.

2.3 Grouped Project

Not applicable. This is not a grouped project.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data Unit / Parameter:	EF _{projected fossil fuel}
Data unit:	tCO ₂ /TJ
Description:	CO ₂ Emission factor of residual fuel oil

⁴ AMARAL, P. et al. Floresta para Sempre: um Manual para Produção de Madeira na Amazônia. Belém: Imazon, 1998. pp. 130. Available at: <http://www.bibliotecaflorestal.ufv.br/bitstream/handle/123456789/3942/Livro_Floresta-para-Sempre-Um-Manual-para-a-Produ%C3%A7%C3%A3o-de-Madeira-na-Amaz%C3%B4nia_IMAZON.pdf?sequence=1>. Last visit on: 16/03/2015.

⁵ BRASIL. Ministério do Meio Ambiente (MMA). Subsídios para a elaboração do plano de ação para a prevenção e controle do desmatamento na Caatinga. Brasília: MMA, 2011c. 128 p. Available at: <http://www.mma.gov.br/estruturas/168/_arquivos/diagnostico_do_desmatamento_na_caatinga_168.pdf>. Last visit on: 16/03/2015

⁶ AMARAL, P. et al. Floresta para Sempre: um Manual para Produção de Madeira na Amazônia. Belém: Imazon, 1998. pp. 130. Available at: <http://www.bibliotecaflorestal.ufv.br/bitstream/handle/123456789/3942/Livro_Floresta-para-Sempre-Um-Manual-para-a-Produ%C3%A7%C3%A3o-de-Madeira-na-Amaz%C3%B4nia_IMAZON.pdf?sequence=1>. Last visit on: 16/03/2015.

Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Available at: < http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf >. Page 2.18. Table 2.3. IPCC. Last visit on: 13/03/2015.
Value applied:	77.4 tCO ₂ /TJ
Justification of choice of data or description of measurement methods and procedures applied	In the baseline scenario, the fossil fuel that would probably 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 substitute of wood than natural gas due to the risks involving natural gas distribution.
Purpose of the data:	The fossil fuel likely to be used by similar consumers is taken from the IPCC default value of residual fossil fuel. This parameter was used to calculate baseline emissions from the use of the fossil fuel that would be used in the baseline scenario, in the absence of non-renewable wood.
Any comment:	Applicable for stationary combustion in the manufacturing industries and construction.

Data Unit / Parameter:	NCV _{non-renewable wood}
Data unit:	TJ/tonne of wood
Description:	Net Calorific Value of non-renewable wood
Source of data:	Brazilian study carried out with <i>Caatinga</i> wood: QUIRINO, W. F. et al. Poder Calorífico da Madeira e de Resíduos Lignocelulósicos . Biomassa & Energia, v.1, n.2, p. 173-182, 2004. Available at: < http://www.renabio.org.br/06-B&E-v1-n2-2004-173-182.pdf >. Last visit on: 17/03/2015. OLIVEIRA, E. et al. Estrutura anatômica da madeira e qualidade do carvão de Mimosa tenuiflora (Willd.) Poir. Revista Árvore, Viçosa-MG, v.30, n.2, p.311-318, 2006. Available at: < http://www.scielo.br/pdf/rarv/v30n2/a18v30n2.pdf >. Last visit on: 17/03/2015
Value applied:	0.019
Justification of choice of data or description of measurement methods and procedures applied	This value provided the energy generated by the amount of wood that would be used in the absence of the project.
Purpose of the data:	Calculation of baseline emissions. This value provides the energy generated by the amount of wood that would be used in the absence of

	the project. It differs from the IPCC value because represents the net calorific value of the local biome
Any comment:	The species used to calculate the average value are typical trees of <i>Caatinga</i> Biome that are usually utilized as fuel in the ceramic industries of the region. 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 Unit / Parameter:	ρ_{wood}
Data unit:	tonne/m ³
Description:	Specific gravity of non-renewable wood
Source of data:	Brazilian studies carried out with <i>Caatinga</i> wood: - 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. - QUIRINO, W. F. et al. Poder Calorífico da Madeira e de Resíduos Lignocelulósicos. Biomassa & Energia, v.1, n.2, p. 173-182, 2004. Available at: < http://www.renabio.org.br/06-B&E-v1-n2-2004-173-182.pdf >. Last visit on: 13/03/2015. - IPCC: Intergovernmental Panel on Climate Change. Orientación del IPCC sobre las buenas prácticas para UTCUTS - chapter3 – Table 3A.1.9-2. - OLIVEIRA, E. et al. Estrutura anatômica da madeira e qualidade do carvão de Mimosa tenuiflora (Willd.) Poir. Revista Árvore, Viçosa-MG, v.30, n.2, p.311-318, 2006. Available at: <http://www.scielo.br/pdf/rarv/v30n2/a18v30n2.pdf>. Last visit on: 13/03/2015. -IBAMA – Madeiras Brasileiras. <https://web.archive.org/web/20091226033704/http://www.ibama.gov.br/lp/f/madeira/caracteristicas.php?ID=195&caracteristica=139>. Last visit on: 13/03/2015.
Value applied:	0.88
Purpose of the data:	Calculation of baseline emissions. The amount of wood used in the baseline was measured by volume units, so this data was used to the unity conversion.
Any comment:	The species used to calculate the average value are typical trees of <i>Caatinga</i> Biome that are usually utilized as fuel in the ceramic industries

	of the region.
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Data Unit / Parameter:	BF_y
Data unit:	Tonnes of wood per thousands of ceramic devices produced per year
Description:	Consumption of non-renewable biomass per thousand of ceramic devices produced per year
Source of data:	Historical data from ceramic owner
Value applied:	2.28
Justification of choice of data or description of measurement methods and procedures 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.
Purpose of the data:	Calculation of baseline emissions. The value is utilized to calculate the real amount of wood displaced to maintain the ceramic production in the baseline scenario. This value is in accordance with the data acquired in other ceramics that employ the same type of kilns.
Any comment:	The value was acquired through the average consumption and production of ceramic devices during the years when the ceramic used to consume non-renewable wood.

3.2 Data and Parameters Monitored

Data Unit / Parameter:	Q_{renbiomass}
Data unit:	Tonnes per month
Description:	Amount of renewable biomasses
Source of data:	Measured by the biomass providers and controlled by the ceramic owner. The registered VCS PD v.02 establishes that the ceramic owner would measure this parameter; however, during the entire monitored period, this parameter was monitored through all the receipts and invoices of biomass received by the ceramic industry.
Description of	The amount of biomass was monitored in accordance to the weight or

measurement methods and procedures to be applied:	volume described in the receipts from the providers. For Algaroba and Native Wood from forest management areas, the values in the receipts are described in m³. However, a conversion factor from m³st (m³ stereo) to m³ had to be applied, since the ceramic owners confirmed measurements of native wood were actually made in mst (m³ stereo), and that is common practice to talk about m³ when in reality they are m³st. Forest residues (sawdust and other biomass from forest management) were also included in this new measurement method. During the current monitoring period the amount of biomass started to be measured by weight in tonnes, in partnership with a third party. The system started in August/2014, and has been working in all measurements since October/2014. With the new system the ceramic stopped measuring the biomass by volume in m³, and now all the measuring process is made by weight in tonnes. Moreover, the registered VCS PD version 02 did not consider the conversion factor from m³ stereo to m³ for the amount of renewable biomass that arrives in m³ stereo unit (parameter Qrenbiomass). Therefore, in this Monitoring Report, the values presented in the table Qrenbiomass of the VCS PD (section 3.3) for algaroba wood were corrected, according to the conversion factors presented in the section Calculation method of this parameter. To demonstrate that native wood from forest management areas is renewable it is necessary the use of DOF (Forest Origin Document), that proves the regular origin of the biomass. Besides that, the Sustainable Management Plans ensure that the native wood is taken from land areas with sustainable management practices. During the monitoring period some biomass evidence were not available. Although the cited biomass data was confirmed as Algaroba wood and a mistake in the receipt description was detected, a compensation measure was adopted. The energy generated by such biomass volume was discounted from the carbon credit generation. For this calculation, the same data used for Algaroba wood was applied.								
Frequency of monitoring/recording:	Monthly								
Value monitored:	Total amount of biomasses consumed during all months of the monitoring period (in tonnes): <table> <tr> <th>Biomass</th><th>Amount of biomass consumed (tonnes)</th></tr> <tr> <td>Algaroba Wood</td><td>4,138.19</td></tr> <tr> <td>Forest Residues</td><td>462.54</td></tr> <tr> <td>Native Wood from forest management areas</td><td>528.00</td></tr> </table>	Biomass	Amount of biomass consumed (tonnes)	Algaroba Wood	4,138.19	Forest Residues	462.54	Native Wood from forest management areas	528.00
Biomass	Amount of biomass consumed (tonnes)								
Algaroba Wood	4,138.19								
Forest Residues	462.54								
Native Wood from forest management areas	528.00								

	More detailed information is available in Appendix 1.										
Monitoring equipment:	No monitoring equipment is used to determine this parameter										
QA/QC procedures to be applied:	Amount of biomass was checked according to receipts of purchase. The energy balance was verified according to the amount of biomass applied. The thermal energy generated with the use of <i>Algaroba</i> wood, forest residues (sawdust and MDF) and native wood from forest management areas per thousands of ceramic devices produced during the current monitoring period was compared to the VCS PD. The thermal energy generated per thousand of ceramic units produced at <i>Kitambar</i> Ceramic on the monitored period was lower than the estimated in the VCS PD. Differences are likely caused by energy efficiency gains.										
Purpose of the data	This parameter was used to : - Compare the total energy produced in the current monitoring period to the thermal energy that would be necessary according to the VCS PD estimates (QA/QC table); - Demonstrate that the Project fits in small scale category (<45MWth/year); - Calculation of leakage emissions due to competing use of biomass.										
Calculation method:	The energy generated by the amount of renewable biomass during the current monitoring period was calculated based on the Net Calorific Value of each biomass, as can be seen on the VCS MR Calculation spreadsheet. Receipts registered on "stereo" as unit of measure were converted to "m³" using the Conversion Factors below <table border="1"> <thead> <tr> <th colspan="2">Conversion factor from "m³ stereo" to "m³"</th></tr> </thead> <tbody> <tr> <td><i>Algaroba</i></td><td>0.3745</td></tr> <tr> <td><i>Native Wood from forest management areas</i></td><td>0.3388</td></tr> </tbody> </table> The amount of biomasses was monitored in accordance to the weight or volume 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 are: <table border="1"> <thead> <tr> <th>Biomass</th><th>Specific gravity (tonne/m³)</th></tr> </thead> <tbody> <tr> <td></td><td></td></tr> </tbody> </table>	Conversion factor from "m ³ stereo" to "m ³ "		<i>Algaroba</i>	0.3745	<i>Native Wood from forest management areas</i>	0.3388	Biomass	Specific gravity (tonne/m ³)		
Conversion factor from "m ³ stereo" to "m ³ "											
<i>Algaroba</i>	0.3745										
<i>Native Wood from forest management areas</i>	0.3388										
Biomass	Specific gravity (tonne/m ³)										

	Algaroba Wood	0.836	
	Forest Residues	0.35	
	Native Wood from forest management areas	0.88	
	Source of data:		
	- Algaroba wood:		
	PEREIRA, J. C. D.; LIMA, P. C. F. Comparação da Qualidade da Madeira de seis Espécies de Algarobeira para a Produção de Energia . Colombo: Embrapa Florestas, 2002. p. 99-107. Available at: < http://www.cnpf.embrapa.br/publica/boletim/boletarqv/bolet45/pag-99_106.pdf >. Last visit on: 13/03/2015.		
	- Native Wood from manamegent areas:		
	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.		
	- Forest residues:		
	PINHEIRO, G. F.; RENDEIRO, G.; PINHO J. T. Densidade Energética de Resíduos Vegetais . 2006. Available at: < http://www.renabio.org.br/03-B&E-014-GiorgianaFP-DensEn-2005-p113-123.pdf >. Last visit on: 18/03/2015.		
	- Native Wood from forest management areas:		
	- The same applied in pwood.		
	Acoording to FERRAZ, Douglas Galvão. Inventário Florestal de Três Fragmentos com Candeia (Eremanthus erythropappus) no Município de Itajubá - MG. 2008.		
	- Algaroba wood (conversion factor):		
	PEREIRA, J. C. D.; LIMA, P. C. F. Comparação da Qualidade da Madeira de seis Espécies de Algarobeira para a Produção de Energia . Colombo: Embrapa Florestas, 2002. P99-107 Available at: < http://web.archive.org/web/20070609133129/http://www.cnpf.embrapa.br/publica/boletim/boletarqv/bolet45/pag-99_106.pdf > Last visit on: 18/03/2015.		
Any comment:	As stated in the VCS PD, the providers listed in the PD are only a few of		

	those that work for the ceramic; nevertheless, it does not exclude the possibility of buying biomass from others. 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.
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Data Unit / Parameter:	PR _y																																																														
Data unit:	Unity of ceramic pieces																																																														
Description:	Production of ceramic devices																																																														
Source of data:	Controlled by the project developer																																																														
Description of measurement methods and procedures to be applied:	This parameter is monitored by the project developer (the ceramic owner). The amount was acquired by counting the total production of the period considered. Values used for the calculations are taken from production control documents. Data is aggregated on a monthly and yearly basis. Measurements are done by an internal control sheet monitored by the project proponent.																																																														
Frequency of monitoring/recording:	Monthly																																																														
Value monitored:	<table><tr><td></td><td></td><td>Period</td><td>PR_y - Production (ceramic units)</td><td></td></tr><tr><td rowspan="8">2014</td><td></td><td>June</td><td>1,286,200</td><td></td></tr><tr><td></td><td>July</td><td>1,581,900</td><td></td></tr><tr><td></td><td>August</td><td>1,373,200</td><td></td></tr><tr><td></td><td>September</td><td>1.286,900</td><td></td></tr><tr><td></td><td>October</td><td>1,468,000</td><td></td></tr><tr><td></td><td>November</td><td>1,241,400</td><td></td></tr><tr><td></td><td>December</td><td>1,131,200</td><td></td></tr><tr><td></td><td>Total 2014</td><td>9,350,800</td><td></td></tr><tr><td rowspan="4">2015</td><td></td><td>January</td><td>1,222,190</td><td></td></tr><tr><td></td><td>February</td><td>1,158,300</td><td></td></tr><tr><td></td><td>March</td><td>1,398,100</td><td></td></tr><tr><td></td><td>Total 2015</td><td>3,778,590</td><td></td></tr><tr><td></td><td colspan="2">Total in the monitoring period</td><td>13,129,390</td><td></td></tr></table>					Period	PR _y - Production (ceramic units)		2014		June	1,286,200			July	1,581,900			August	1,373,200			September	1.286,900			October	1,468,000			November	1,241,400			December	1,131,200			Total 2014	9,350,800		2015		January	1,222,190			February	1,158,300			March	1,398,100			Total 2015	3,778,590			Total in the monitoring period		13,129,390	
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		Total 2015	3,778,590																																																												
	Total in the monitoring period		13,129,390																																																												
Monitoring equipment:	No monitoring equipment is used to determine this parameter. Production is counted by trained personnel on <i>Kitambar</i> ceramic.																																																														

QA/QC procedures to be applied:	Data concerning PR_y measurement points are from an internal control documents used by <i>Kitambar Ceramic</i> . These documents are organized per month and daily filled according to data based on ceramic units burned in the kilns.
Purpose of the data	This parameter is used to calculate baseline emissions and the total energy produced in the current monitoring period in order to compare to the thermal energy necessary in the VCS PD (QA/QC table).
Calculation method:	The ceramic industry has an internal control of the quantity of ceramic units produced. It was rechecked according to the biomass employed in the ceramic kilns.
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 Unit / Parameter:	Origin of renewable biomass
Data unit:	Not applicable
Description:	Renewable origin of the biomass
Source of data:	Controlled by the project developer
Description of measurement methods and procedures to be applied:	This information was given by the biomasses providers. The guarantee of acquiring renewable wood was achieved by invoices from the providers. As stated in the section 2.2, the biomasses (Algaroba wood, native wood from management areas and forest residues) are considered renewable as fulfilling the options described in the methodology applied. According to the IBAMA Normative Instruction N° 112 from August 21st, 2006, the entrepreneur who uses raw material from native forests is obliged to use the DOF (Forest Origin Documents) to control the origin, transport, and storage of forest products and by-products. Furthermore, the other renewable biomasses used by the project, such as residues from algaroba wood and forest residues, do not require documents for residues, since they do not fall under the forest by-products definition of IBAMA Normative Instruction N° 112/06. Forest residues are acquired from suppliers near the Project site. These suppliers provided evidences of the origin of biomass through the receipts and invoices acquisition. In addition, part of the suppliers was interviewed by phone. Most suppliers interviewed acquire either Medium Density Fiberboard (MDF) from large industries in the Southeast region

	of Brazil or wood from forest plantations of exotic species (such as Pinus trees) sourced from the Southeast region of Brazil⁷, although some as reported in the audios are not located in the Southwest region, such as Pará and Bahia states. A new procedure to prove the origin of renewable biomass was applied in this monitoring period. In order to guarantee a continuous assessment of the relevant suppliers of Kitambar industry project activity, invoices and receipts of sawdust/MDF were also collected. The data collected represent 92% of Kitambar demand for this biomass for this monitoring period, adding proven and tracked. The proved biomass represent 89% from the biomass in question for the period, because unfortunately some supplier refused to provide evidences. For those the audio is the material that we obtained. Both biomasses are considered renewable. MDF boards are typically produced in line with sustainable production standards, such as the Forest Stewardship Council (FSC). Forest plantations are subject to forest management techniques.
Frequency of monitoring/recording:	Annually
Value monitored:	Not applicable.
Monitoring equipment:	No monitoring equipment was used to determine this parameter.
QA/QC procedures to be applied:	The biomass is considered renewable as it is according to the definition given by the applied methodology.
Purpose of the data	Not directly applied for the calculation. This parameter is used to guarantee that the amount of biomass acquired by the project proponent has a renewable origin. It is also necessary to comply with procedures required by the methodology AMS-I.E, Version 01.
Calculation method:	Not applicable
Any comment:	All the renewable biomasses utilized are in accordance with definitions of renewable biomass set in the applied methodology. 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 Unit / Parameter:	Renewable biomass surplus
Data unit:	tonnes or m ³
Description:	Amount of renewable biomass available

⁷ Evidences to such statement were made available to the verification team.

Source of data:	Monitored								
Description of measurement methods and procedures to be applied:	It was used to calculate the leakage of renewable biomass. The sources of leakages predicted in “General guidance on leakage in biomass project activities” of Indicative Simplified Baseline and Monitoring Methodologies for Selected Small-Scale CDM Project Activity Categories, were monitored. The measurement of the leakage was based in national and international articles and database every monitoring period. The sources provided information about the biomass availability in the project activity’s region. The bibliographic references are described on the section 4.3 “Leakage”.								
Frequency of monitoring/recording:	Annually								
Value monitored:	<table border="1"> <thead> <tr> <th>Biomass surplus</th><th>Surplus</th></tr> </thead> <tbody> <tr> <td>Algaroba wood in m³ (2007)</td><td>2,500,000</td></tr> <tr> <td>Native wood from management areas in m³ (2012)</td><td>1,151,920</td></tr> <tr> <td>Forest Residues in m³ (2007)</td><td>319,891.88</td></tr> </tbody> </table> Detailed information in Section 4.3.: “Leakage”.	Biomass surplus	Surplus	Algaroba wood in m ³ (2007)	2,500,000	Native wood from management areas in m ³ (2012)	1,151,920	Forest Residues in m ³ (2007)	319,891.88
Biomass surplus	Surplus								
Algaroba wood in m ³ (2007)	2,500,000								
Native wood from management areas in m ³ (2012)	1,151,920								
Forest Residues in m ³ (2007)	319,891.88								
Monitoring equipment:	No monitoring equipment is used to determine this parameter.								
QA/QC procedures to be applied:	Data available regarding the ceramic industries fuel consumption was employed to monitor the leakage								
Purpose of the data	Calculation of leakage emissions due to competing use of biomass.								
Calculation method:	The amount of biomass used by the project activity in each year of the crediting period is compared to total biomass available, as estimated on the VCS PD.								
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 Unit / Parameter:	Leakage of non-renewable biomass
Data unit:	tCO ₂ e
Description:	Leakage resulted from the non-renewable biomass
Source of data:	Monitored
Description of	The three sources of leakages predicted in the applied methodology

measurement methods and procedures to be applied:	were monitored. Scientific articles, official statistical data, regional and national surveys were provided in order to ensure that there was no leakage from non-renewable biomass (or to estimate the leakage). Please see Section 4.3: "Leakage".
Frequency of monitoring/recording:	Annually
Value monitored:	0
Monitoring equipment:	No monitoring equipment is used to determine this parameter.
QA/QC procedures to be applied:	Data available regarding the ceramic industries fuel consumption were utilized to monitor the leakage.
Purpose of the data	Calculation of leakage emissions. This parameter is used to evaluate if there is any source of indirect emission related to non-renewable biomass. If applicable, leakage emissions are used to adjust emission reductions resulting from the project.
Calculation method:	Not applicable.
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 Unit / Parameter:	$f_{NRB,y}$
Data unit:	Percentage
Description:	Fraction of biomass (wood) used in the absence of the project activity in year y that can be established as non-renewable biomass using survey methods
Source of data:	Survey methods
Description of measurement methods and procedures to be 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. According to Associação Plantas do Nordeste (APNE, 2012) article "Plantas de Manejo Sustentado na Caatinga". Available at: http://www.cnip.org.br/planos_manejo.html. Last visited on 13/03/2015, the area of Caatinga with sustainable use corresponds to 340,000 ha⁸. Besides that, according to the Ministry of the Environment (MMA), the approximate area of Caatinga biome is 844,453 km², which means

⁸ According to Associação Plantas do Nordeste 2012. Available at: <http://www.cnip.org.br/planos_manejo.html>. Last visited on: 13/03/2015.

	84,445,300 ha. Therefore, the percentage of wood with sustainable use in Caatinga Biome is around 0.4%⁹ Two sheets were made to calculate the amount of wood consumed. The first one encompasses the amount of wood consumed by the ceramics located at the Caatinga biome. The other sheet calculates the amount of wood consumed regarding only Kitambar Ceramic. Dividing these values by the total of wood available, it was achieved the amount of renewable biomass that has been saved by all the project activities or only by Kitambar project, respectively¹⁰. Afterwards, summing each value with the sustainable use areas defined by APNE (2012), two fractions of renewable biomass were acquired. Finally, each value was subtracted from 100% to achieve the $f_{NRB,y}$. Therefore, it was taken the smaller value in order to be more conservative. These sheets are available at the VCU Estimates spreadsheet.
Frequency of monitoring/recording:	Annually
Value monitored:	99.3%
Monitoring equipment:	No monitoring equipment is used to determine this parameter.
QA/QC procedures to be applied:	The monitoring of this parameter was based in national and international articles and database every monitoring period. The sources provided information about the sustainable use of Caatinga biome. Wood saved from projects developed by Sustainable Carbon in the same biome and that have applied the same methodology was considered in this fraction¹¹. CDM or VCS registered projects were also included in this fraction if placed in the same region and using the same methodology. Moreover the amount of non-renewable biomass applied in the project activity were monitored monthly and were considered in the value of $f_{NRB,y}$ parameter.
Purpose of the data	This parameter is used to calculate Baseline emissions. The $f_{NRB,y}$ determines the fraction of biomass (wood) used in the absence of the project activity that can be established as non-renewable biomass.

⁹ According to MMA, the approximate area of Caatinga biome is 844,453 km². Available at: <<http://www.mma.gov.br/biomas/caatinga>>, visited on 21/07/2015.

¹⁰ According to data from project activities elaborated by Sustainable Carbon – Projetos Ambientais LTDA.

¹¹ Document available at: < http://mer.markit.com/br-reg/public/index.jsp?entity=project&sort=project_name&dir=ASC&start=0&acronym=&limit=15&name=sustainable+carbon&standardId> Last visit on: 16/03/2015.

Calculation method:	The values from wood residues should be determined <i>ex ante</i> ¹² . Detailed information in Section 4.3 - 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.

3.3 Monitoring Plan

The monitoring is done with the aim of determining the most approximate quantity of non-renewable wood 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 CO₂e. Section 3.2 describes data and parameters monitored, as well as the procedures involved on the monitoring plan.

Ceramic personnel are responsible to monitor the operating conditions on the factory, including the amount of renewable biomass consumed and the monthly production of ceramic devices (parameters $Q_{renbiomass}$ and PR_y). Ceramic personnel are also responsible to store invoices, receipts of sales and other documents related to purchase or acquisition of biomass.

Ceramic personnel register monitoring data regarding parameters $Q_{renbiomass}$ and PR_y on electronic spreadsheets, which are shared with Sustainable Carbon team using an internet cloud service (dropbox). This gives Sustainable Carbon real time access to monitoring data.

Sustainable Carbon is responsible to assess if the biomasses are from renewable origin, to evaluate if there is a surplus of renewable biomass and to calculate emission reductions, including an assessment of leakage emissions and the determination of parameter $f_{NRB,y}$.

In the current monitoring period Sustainable Carbon performed an analysis to verify if biomass and production data were being correctly filled in the monitoring spreadsheets.

Analysis on production data is performed by a series of comparisons between different measurement points of production (molding machine, kiln loading and kiln unloading) to detect inconsistencies or suspicious data. Analysis on biomass data is performed by a series of comparisons between the amount of biomass and the cost over months to identify inconsistencies or unexpected variations in these parameters.

Sustainable Carbon is responsible for providing the required guidance to the ceramic factory, to evaluate biomass and production data, in order to minimize errors, including assisting the ceramic in case the person in charge of the project monitoring is replaced.

The origin of renewable biomass is given by the biomass providers. The guarantee of acquiring algaroba wood and forest residues (sawdust) is achieved by invoices from the providers and native wood from management areas is achieved by DOF (Forest Origin Documents). The amount of biomasses is monitored in accordance to the weight or volume described in the receipts from the providers. In addition, Sustainable Carbon has interviewed a sample of providers of forest residues (sawdust) to assess the origin of such biomass, as described in the section 3.2.

¹² According to CDM General guidance on leakage in biomass project activities, version 3. Available at: <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved/history/c_leak_biomass/guid_biomass_v03.pdf>. Last visited on: 13/03/2015.

The amount of products produced per year is acquired by counting the total production. The measurement is made by an internal control sheet monitored by the project proponent, which controls the amount of ceramic units that enter in the molding machine.

The three sources of leakages predicted in the applied methodology are monitored. Scientific articles official statistical data regional and national surveys are provided in order to ensure that there is no leakage from non-renewable biomass (or to estimate the leakage). Based on this information, Sustainable Carbon is responsible to assess if the biomasses are from renewable origin, to evaluate if there is a surplus of renewable biomass and to calculate emission reductions, including an assessment of leakage emissions and the determination of parameter $f_{NRB,y}$. Sustainable Carbon also assists the Ceramic personnel to double check the monitored data on biomass consumption and ceramic devices production.

Non-conformities identified in the double check procedures were clarified between Sustainable Carbon technical team and the monitoring responsible on the ceramic during site visits for data collection, by reassessing existing documents and sources of information.

The responsible for the monitoring plan are *Mr. Severino Francisco Torres* and *Mr. Antônio Marcos Tavares Rocha* from *Kitambar* ceramic, Sustainable Carbon technical team (including those members described on Section 1.3) was also involved in the project monitoring.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline emissions are estimated following procedures of the applied methodology: AMS-I.E.: Switch from Non-Renewable Biomass for Thermal Applications by the User – Version 01, valid from 01/02/2008 to 08/04/2010¹³. The project activity in this monitoring period (10 months) generated 122.17 TJ per year. Converting this number to MWh, it was generated 33,936.23 MWh per year, which corresponds to the use of 3.87 MW_{thermal} on average of the kilns capacity during the monitored period, which is less than the limits of 45 MW_{thermal} for Type I Small scale project activities.

Baseline emissions

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

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

¹³ Available at: <

http://web.archive.org/web/20090304141849/http://cdm.unfccc.int/UserManagement/FileStorage/CDM_AMSP4VBBO5G54RXDE9KQ6FJWMGHZLHFA5 >. Last visit on: 17/03/2015.

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

EF_{projected fossil fuel}: Emission factor for the projected fossil fuel consumption in the baseline in tCO₂/TJ¹⁴.

B_y is determined using the 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 thousand of ceramic devices

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

Where:

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

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

Where:

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

Using the Equations 3, 4 and 5 in the Equation 1, it results to:

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

As shown in the calculations above, the η_{old} and the NCV biomass are not required to calculate the Emission Reductions, thus they were excluded.

The exact production (PR_y) was monitored by the project proponent based on data from ceramic units burned in the kilns. Data is aggregated on a monthly and yearly basis. Measurements are done by an internal control sheet monitored by the project proponent.

¹⁴ The fossil fuel likely to be used by similar consumers is taken the IPCC default value of residual fossil fuel.

The value of BF_y was determined through historical consumption of non-renewable biomass by the ceramic. It was calculated by dividing the monthly consumption of each kiln at the baseline from the monthly production of each kiln at the baseline, in thousands of pieces.

Baseline emissions during the monitored period are summarized in the following table:

Table 2. Baseline emissions for *Kitambar* ceramic

Year	Month	Baseline emissions (tCO ₂ e)
2014	June	4,261
	July	5,174
	August	4,587
	September	4,324
	October	4,932
	November	4,171
	December	3,800
	Total 2014	31,249
2015	January	4,106
	February	3,892
	March	4,697
	Total 2015	12,695
Total in the monitoring period		43,944

4.2 Project Emissions

The applied methodology does not include any source of project emissions.

4.3 Leakage

Leakage is estimated as 0 (zero) tCO₂e during the entire monitoring period.

The Category AMS-I.E 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, should also be 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 below).

Table 3. Sources of leakage according to the type of the biomass

Biomass Type	Activity/ Source	Shift of pre project	Emissions from biomass	Competing use of
--------------	------------------	----------------------	------------------------	------------------

		activities	generation/ cultivation	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 a 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 3, the possible sources of leakage of the present project activity is the competing use of *Algaroba* wood, forest residues (sawdust and MDF) and native wood from management areas. All of these biomasses have enough availability as showed below demonstrating the lack of leakage for each biomass.

Algaroba wood

According to Silva (2007)¹⁵, *Algaroba*¹⁶ (*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 1940'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 areas¹⁷.

A research made by EMBRAPA¹⁸, which encompass the States of *Pernambuco* and *Bahia*, affirmed that *Algaroba* is characterized as an invasive exotic plant due to its fast expansion, which

¹⁵ 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.

¹⁶ Algaroba may also be known as mesquite

¹⁷ EMBRAPA, Projeto vai definir manejo para evitar invasão da Algaroba no ambiente semi-árido. Available at: < <http://www.cpatas.embrapa.br:8080/noticias/noticia17.html> >. Visited in: 17/03/2015

¹⁸ 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.

causes many environmental impacts¹⁹. This source stated that there were several centers of *Algaroba* operation highlighting the San Francisco Basin, which is comprised for many municipalities from the states of *Bahia* and *Pernambuco*, including this project region. Besides, *Algaroba* presents a considerable capacity of regeneration and dispersal²⁰, which means that the plant does not die, it sprouts again stead.

The research's author reported that wood from *Algaroba* exploration on San Francisco Basin is mainly commercialized as fuel for industries of vegetable oil, leather, ceramic and bakeries. On the other hand, *Algaroba* wood is not sold for stake²¹, pegs and poles uses. *Algaroba* firewood is produced by the harvest of *Algaroba* trees occurring in certain areas. This is performed either by the land owner or by the biomass suppliers. In both cases, biomass suppliers purchase nearly all the wood harvested, leaving a small amount for the land owners to use as fenceposts.

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 IBAMA²².

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)²³, wood's production by *Algaroba* is at least 5 m³/ha/year. The production of *Algaroba* wood in the project's region is about 2,500 thousands of m³ per year. In this monitoring period *Kitambar* Ceramic consumed approximately 5,939.98 m³ of *Algaroba* wood per year, which represented less than 1% of the total.

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.

Algaroba forest areas are usually not subject to formal forest management techniques, but left largely unmanaged between harvests. It is important to notice that there are no national or regional

¹⁹ 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.

²⁰ EMBRAPA, Projeto vai definir manejo para evitar invasão da Algaroba no ambiente semi-árido. Available at: <<http://www.cpatas.embrapa.br:8080/noticias/noticia17.html>>. Visited in: 13th March, 2015.

²¹ Heavy pole to which cattle is tied.

²² 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>.

²³ EMBRAPA, Comunicado Técnico Nº, Nov/92, p.1-2. Available at: <http://www.cpatas.embrapa.br/public_eletronica/downloads/COT51.pdf>. Last visit on: 13/03/2015.

forest or nature conservation regulations applicable to Algaroba forests, since this is an exotic species.

However, it can be considered that 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. This is so because Algaroba has a strong capacity of regeneration, vigorously sprouting after harvest. The sprouts grow very fast, and quickly accumulate wood, thus maintaining the carbon stocks even if no formal forest management techniques are applied. Therefore, Algaroba firewood could be considered a renewable biomass in accordance with option I from CDM definition of renewable biomass is available on Annex 18 of the 23rd Report from the Executive Board.

Forest Residues

Forest Residues are also a likely 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, considering that around 22% of the wood produced will generate sawdust²⁴. The production of wood in the state of *Pernambuco* was of 1,585.86 m³²⁵ in 2007. Thus, the production of sawdust is around 319,891.88 m³ per year.

In this monitoring period *Kitambar* ceramic utilized 1,585.86 m³ per year of sawdust and MDF which represented less than 1% of the biomass availability in the state of *Pernambuco*. This way, this renewable biomass does not have potential to generate leakage emissions due to its high availability.

The forest residues (sawdust) 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".

Native wood from management areas

This biomass is composed of firewood that is produced in existing areas of native forest where sustainable management techniques are applied. These techniques aim to ensure sustainable exploitation of wood, ensuring the conservation of areas and carbon stocks.

In this monitoring period *Kitambar* ceramic utilized 720.00 m³ per year of native wood from management areas which represented less than 1% of the biomass availability in the state of *Pernambuco*. This way, this renewable biomass does not have potential to generate leakage emissions.

²⁴ 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.

²⁵ According to Geographic and Statistic Brazilian Institute (IBGE). Available at: <<http://www.ibge.gov.br/estadosat/temas.php?sigla=pe&tema=extracaovegetal2007>>. Last visit on: 13/03/2015.

The sustainable forest management plan can be organized into three stages: firstly, the division of the property in exploitable areas and areas of permanent preservation that are inaccessible to exploitation. The second stage is the planning of roads that connect the area with primary roads. In the third stage, the allocated area is divided for exploration in blocks in order to sustain forest exploitation annually²⁶. Furthermore, the minimum requirements of the management plan are defined by Article 31 of Brazilian Law 12.651/2012, law about protect of native vegetation.²⁷

In regard to wood from areas with sustainable forest management plan, Sustainable Carbon has developed a methodology that assesses the availability and surplus of Caatinga firewood from forest management plans. This assessment was done for the certification of a project located in Buenos Aires/PE, which in the same region of Kitambar Ceramic (both sites are approximately 150 Km apart, but source their biomass from similar regions). Therefore, conclusions from this assessment are considered relevant to the native wood from forest management areas consumed by Kitambar Ceramic²⁸.

According to the methodology applied, the effective capacity of a managed forest to sustain a certain level of harvest depends on its growth rate, indicated by the Mean Annual Increment (MAI). This value represents the mean rate of harvestable growth of wood that is expected to occur in the managed area and consists of measuring the harvestable stock by an inventory and dividing this value by the number of years in the cutting cycle.

However, this methodology does not take into consideration two facts that in practice increase the standing stock in the coupes not yet harvested.

- The trees keep growing after the inventory is made so that their volume and mass will continuously increase. Thus, in every coupe of the cutting series the forest will be older and more heavily stocked than it was at the time of the inventory;
- New trees grow in the not harvested coupes along the same time series, adding new biomass to the standing stock.

When these two factors are considered it is evident that the standing stock in the not harvested coupes is dynamic and grows along the cutting cycle, which means an increasing harvestable stock can be expected along a coupes series.

Thus, it can be stated that the growth of trees in the not harvested coupes originates increases in the standing stock along the cutting cycle, which results in average 27% higher that the starting stock as calculated by the forest inventory. Furthermore, in most cases, a lapse of one year occurs

²⁶ AMARAL, P. et al. **Floresta para Sempre**: um Manual para Produção de Madeira na Amazônia. Belém: Imazon, 1998. pp. 130. Available at: <http://www.bibliotecaflorestal.ufv.br/bitstream/handle/123456789/3942/Livro_Floresta-para-Sempre-Um-Manual-para-a-Produ%C3%A7%C3%A3o-de-Madeira-na-Amaz%C3%B4nia_IMAZON.pdf?sequence=1>. Last visit on: 13/03/2015.

²⁷ BRASIL. Lei nº. 12.651, de 25 de maio de 2012. Dispões sobre a proteção da floresta nativa. **Diário Oficial [da] República Federativa do Brasil, Brasília, DF, 28 de mai. 2012.** Available at: <http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm>. Last visited on: 13/03/2015.

²⁸ Evidences to such statement were made available to the verification team.

between the inventory is made and a Forest Management Plan (FMP) is approved, and frequently another year passes until the FMP starts to harvest the first coupe. Based on that, it is reliable to state that a surplus of biomass exists, since the average stock of harvestable firewood along the cutting cycle of FMPs in Pernambuco State is at least 25% higher than the estimate in the Forest Inventory and the corresponding cutting authorizations issued by Pernambuco State authority (Agência Estadual de Meio Ambiente - CPRH).

In order to evaluate the surplus availability of wood from sustainable forest management areas, a comparison was performed between the effective annual availability of firewood and the amount of native firewood provided with Forest Origin Document (in Portuguese, DOF - Documento de Origem Florestal), in the state of Pernambuco in the year 2012. The annual availability of native wood data was based on the Forest Management Plans in the State of Pernambuco, registered by the Environmental Authority of Pernambuco State, CPRH. In addition, the effective available firewood was calculated considering the increase of 27% in the standing stock along the cutting cycle.

Comparing the effective available amount of firewood and the amount of wood provided by Forest Origin Documents, the verified surplus of wood from management plans was of 154.17% in 2012. This value determines that the availability of wood from sustainable forest management serves local consumers, with significant surplus in the State of Pernambuco. This data demonstrates effective availability of 480,504 stereo meters of wood per year against total annual consumption of 189,049 stereo meters, which represents firewood surplus of 154% for Pernambuco in year 2012. This is the outcome of the quantitative analysis reported by Brazilian Environmental Authorities, which are the responsible to control the annual availability of wood and its consumption through Forest Origin Documents. It is important to note that there are some barriers to the commercialization of wood from management areas, such as distance from centers of consumption and the low price of the firewood from deforestation, causing an unfair competition.

In conclusion, the official data showed a large surplus of native wood from management plans in 2012. Hence, Sustainable Carbon considers that data indicates there is abundant firewood in the project region to avoid possibility of competing uses of biomass due to the project implementation.

The complete methodology and source of the official data provided by Environmental Authority of Pernambuco State will be made available to the verification team and the GS Secretariat

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 could be 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

The carbon credits incomes stimulate the use of renewable biomass to other ceramic companies presenting a huge possibility for sustainable development in the region. Therefore, the sources of leakages mentioned above are not applicable as the project activity does 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 and there is current great amount of renewable biomasses available locally as described before. The non-renewable biomass employed which would be employed in this project activity is not being saved for other project activity, since other ceramics were already consuming wood from non-sustainable forest management (common practice).

The project will contribute to reduce the use of non-renewable biomass, especially due to the incentive of carbon credits. Therefore, it can be concluded that this source of leakage, until the date of this monitoring report, is not considered for this project activity. This leakage was monitored in order to guarantee the project conservativeness.

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 was no transference of equipment, in spite of new equipment had to be acquired.

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

Table 4. Production – $Q_{\text{renbiomass}}$ - QA/QC Procedure

	VCS PD	Monitoring Period
Production (thousand of ceramic pieces)	10,500.00	13,129.39
Algaroba Wood Consumption (tonnes)	3,488.05	4,138.19
Cashew Tree Residues Consumption (tonnes)	673.99	0.00
Coconut husk (tonnes)	857.00	0.00
Forest Residues (tonnes)	0.00	462.54

Native wood from management plan Consumption (tonnes)	0.00	528.00
Thermal Energy (TJ)	93.18	101.81
Thermal energy per thousand of pieces produced (TJ/thousand of pieces)	0.009	0.008

As can be verified on Table 5, the thermal energy generated by the use of *Algaroba*, forest residues and native wood from management areas per thousands of ceramic devices produced during the current monitoring period was 12% lower than the VCS PD version 02. This difference is likely caused by the efficiency increase in comparison with the VCS PD version 02.

Therefore, based on Category AMS-I.E: Switch from Non – Renewable Biomass for Thermal Application by the User (Version 01, valid from 01/02/2008 to 08/04/2010) this project activity contributes to sustainable development, once the ceramic company is using renewable biomass and applying the SOCIALCARBON methodology.

4.4 Net of GHG Emission Reductions and Removals

Table below summarizes the emission reductions for this monitoring period²⁹.

Table 5. Emission reductions for the monitoring period.

Kitambar Ceramic				
Period		PR_y - Production (ceramic units)	B_y (tons)	ER_y (tCO₂e)
2014	June	1,268,200	2,891	4,261
	July	1,581,900	3,607	5,174
	August	1,373,200	3,131	4,587
	September	1,286,900	2,934	4,324
	October	1,468,000	3,347	4,932
	November	1,241,400	2,830	4,171
	December	1,131,200	2,579	3,800
	Total 2014	9,350,800	21,320	31,249

²⁹ Emission reductions are equal to the baseline emissions, since there are no project emissions according to the applied methodology and since leakage emissions are estimated at zero tCO₂e.

2015	January	1,222,190	2,787	4,106
	February	1,158,300	2,641	3,892
	March	1,398,100	3,188	4,697
	Total 2015	3,778,590	8,615	12,695
Total in the monitoring period		13,129,390	29,935.01	43,944

Table 6. Emission reductions for the monitoring period.

Year	Baseline emissions or removals (tCO₂e)	Project emissions or removals (tCO₂e)	Leakage emissions (tCO₂e)	Net GHG emission reductions or removals (tCO₂e)
2014	31,249	0,00	0,00	31,249
2015	12,695	0,00	0,00	12,695
Total in the Monitoring Period	43,944	0,00	0,00	43,944

5 APPENDIX

5.1 Appendix 1

Table 7. Biomass per month for the monitoring period.

Period		Algaroba Wood (tonnes)	Cashew Tree (tonnes)	Forest Residues (tonnes)	Native Wood from forest management (tonnes)
2014	June	375.70	0.00	37.56	118.80
	July	257.92	0.00	50.10	268.40
	August	556.89	0.00	42.83	140.80
	September	485.97	0.00	31.56	0.00
	October	431.22	0.00	39.79	0.00
	November	446.75	0.00	63.98	0.00
	December	406.93	0.00	91.95	0.00
	Total 2014	2,961.38	0.00	357.77	528.00
2015	January	373.12	0.00	35.47	0.00
	February	356.03	0.00	46.78	0.00
	March	447.66	0.00	22.52	0.00
	Total 2015	1,176.81	0.00	104.77	0.00
Total of monitored period		4,138.19	0.00	462.54	528.00