

J L SILVA CERAMIC FUEL SWITCHING PROJECT



Document Prepared By Sustainable Carbon - Projetos Ambientais Ltda

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1 PROJECT DETAILS

1.1 Summary Description of the Project

This project activity was developed by Carbono Social Serviços Ambientais LTDA. (Social Carbon Company) in 2009, which has changed its company name to Sustainable Carbon – Projetos Ambientais LTDA. This document comprises the renewal of the project crediting period.

J L Silva is a red ceramic company located in Lajedo municipality, in the state of *Pernambuco*, northeast region of Brazil. The ceramic company produces bricks and flagstones, destined mainly for the regional market in *Pernambuco*. In the years prior to the project initiation (baseline scenario) the fuel employed to fire the ceramic devices was native wood obtained from the *Caatinga* biome.

The *Caatinga* is an exclusively Brazilian biome, which represents 11% of all Brazilian territory. In the last years, accelerated deforestation, mainly due to native wood consumption, achieved around 46% of the biome's area¹.

GHG emissions generated from wood combustion were not compensated by replanting. An opposite scenario occurs with the renewable biomasses employed in this project activity, which have carbon neutral lifecycle.

In opposition to the identified baseline, the project activity generates thermal energy without stimulating deforestation and uses abundant renewable biomass. This fuel switching project is reducing greenhouse gases (GHG) emissions through the substitution of native wood for renewable biomasses.

Therefore, this project could only be 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.

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. The switching of non-renewable fuel (non-renewable wood) to renewable biomasses is expected to reduce an average of 20,941 tCO₂e per year during the second crediting period of the Project. This is the revalidation for the second crediting period started on 01-October-2016 and will end on 30-September-2026.

Then, emissions reductions are expected to reduce **209,409 tCO₂e** in total during this crediting period.

The contribution to sustainability has been monitored through the SOCIALCARBON® Standard, which is based in six main resources: Technology; Natural; Financial; Human; Social and Carbon Resources.

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);

¹ MMA - Ministério do Meio Ambiente. *Caatinga*. Available at: <<http://www.mma.gov.br/biomas/caatinga>> Last visit on: February 21st, 2018.

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

1.3 Project Proponent

Organization name	J L Silva Ceramic: Cerâmica Lopes Eireli - EPP (The ceramic has changed its company name)
Contact person	<i>Mr. Everaldo Lopes da Silva</i>
Title	<i>Mr. Everaldo Lopes da Silva: Director and owner. Mrs. Ivone Alexandre: Secretary and monitoring data responsible.</i>
Address	<i>Sítio Prata, without number, km 1 - Estrada Lajedo - Calçado, Zona Rural, Lajedo, Pernambuco, Brazil. Post code: 55385-000</i>
Telephone	+55 (87) 3773-1140 / (87) 3773-3897
Email	ceramicalopes@hotmail.com

Organization name	Sustainable Carbon - Projetos Ambientais Ltda
Role in the project	Project Proponent, Project developer and Project idealizer.
Contact person	Marcelo Hector Sabbagh Haddad Fernanda Alves de Almeida Fernanda Sayuri Suzuki Guilherme Lucas Medeiros Prado Lívia Demier Mauri Luana Ribeiro Alves
Title	Marcelo Hector Sabbagh Haddad: Technical coordinator Fernanda Alves de Almeida: Technical analyst Fernanda Sayuri Suzuki: Technical analyst Guilherme Lucas Medeiros Prado: Technical analyst Lívia Demier Mauri: Technical analyst Luana Ribeiro Alves: Technical analyst
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1.4 Other Entities Involved in the Project

No other entity was involved in the project activity.

1.5 Project Start Date

According to version 07 of the VCS PD², project start date was defined as 01-January-2006. On this date, the project began reducing or removing GHG emissions, i.e. the ceramic factory started using renewable biomass as fuel.

1.6 Project Crediting Period

The first crediting period for this project started on 01-October-2006 and ended on 30-September-2016. The second crediting period starts on 01-October-2016 and ends on 30-September-2026.

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

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	X
Large project	

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
From October to December - 2016	5,235
2017	20,941
2018	20,941
2019	20,941

² Document available at: <http://www.vcsprojectdatabase.org/#/project_details/198>. Last visit on: February 21st, 2018.

2020	20,941
2021	20,941
2022	20,941
2023	20,941
2024	20,941
2025	20,941
From January to September - 2026	15,705
Total estimated ERs	209,409
Total number of crediting years	10
Average annual ERs	20,941

1.8 Description of the Project Activity

This fuel switching project activity reduces greenhouse gases (GHG) emissions through the substitution of native wood from deforestation activity for renewable biomasses to generate thermal energy. Emissions launched during the combustion of native wood from deforestation activities are not compensated by replanting, which is a carbon sequestration method. An opposite scenario occurs with the renewable biomasses employed by this project activity, which have carbon neutral cycle.

The main goal of this project activity is to minimize the negative impacts of the deforestation of the Caatinga biome. Moreover, in opposition to the identified baseline, the project activity generates thermal energy without stimulating deforestation by using abundant renewable biomasses.

The use of many types of biomasses is expected, which can be utilized combined or isolated, since their renewable origin can be verified. The type and amount of each biomass employed may change according to its availability.

Since 2010 the production process at J L Silva Ceramic encompasses four continuous kilns (Hoffmann) in order to burn the fuel and fire the ceramic units and also two intermittent kilns (*Paulistinha*) aiming to produce flagstones. Three of the four Hoffman kilns produce, together, approximately 2,500 tonnes of ceramic pieces per month. The Hoffman kiln acquired in 2010 has 84 lines, which represents 504 lines burned monthly. Considering that each line produces 3,968 ceramic pieces, the new kiln produces, approximately, 2 millions of ceramic pieces per month.

Table 1: Scenario of the ceramic (based on original baseline)

Production at baseline (tonnes of ceramic units produced per year)	55,440
Non-renewable wood consumption at baseline (tonnes per year)	16,440
BFy (tonnes of wood per tonne of ceramic blocks produced)	0.2965

The implementation of the project activity saves energy due to the following modifications:

- Use of biomasses with less surface area than wood;
- Insertion of air with the new fuels, increasing the oxygenation;
- Reduction of thermal energy loss since the entrances will be kept closed or connected to the equipments;
- Injection of biomasses controlled by equipments, avoiding surplus of fuel often occurred when using wood.

Most of these improvements were made using the income derived from the carbon credits trade, since the implementation of the project.

1.9 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 industry limits. *J L Silva Ceramic* is located in *Brazil*, in the state of *Pernambuco* which is indicated in Figure 01. The project site has the following postal address:

J L Silva Ceramic

Sítio Prata, s/n

Lajedo – PE – Brazil

Postal Code: 55385-000.



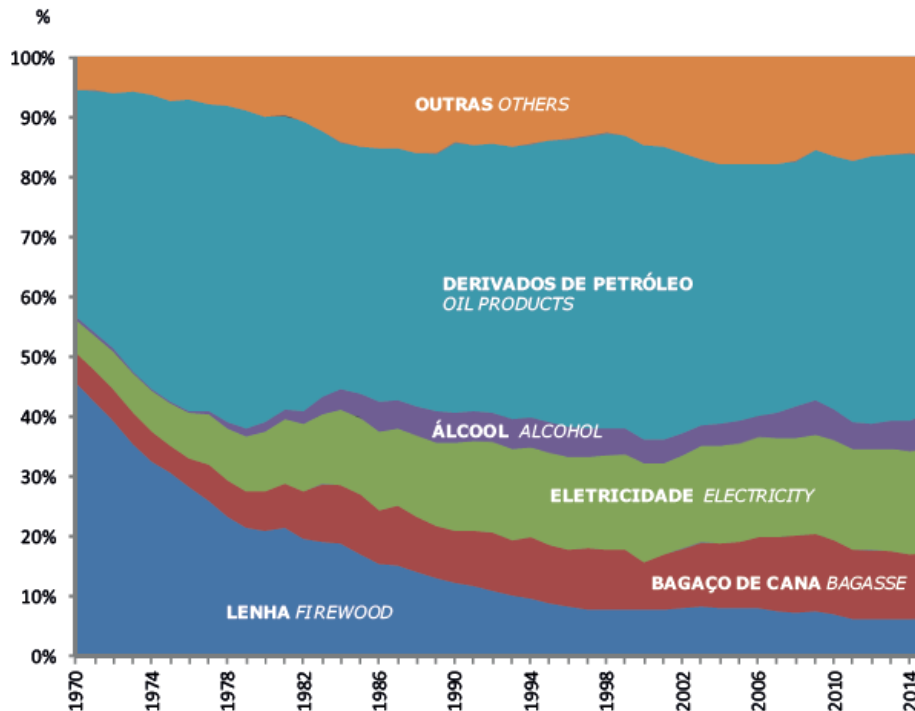
Figure 1. Geographic location of the cities of the project activity that has the following coordinates in Pernambuco State: Lajedo: 08°39'49" S and 36°19'12" W.

1.10 Conditions Prior to Project Initiation

The scenario prior to the project initiation was based on the use of native wood without sustainable management as fuel within the Brazilian ceramic sector. Deforestation firewood offered with low prices has been commonly utilized by ceramic industries.

Although firewood from deforested areas has been used 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 needs³. The chart below demonstrates that the consumption of firewood has decreased in Brazil since 1970's.

³BRITO, J.O. Energetic use of Wood. Available at: <http://www.scielo.br/scielo.php?pid=S0103-40142007000100015&script=sci_arttext&tlng=ES>. Last visit on: November, 29th, 2017.



Although the Brazilian consumption of firewood is decreasing in general, the Brazilian's Energy and Mine Ministry has been monitoring all energetic sectors of Brazil since 1970 and firewood appears over the monitored years as a significant source of thermal energy for ceramic sector.

Since the implementation of the project in 2006, the scenario has changed. However, despite the non-renewable firewood consumption has decreased, it can be seen that the use of native wood from deforestation by ceramic industry in Brazil is still a common practice (see section 2.4). The fact that the ceramic industry had historically operated using wood without sustainable management as fuel clearly confirms that the project was not implemented to create GHG emissions for the purpose of its subsequent removal or destruction.

The Caatinga Biome is the main vegetal formation of the northeastern semi-arid region and occupies 10% of the Brazilian territory. There are more than 840 thousand square kilometers spread across 10 states.⁴

⁴ Available at: "Caatinga - Ministério do Meio Ambiente." Available at: <<http://www.mma.gov.br/biomas/caatinga>>. Last visit on: November, 29th 2017.

One of the main causes of deforestation in Caatinga biome is for thermal energy generation. Almost 40% of the energy consumed in the Northeast still coming from burning wood⁵. Nevertheless, few people care about the importance of native trees in the maintenance of life in the semi-arid Northeast.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

This project is in accordance to relevant environmental laws, statutes and regulatory frameworks, such as the following ones⁶:

- CONAMA⁷ Resolution nº 237/97 which establishes the guidelines to the Environmental Licensing process for extraction activity and treatment of minerals, such as clay and for non-metallic mineral products industry, such as the ceramic industry. According to this legislation, the ceramic companies must have an operational license as well as a clay extraction license, both emitted by competent municipal, state or federal authority, under a valid time⁸.
- Law nº 6.938/81 which establishes the National Environment Policy, its objectives and mechanisms for formulation and implementation⁹.
- Law nº 9.605/98 which provides for criminal and administrative sanctions derivative from harmful conducts to the environment¹⁰.
- Law nº 12.305/10 which establishes the National Solid Waste Policy¹¹.

⁵ More information at: "Todo ano, quase três mil hectares de vegetação nativa ... - G1 - Globo." 13 mar. 2011, <http://g1.globo.com/natureza/noticia/2011/03/todo-ano-quase-tres-mil-hectares-de-vegetacao-nativa-viram-lenha.html>. Last visit on: November, 29th, 2017.

⁶ NUNES, M.B. Dossiê Técnico: Impactos Ambientais na Indústria da cerâmica vermelha. Rede de Tecnologia e Informação do Rio de Janeiro (REDETEC), 2012. Available at: <<http://respostatecnica.org.br/dossie-tecnico/downloadsDT/NTcwNQ==>>. Last visit on: November 29th, 2017.

⁷ 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. 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>>. Last visit on: November 29th, 2017.

⁸ Document available at: <<http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=237>>. Last visit on: November 29th, 2017.

⁹ Document available at: <<http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=313>>. Last visit on: November 29th, 2017.

¹⁰ Document available at: <<http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=320>>. Last visit on: November 29th, 2017.

¹¹ Document available at: <http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm>. Last visit on: November 29th, 2017.

- CONAMA Resolution nº 8/90 which establishes the maximum limits for the emission of pollutants in the air for external combustion processes from fixed sources of pollution¹².
- Law nº 12.651/12 which establishes general norms on the protection of vegetation, areas of Permanent Preservation and areas of Legal Reserve; Logging, supply of forest raw material, control of the origin of forest products and control and prevention of forest fires.

The CPRH is the State Environmental Agency of *Pernambuco* responsible to issue the environmental licenses according to CONAMA Resolution nº 237/97¹³.

Besides that, all the biomasses utilized in this project activity do not require legal documents specifically for residues, which do not fall under the by-product definition of IBAMA Normative Instruction N° 112 from August 21st, 2006¹⁴. Furthermore, the Operational License of the state of Pernambuco does not require any documents for the use of these types of biomass.

The project is also in accordance to DNPM (National Department of Mineral Production¹⁵) for the Mineral Resources exploitation.

1.12 Ownership and Other Programs

1.12.1 Project Ownership

Cerâmica Lopes Eireli EPP is the owner of the operation that characterizes the activity of this project, as evidenced by its operating licenses.

1.12.2 Emissions Trading Programs and Other Binding Limits

Not applicable.

¹² Document available at: <<http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=105>>. Last visit on: November 29th, 2017.

¹³ More information at: <<http://www.cprh.pe.gov.br/home/43066%3B63210%3B10%3B0%3B0.asp>>. Last visit on: February 21st, 2018.

¹⁴ Document available at: <<http://www.ambiente.sp.gov.br/legislacao/madeira-legal-legislacao/instrucao-normativa-ibama-n-112/>>. Last visit on: February 14th, 2017.

¹⁵ 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/acesso-a-informacao/institucional>>. Last visit on: February 14th, 2017.

1.12.3 Other Forms of Environmental Credit

This 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 standard.

1.12.4 Participation under Other GHG Programs

This project has not been registered under any other GHG programs.

1.12.5 Projects Rejected by Other GHG Programs

This project was not rejected under any formal GHG reduction or removal program. The project report was produced to make the project public and available to voluntary measures or other opportunities of the carbon market.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

Not applicable. This is not a grouped project.

Leakage Management

Not applicable since that leakage is estimated as zero tCO₂e (see section 3.3).

Commercially Sensitive Information

None of the information exposed to the Validation and Verification Body was withheld from the public version of the report.

Sustainable Development

The project activity contributes to the level reduction of greenhouse gas (GHG) emissions by avoiding the incentive of non-renewable fuels utilization. In addition, the project activity will contribute to the sustainable development of the host country, such as:

- The use of clean and efficient technologies through the use of renewable biomass as fuel. By these means, the project is in accordance to Agenda 21, Brazilian Sustainable Development Criteria and Sustainable Development Goals;
- A pioneer initiative that encourages the development of new technologies throughout the country, which replaces the use of non-renewable fuels with renewable biomass which presents an efficient thermal energy generation potential as shown in the project demonstration.
- The use of renewable biomasses results in GHG emission reductions. This way the project does not cause any additional negative impacts as all generated energy is a result of the best exploitation of the natural resources available. In addition, the project improves the local environmental

conditions by establishing proper treatment for the renewable biomasses and also by contributing to the reduction on the use of fossil fuels.

Further Information

The project is eligible according to:

- Legislative: the project attends all legal requirements;
- Technical: alterations/adaptations required are technically feasible;
- Economic: carbon credits will make the project feasible;
- Sectoral: incentive of good practices to the sector;
- Social: SOCIALCARBON methodology is being applied in order to improve long term sustainability conditions. The regional culture of burning wood without sustainable management 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 crediting period.

2 APPLICATION OF METHODOLOGY

2.1 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 7.0, valid from 22-July-2016 to 31-October-2017¹⁶. This category comprises small thermal appliances that displace the use of non-renewable biomass by introducing new renewable energy end-user technologies.

2.2 Applicability of Methodology

The methodology is applicable for project activities that avoid greenhouse gases emissions by using renewable biomass in order to generate thermal energy. In addition, the methodology is applicable if the project generates less than 45MW of energy, which is accomplished by the project as it generates 5.79 MW.

There are no similar registered small-scale CDM project activities in the region of the project activity once Sustainable Carbon - Projetos Ambientais LTDA made a research and did not find any registered small–

¹⁶ This version of the methodology is available at: <https://cdm.unfccc.int/methodologies/DB/9LFOR81TCT5FLI1AJYP46CQY8O2J79>. Last visit on: January 03rd, 2018.

scale CDM Project activity in the region. 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 areas without any kind of management cannot be considered a renewable source of biomass, since it interferes in the carbon pools and increases 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 23¹⁷.

Firewood coming from reforestation activities is considered renewable according to option I of the UNFCCC definition of renewable biomass (Annex 18, EB 23), as it fits all the assumptions below:

“The biomass is originating from land areas that are forests¹⁸ 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.”

Other possible biomass types, such as renewable native wood, algarroba wood, cashew tree pruning, coconut husk, sawdust, sugar cane bagasse, residues from tree pruning, aveloz wood and eucalyptus wood are agro-industries residues; thus, they are considered renewable according to option V of UNFCCC definition of renewable biomass: “The biomass is the non-fossil fraction of an industrial or municipal waste”. Sugar cane bagasse, coconut husk and sawdust are common residues in the region generated. Bagasse is generated by industries to produce sugar and alcohol. The sawdust is resulted from wood manufacturing. Eventually, the coconut husk is widely generated due to the utilization of the coconut fruit for diverse finalities.

2.3 Project Boundary

According to the applied methodology, the project boundaries for the grouped project are the physical geographical areas of the use of biomass or the renewable energy.

In the baseline scenario, there is use of non-renewable biomass to burn ceramic devices in the ceramic 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).

¹⁷ ANNEX 18: DEFINITION OF RENEWABLE BIOMASS. Available at: <https://cdm.unfccc.int/EB/023/eb23_repan18.pdf>. Last visit on: February 21st, 2018.

¹⁸ The forest definitions as established by the country in accordance with the decisions 11/CP.7 and 19/CP.9 should apply.

Table 2: Gases included in the project boundary

Source		Gas	Included?	Justification/Explanation
B a s e l i n e	Emissions from the combustion of non-renewable biomass	CO ₂	Yes	The major source of emissions in the baseline
		CH ₄	No	Deforestation rates will probably decay. Excluded for simplification. This is conservative.
		N ₂ O	No	Possibly emissions from wood burning will be excluded for simplification. This is conservative.
		Other	No	Not applicable
P r o j e c t	Emissions from the combustion of non-renewable biomass	CO ₂	Yes	Included in case of biomass providers are located over a distance of 200km.
		CH ₄	No	Excluded for simplification. This emission source is assumed to be very small.
		N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small.
		Other	No	Excluded for simplification. This emission source is assumed to be very small.

The following figure provides a diagram of the Project boundary:

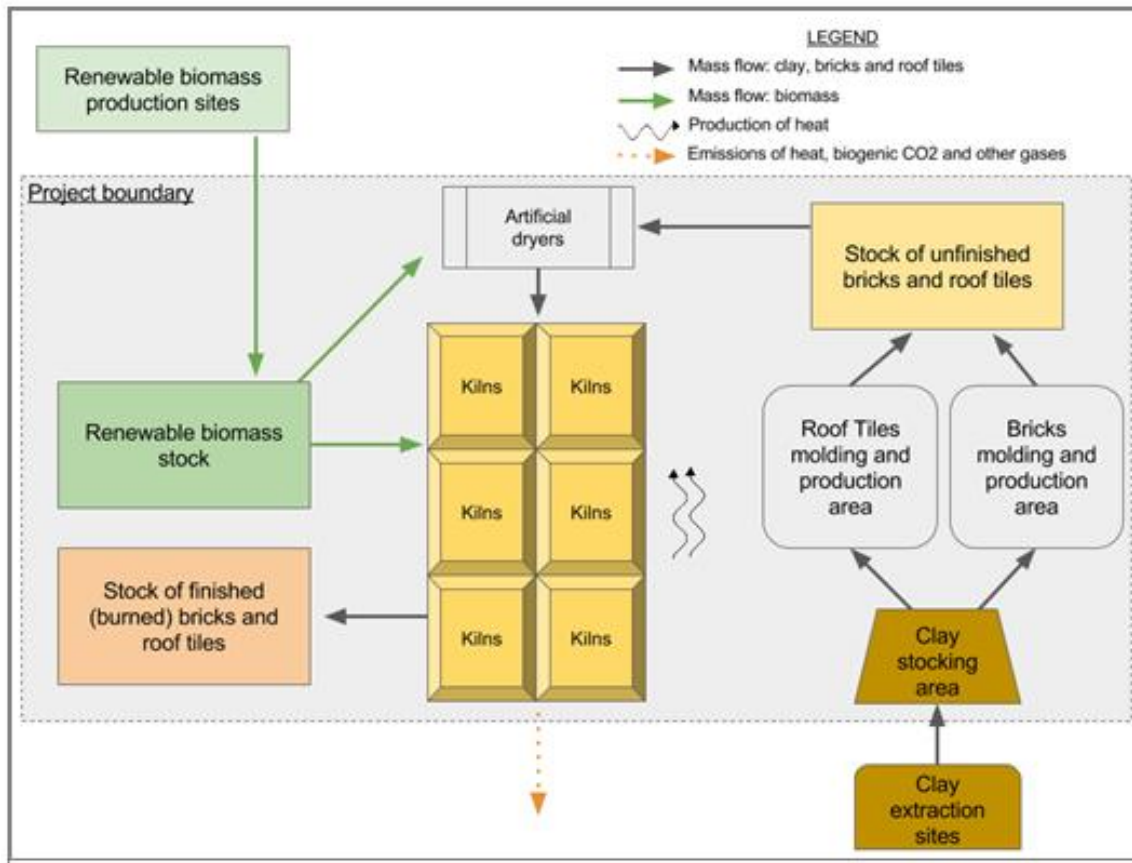


Figure 2. Diagram representing of project boundaries.

2.4 Baseline Scenario

It is assumed that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs.

The original baseline scenario for this project activity was defined according to the Methodology AMS-I.E and comprises the switch from non-renewable biomass for thermal applications. This baseline scenario was established during the project validation and is still valid. However, due to the implementation of the project there is no use of non-renewable biomass in the ceramic factory nowadays.

In order to assess the continued validity of the baseline and to update the renewal of the crediting period,

the CDM Methodological Tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period"¹⁹ is applied as follows:

Step 1: Assess the validity of the current baseline for the next crediting period

The validity of the current baseline is assessed using the following Sub-steps:

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

The current baseline complies with all relevant mandatory national and/or sectoral policies. However, despite the existence of specific legislation for protection of native vegetation, the illegal use of wood is still a common practice in the northeast region. According to Chaves (2016)²⁰, the ceramic sector remains highly dependent on native firewood. The firewood is necessary for the activities of burning products and for artificial drying. As native firewood is the cheapest fuel source it has consolidated as the main energy source of this industry. This is a concern, since it contributes to systematic deforestation.

Only the red ceramics production segment showed an annual consumption of around 8 million m³ stereo of firewood, being the group of the main consumers of this energy input in the industrial sector of the Northeast of Brazil. Chaves (2016) also identified that according to the owners, the consumer market for firewood has preference for illegal firewood due to the lower price. The study also concludes that there is a lack of control regarding the Document of Forest Origin (DOF)²¹, which contributes to the illegal market.

The State of Pernambuco is also inserted in this context. A newspaper report from "Brasil de Fato" from 29/07/2016, states that popular movements have denounced illegal firewood extraction in Pernambuco State. According to the report, around 150 trucks are loaded with illegal firewood from the Caatinga biome weekly, due to a lack of surveillance by the responsible environmental agencies, such as IBAMA (Federal Environmental Agency) and CPRH (State Environmental Agency).

Besides that, according to a study of ELLA Project (2017)²², about 55% of the total biomass demand in the Northeast region, comes from non-renewable sources, i.e., biomasses that are not into a carbon

¹⁹ UNFCCC Methodological Tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period". Available at :<<http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf>> Last visit on: 21st February, 2018.

²⁰ CHAVES, Anny Gabrielle da Cruz. "Diagnóstico da exploração de lenha em planos de manejo florestal sustentável na Caatinga do Rio Grande do Norte". Universidade Federal do Rio Grande do Norte, 2016. Available at: <<https://repositorio.ufrn.br/jspui/handle/123456789/22474>>. Last visit on: February 21st, 2018.

²¹ The Forest Origin Document - DOF - established by Ministerial Order No. 253 of August 18, 2006 of the Ministry of the Environment - MMA - represents the compulsory license for the control of the transportation of forest product and by-product from native origin. Available at: <<https://servicos.ibama.gov.br/index.php/autorizacoes-e-licencas/documento-de-origem-florestal-dof>>. Last visit on: February 21st, 2018.

²² INT/MCTIC – Instituto Nacional de Tecnologia – Ministério da Ciência, Tecnologia, Inovações e Comunicações. Cerâmica Vermelha – Projeto EELA no Brasil. "Eficiência Energética em ladrilleras", 2017. p. 53 and 54.

sequestration cycle emitted to the atmosphere at the moment of its combustion. The table below indicates the availability of non-renewable biomass in 2006 and 2016.

Table 3: Non-renewable biomass supply in the Northeast region (Adapted from EELA, 2017)

	2006	2016	Unit
Total Demand NE	2.8	3	MtMS/a
Non Renewable Supply NE	80	55	%
GHG generation demand	2.24	1.65	MtMS/a
Balance	-0.59		MtMS/a
	-1.03		MtCO ₂ /a

MtMS/a - Million tonnes of dry material per year
MtCO₂/a - Million tonnes of carbon dioxide per year

As established above, firewood has appeared as a significant source of thermal energy for the red ceramic sector.

The following tables demonstrate that in the last ten years the consumption of firewood in the Brazilian ceramic industry remained at considerable values. Around 50% of the fuel utilized in the ceramic industry sector comes from firewood source²³.

Table 4. Distribution of fuel employed at the ceramic sector in Brazil (10³ tep (toe)). (Source National Energy Balance, 2016)

²³ Energy Research Company. National Energy Balance 2016 - Base year 2015. Available at <https://ben.epe.gov.br/downloads/Relatorio_Final_BEN_2016.pdf>. Last visit on: February 21st, 2018.

	10 ³ tep (toe)										
FONTES	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	SOURCES
GÁS NATURAL	901	960	1.007	977	1.141	1.288	1.314	1.354	1.339	1.324	NATURAL GAS
CARVÃO VAPOR	42	33	44	31	30	52	35	39	50	62	STEAM COAL
LENHA	1.762	1.885	2.122	2.081	2.275	2.387	2.458	2.631	2.657	2.312	FIREWOOD
OUTRAS RECUPERAÇÕES	32	35	53	53	58	61	62	65	66	59	OTHER WASTES
ÓLEO DIESEL	8	7	8	8	6	31	28	24	26	24	DIESEL OIL
ÓLEO COMBUSTÍVEL	285	313	322	322	295	125	113	125	102	59	FUEL OIL
GÁS LIQUEFEITO DE PETRÓLEO	151	153	166	176	165	169	161	163	171	173	LIQUEFIED PETROLEUM GAS
OUTRAS DE PETRÓLEO	76	170	173	178	195	270	275	289	292	262	OTHER PETROLEUM SECUNDARIES
GÁS CANALIZADO	0	0	0	0	0	0	0	0	0	0	GASWORKS GAS
ELETRICIDADE	276	284	298	301	319	342	359	380	376	339	ELECTRICITY
OUTRAS NÃO ESPECIFICADAS	0	0	0	0	0	0	0	0	0	0	OTHERS
TOTAL	3.533	3.841	4.193	4.128	4.485	4.724	4.803	5.069	5.079	4.614	TOTAL

Table 5. Distribution of fuel employed at the ceramic sector in Brazil (%). (Source: National Energy Balance, 2016)

	%										
FONTES	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	SOURCES
LENHA	49,9	49,1	50,6	50,4	50,7	50,5	51,2	51,9	52,3	50,1	FIREWOOD
GÁS NATURAL	25,5	25,0	24,0	23,7	25,4	27,3	27,4	26,7	26,4	28,7	NATURAL GAS
ÓLEO COMBUSTÍVEL	8,1	8,1	7,7	7,8	6,6	2,6	2,3	2,5	2,0	1,3	FUEL OIL
ELETRICIDADE	7,8	7,4	7,1	7,3	7,1	7,2	7,5	7,5	7,4	7,3	ELECTRICITY
OUTRAS	8,7	10,4	10,6	10,8	10,1	12,3	11,6	11,4	11,9	12,6	OTHERS
TOTAL	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	TOTAL

Step 1.2: Assess the impact of circumstances

As can be seen in the tables 4 and 5 above, the most likely scenarios in the absence of native wood from deforestation areas would be the use of natural gas, fuel oil, electricity and others non-specified.

A probable baseline scenario would be the use of Natural Gas. However, although there is distribution / gas pipe in the region, the inconstant distribution of natural gas made the project proponents not to trust in

this fuel, as 75%²⁴ of the natural gas consumed in Brazil proceeds from Bolivia, therefore excluding this possibility.

Another probable scenario in the absence of native wood would be the use of fuel oil²⁵, which is not viable considering its higher prices when compared with non-renewable biomass. Besides, the fuel oil requires more technology to be inserted.

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

Not applicable. The baseline scenario of the project activity is the continuation of use of the current equipment(s) without any investment and the project proponent will not undertake any investment later

Step 1.4: Assessment of the validity of the data and parameters

Data and parameters determined at the start of the crediting period and not monitored during the crediting period are still valid, as the baseline scenario identified in the region is the consumption of non-renewable wood.

The parameter $EF_{\text{projected fossil fuel}}$ value changed to 81.6 TCO₂/TJ and it is a fixed parameter while NCV_{biomass} changed from fixed parameter to monitored parameter and its value remains the same according to the applied methodology²⁶. The parameter EF_{CO_2} was included according to a necessity of the applied methodology. Furthermore p_{biomass} and BF_y remains as fixed parameters with the same values of the first crediting period.

Thus, the baseline identified for this project activity would be the utilization of non-renewable native wood to provide thermal energy to the ceramic kilns.

Step 2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

Although the baseline scenario is still valid, the baseline emissions have been revised due to the updated values of fixed parameters, as per the new version of the applied methodology.

Step 2.2: Update the data and parameters

²⁴ Document available at: "A regulação da importação e exportação de gás natural no Brasil" <https://periodicos.ufrn.br/direitoenergia/article/view/5014/4041>. Last visit on: February 21st, 2018.

²⁵ MIRANDA, M. A. S. Potencial da Biomassa Florestal para produção de Energia Térmica Industrial. Universidade Federal de Viçosa, 2015. Available at: <http://www.locus.ufv.br/bitstream/handle/123456789/6668/texto%20completo.pdf?sequence=1&isAllowed=y>. Last visit on: February 21st, 2018.

²⁶ Switch from non-renewable biomass for thermal applications by the user. Available at https://cdm.unfccc.int/filestorage/J/2/H/J2H1I470Y38ZS6WFCEOPM5NBVRG9QX/EB90_repan12_AMS-IE_%28v07.0%29.pdf?t=TkF8cDY5amNtfDBKEXPmn2IVifTAJdOu8OGk Last visit: March, 2018

$EF_{CO_2,f}$ was included as a fixed parameter for cases when project emissions have to be calculated. The parameter $EF_{projected\ fossil\ fuel}$ was updated as the applied version of the methodology.

2.5 Additionality

Discussed and approved during validation process. The project activity is not mandated by any systematically enforced law, statute or other regulatory framework or policies that give comparative advantage to less emissions-intensive technologies or activities relative to more emissions-intensive technologies or activities need not be taken into account.

2.6 Methodology Deviations

Not applicable. No methodology deviations were applied at the time of project revalidation.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

It is assumed that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs. The calculation of emission reductions are described below:

$$BE_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected_fossil_fuel} \quad (\text{Equation 1})$$

Where:

BE_y:	Baseline emissions during the year y in tCO ₂ e
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/tonne
$EF_{projected\ fossil\ fuel}$:	Emission factor for the projected fossil fuel consumption in the baseline in tCO ₂ e/TJ ²⁷ .

²⁷ Value obtained on the AMS-I.E.: Switch from non-renewable biomass for thermal applications by the user - Version 7.0.

B_y is determined using the following option:

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

$$B_y = \sum_i^n HG_{p,y} \div (NCV_{biomass} \times \eta_{old,i}) \quad (\text{Equation 2})$$

Where:

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

$\eta_{old,i}$: Efficiency of pre-project device per type of device i.

$$HG_{p,y} = SGE \times PR_y \quad (\text{Equation 3})$$

Where:

SGE: Specific energy which has to be generated in the process to produce a certain amount of ceramic units in TJ/tonnes of ceramic units fired.

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

$$\eta_{old} = \frac{SGE}{SFE} \quad (\text{Equation 4})$$

Where:

SFE: Specific fuel energy needed for the process to produce a certain amount of ceramic units in TJ/ tonnes of ceramic units

$$SFE = BF_y \times NCV_{biomass} \quad (\text{Equation 5})$$

Where:

BF_y: Consumption of non-renewable biomass per tonne of ceramic units fired in year *y*

Using the Equations 4, 5 and 6 in the Equation 3, it results to:

$$B_y = PR_y \times BF_y \quad (\text{Equation 6})$$

3.2 Project Emissions

According to Methodological tool²⁸ the project emissions could be a result of biomass transportation of a distance over 200Km or emissions from energy consumption associated with processing of biomass residue. Since it is a small scale project, may neglect emissions from energy consumption associated with cultivation of biomass. If the biomass providers are located over a distance of 200 Km of the Ceramic factory, it will be calculated using the Methodological tool “Project and leakage emissions from transportation of freight” – 0.1.1.0 where it will be use the option B “using conservative default values”. The emissions caused by transportation will be monitored during the verification to ensure the distance is less than 200Km and if it is over than 200km calculate the emissions by the following equation:

$$PE_{TR,m} = \sum_f D_{f,m} \cdot FR_{f,m} \cdot EF_{CO_2,f} \cdot 10^{-6} \quad (\text{Equation 7})$$

Where:

PE_{TR,m} : Project emissions from road transportation of freight monitoring period *m* (tCO₂)

D_{f,m} : Return trip road distance between the origin and destination of freight transportation activity *f* in the monitoring period *m* (km)

FR_{f,m} : Total mass of freight transported in freight transportation activity *f* in monitoring period *m* (t)

EF_{CO₂,f} : Default CO₂ emission factor for freight transportation activity *f* (g CO₂ / t km)

²⁸ Available at < <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf> > Last visit: March, 2018.

f : Freight transportation activities conducted in the project activity in monitoring period *m*

3.3 Leakage

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)³⁰ 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 6. 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	In the absence of the project the land would be used as a cropland/wetland	X	X	-

³⁰ Document available at: <http://cdm.unfccc.int/methodologies/SSCmethodologies/AppB_SSC_AttachmentC.pdf>. Last visit on July 25th, 2017.

(woody or non-woody)	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 above, the possible sources of leakage of the present project activity is the competing use of sawdust / forest residues, cashew tree residues, native wood from forest management, coconut husk, algaroba wood, aveloz wood, eucalyptus wood from reforestation, sugar cane bagasse and bamboo. All of these biomasses have enough availability as shown below demonstrating the lack of leakage for each biomass.

Cashew tree wood

Cashew cultivation is very significant to Brazilian economy, generating an important income of around 150 million US dollars per year. It is especially important in the northeast region, where represents about 95% of Brazilian's cashew production. The Brazilian production achieved 134,580 tonnes of cashew-nuts in 2017 spread in an area of around 565,000 hectares³¹.

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 time. This way, cashew cultivation should prune undesirable branches of the cashew trees³². 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 generation per year, however its abundant availability is well-known all over the country.

³¹ According to IBGE. Available at: < <https://sidra.ibge.gov.br/home/lspa/brasil> >. Last visited on: January, 2018.

³² SÁ, Filadelfio Tavares et al. **Plantando Caju**. EMBRAPA, 2000. Available at: <https://www.agencia.cnptia.embrapa.br/Repositorio/Plantando_caju_000g0591zi302wx5ok0q43a0rzjrgez3.pdf>. Last visited on: February, 2018.

Cashew trees cultivation presents a density of 125 trees per hectare³³, and the production of firewood residues from each tree is 2.5 kg per year³⁴. The cultivation of cashew in the Northeast region of Brazil occupies in an area of 564,212 hectares in 2017³⁵. This way, the production of residues from cashew trees within the Brazilian Northeast region is around 176,316 tonnes per year. The project activity estimated consumption of residues from cashew trees residues would be around 1,224.95 tonnes per year, which represents less than 1% of the total production of residues from cashew trees within the Northeast region.

Algaroba wood

According to Silva (2007)³⁶, *Algaroba*³⁷ (*Prosopis juliflora* (Sw.) D.C.) is a tropical legume tree fairly common in the semi-arid region of Brazil, which thrives in dry environments where other plants would hardly survive. A research made by EMBRAPA³⁸, which encompass the States of Pernambuco and Bahia, affirmed that *Algaroba* is characterized as an invasive exotic plant due to its fast expansion, which causes many environmental impacts³⁹. This source stated that there were several centers of *Algaroba* operation highlighting the San Francisco Water 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 dispersal⁴⁰ which means that the plant does not die, it sprouts again instead.

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. 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 IBAMA⁴¹.

The same research estimated that in the Northeast semi-arid region there were about 500 thousands hectares spread through every typs region land. Moreover, according to EMBRAPA

³³ According to SEBRAE, CE. "Estudo Setorial Cajucultura". According to the study, the spacing of planting cashew tree is around 10m by 8m, which means one hectare has around 125 trees. Available at: <http://www.iac.sp.gov.br/areasdepesquisa/frutas/frutiferas_cont.php?nome=Caju>. Last visited on: January, 2018.

³⁴ CEPEL. Manual de Aplicação de sistemas descentralizados de Geração de Energia elétrica para projetos de Eletrificação rural. Eletrobrás, Rio de Janeiro RJ, 2000. 41 p.

³⁵ According to IBGE. Available at: <<https://sidra.ibge.gov.br/home/lspa/nordeste>>. Last visited on: January, 2018.

³⁶ 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.

³⁷ Algaroba may also be known as mesquite.

³⁸ 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.

³⁹ 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

⁴⁰ EMBRAPA, Projeto vai definir manejo para evitar invasão da Algaroba no ambiente semi-árido. Available at: <http://www.cpatas.embrapa.br:8080/noticias/bkp_noticiasantigas/noticia17.html>. Last visit on: February, 2018.

⁴¹ 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>. Last visit on February, 2018.

(1992)⁴², 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, which corresponds to 1,900,000 tonnes per year. As *JL Silva* ceramic would consume approximately 2,054 tonnes of *Algaroba* wood per year, it represented just 0.11% of the total of *Algaroba* wood produced in the region.

Native wood from forest management

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 annually. Furthermore, the minimum requirements of the management plan are defined by Article 19 of Brazilian Forest Code, and are regulated by Decree 5975/06⁴³.

Considering that the rotation cycle is defined between 12 and 15 years, the period used to estimate the production of wood with sustainable forest management plan in *Caatinga* biome was 13,5 years, medium value. Another important parameter is the MAI (mean annual increment), that according to MMA (2015) is around 15 m³/ha.year⁴⁴, which leads to 4,5 m³/ha.year.

The total area properly regularized with sustainable forest management plan in the *Caatinga* biome corresponds to around 400,000 hectares. There are around 588 sustainable forest management plans operating in this biome⁴⁵.

Considering that the exploration is in blocks (in order to sustainable forest exploitation annually)⁴⁶, the area available for exploration is around 29,630 ha/year in *Caatinga* biome. In addition, it was considered the productivity of wood in *Caatinga* biome as 60.75 m³/ha.

Therefore, the production of wood with sustainable forest management plan in *Caatinga* biome was around 1,800,022.5 m³ in 2012, which represents 1,643,420.5 tonnes. As the ceramic consumption presented in this project activity will be about 530.74 tonnes per year, the consumption of this kind of fuel represents just 0,03% of the total of wood with sustainable forest management plan produced in the region.

Coconut husks

⁴² EMBRAPA, Comunicado Técnico N^o, Nov/92, p.1-2. Available at: <http://www.cpatsa.embrapa.br/public_eletronica/downloads/COT51.pdf>. Last visit on: February, 2018.

⁴³ BRASIL. Lei n^o. 4.771, de 15 de setembro de 1965. Código Florestal. **Diário Oficial [da] República Federativa do Brasil**, Brasília, DF, 16 de set. 1965. Available at: <http://www.planalto.gov.br/ccivil_03/LEIS/L4771.htm>. Last visit on: January, 2018.

⁴⁴ BRASIL. Estatística Florestal da Caatinga/MMA. Ano 2. Vol. 2 (ago. 2015). Natal, RN: APNE, 2015. Available at: <[136p.https://goo.gl/DEiSiq](https://goo.gl/DEiSiq)>. Last visit on: January, 2018.

⁴⁵ CNIP, 2012. Available at: < http://www.cnip.org.br/planos_manejo.html>. Last visit on: January, 2018.

⁴⁶ BRASIL. Manejo sustentável dos recursos florestais da Caatinga/MMA. Secretaria de Biodiversidade e Florestas. Departamento de Florestas. Programa Nacional de Florestas. Unidade de Apoio do PNF no Nordeste._Natal: MMA, 2008. 28p. Last visit on: January, 2018.

The coconut has diverse uses, such as food, water, fiber among others. In the northeast region of Brazil, the production of coconuts was around 1,334,338 thousands of units in 2017⁴⁷. Each unit produces around 1.75 Kg⁴⁸ of residues, thus 2,335,091.5 tonnes of coconut husks were generated in 2017. The project activity will employ around 350 tonnes of coconut husk per year, representing less than 1% of the coconut husk available at the region.

Sawdust

Sawdust is 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.

The production of timber in the Northeast Region of Brazil was of 1,129,176 m³⁴⁹ in 2016. Considering that around 22% of the wood produced will generate sawdust⁵⁰. Thus, it can be assumed that around 248,835.2 m³ or 60,964.62 tonnes of sawdust was generated. The average use of sawdust in this project activity would be 144.87 tonnes, that represents 0.24% of the production. This way, this renewable biomass did not have potential to generate leakage emissions.

Eucalyptus wood (reforestation wood)

The area destined for afforestation in Brazil corresponds to 5.6 millions of hectares, where the *Eucalyptus* genus corresponds to 3.5 millions of this area, and can generate 23 to 25 tonnes of biomass per hectare⁵¹. The grand majority of these cultivations were established in the middle of 1970 to 1980.

In addition, sustainable management afforestation practices in Brazil (i.e. the techniques of preparation, fertilization, control of weeds, improved seeds, cloning and reform) were introduced and constantly improved in order to increase its productivity⁵². As a consequence, Brazil withholds the best productivity rates (in m³/ha/year) over the world due to the adaptation of these species to the Brazilian territory and the success of the experiments of genetic improvement⁵³. The total area of Eucalyptus wood cultivation in the Northeast Region of Brazil is 901,218 ha. Eucalyptus can generate around 25 tonnes of biomass per hectare⁵⁴ that represents 22,530,450

⁴⁷ According to IBGE Available at: <<https://sidra.ibge.gov.br/home/lspa/nordeste>> Last visited on: January, 2018.

⁴⁸ According to BBC Available at: http://www.bbc.com/portuguese/noticias/2014/02/140207_coco_sub_reciclagem_cidades_pai Last visited on: January, 2018.

⁴⁹ According to IBGE <<https://cidades.ibge.gov.br/>> Last visit: February, 2018

⁵⁰ 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.

⁵¹ Brazilian Society of Forestry. Source: <<http://www.sbs.org.br/atualidades.php>>. Last visited: November, 2017

⁵² MCT/IPEF. *Silvicultura e Manejo*

⁵³ JUVENAL, T. L.; MATTOS, R. L. G. *O setor florestal no Brasil e a importância do reflorestamento*. BNDES Setorial, Rio de Janeiro, n. 16, p. 3-30, set. 2002.

⁵⁴ Source: IBGE: Available at: <http://www.imaflorestal.com/noticias/producao-de-biomassa-um-novo-uso-para-o-eucalipto> Last visited on: March 30th, 2017.

Considering that the factory would use just this biomass for one year to generate 92.92 TJ, it was estimated the average of annual consumption of this kind of fuel as around 5,956.41 tonnes, which represents 0.03% of the total of *Eucalyptus* wood produced.

Residues from tree pruning

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.

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 activity⁵⁵.

Sugar Cane Bagasse

According to CGEE, one tonne of sugar cane produces about 140 kilograms of sugar cane bagasse and finally 90% of this amount can be used to energy production. According to UNICA, Alagoas, Bahia and Pernambuco produced 31,590,000 tonnes of Sugar Cane in 2016⁵⁶. Thus, the production of sugar cane bagasse that can be used to energy was around 3,980,340 tonnes. This project activity will employ 609.30 tonnes representing 0.015% of the Sugar Cane Bagasse available in the region.

Aveloz wood

Euphorbia tirucalli, most known as Aveloz, is a juicy plant and medium size tree, widespread occurrence in the continents. The plant is usually used in popular, folk medicine. The specie has origin in Africa, grows and develops well at tropical weather and also became a very successful intruder in Caatinga biome. The branch leaves are usually used for cancer treatment by popular medicine in Brazilian Northeast. This fact has been subject of many medicine studies of pharmacy in Brazil. Aveloz is a shrub that grows over a limit of 3m, and is used as quickset. This specie forms dense shrubs, which are cut to avoid the invasion to the property. It is important lay emphasis on the fact that the Aveloz would be extracted even without the project activity, and would not have another sustainable destination. According to IBGE (Instituto Brasileiro de Geografia Estatística) in 2008 the State of Pernambuco produced approximately 1.8 million per m3 of firewood⁵⁷, which

⁵⁵ Available at: <http://cenbio.iee.usp.br/download/documentos/notatecnica_ix.pdf>. Last visit: February, 2018

⁵⁶ Source: Unica Available at <http://www.unicadata.com.br/historico-de-producao-e-moagem.php?idMn=32&tipoHistorico=4&acao=visualizar&idTabela=1803&safr=2015%2F2016&estado=BA%2C%20PE> Last visited on 30/03/2017

⁵⁷ IBGE – Instituto Brasileiro de Geografia e Estatística. Pernambuco: Extração vegetal e silvicultura 2008. Available at: <<http://www.sidra.ibge.gov.br/bda/extveg/default.asp?t=2&z=t&o=18&u1=23&u3=1&u2=23>>. Last visit on: February, 2018.

representes 1,008,000 tonnes. The average use of Aveloz wood in this project activity would be 233.11 tonnes that represents just 0.024% of the production.

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 equipments had to be acquired.

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

3.4 Net GHG Emission Reductions and Removals

This category comprises small thermal appliances that displace the use of non-renewable biomass by introducing new renewable energy end-user technologies. 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 CO₂.

The Emission Reductions are estimated based on the equation below:

$$ER_y = BE_y - PE_y - LE_y \quad (\text{Equation 8})$$

Where:

ER_y: Emission Reductions in year y in tCO₂e

PE_y: Project Emissions in year y in tCO₂e

LE_y: Leakage Emissions in year y in tCO₂e

Table 7: Estimated net GHG emission reductions or removals (tCO₂e)

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
October to December 2016	5,235	0	0	5,235
2017	20,941	0	0	20,941
2018	20,941	0	0	20,941
2019	20,941	0	0	20,941
2020	20,941	0	0	20,941

2021	20,941	0	0	20,941
2022	20,941	0	0	20,941
2023	20,941	0	0	20,941
2024	20,941	0	0	20,941
2025	20,941	0	0	20,941
January to September 2026	15,705	0	0	15,705
Total	209,409	0	0	209,409

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	EF_{projected fossil fuel}
Data unit	tCO ₂ /TJ
Description	Emission factor for the substitution of non-renewable woody biomass by similar consumers.
Source of data	AMS-I.E.: Switch from non-renewable biomass for thermal applications by the user - Version 7.0. Available at: https://cdm.unfccc.int/methodologies/DB/9LFOR81TCT5FLI1AJYP46CQY8O2J79 Last visit on: February 15 th , 2018.
Value applied	81.6 tCO ₂ /TJ
Justification of choice of data or description of measurement methods and procedures applied	This value represents the emission factor of the substitution fuels likely to be used by similar users, on a weighted average basis. It is assumed that the mix of present and future fuels used would consist of a solid fossil fuel (lowest in the ladder of fuel choices), a liquid fossil fuel (represents a progression over solid fuel in the ladder of fuel use choices) and a gaseous fuel (represents a progression over liquid fuel in the ladder of fuel use choices). Thus a 50 per cent weight is assigned to coal as the alternative solid fossil fuel (96 t CO ₂ /TJ) and a 25 per cent weight is assigned to

	both liquid and gaseous fuels (71.5 t CO ₂ /TJ for kerosene and 63.0 t CO ₂ /TJ for liquefied petroleum gas (LPG)).
Purpose of Data	The fossil fuel likely to be used by similar consumers is taken from the applied methodology. 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.
Comments	Applicable for stationary combustion in the manufacturing industries and construction.

Data / Parameter	ρ_{biomass}
Data unit	tonne/m ³
Description	Specific gravity of non-renewable wood
Source of data	Brazilian studies 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/arquivos/p_poder_lignocelulosicos_11_107.pdf. Last visit on: February 15th, 2018. - 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. - LORENZI, H. Árvores Brasileiras: Manual de Identificação e Cultivo de Plantas Arbóreas Nativas do Brasil, vol.2. 4.ed. Nova Odessa, SP: Instituto Plantarum, 2002. EMBRAPA. Comunicado Técnico: Características Físico-Mecânicas e Energéticas de Madeira do Trópico Semi-Árido do Nordeste do Brasil. Nº63, mar/96, p.1-12
Value applied	0.9133
Justification of choice of data or description of	The species used to calculate the value are typical trees of <i>Caatinga</i> Biome that are usually employed as fuel in the ceramic factories of the region.

measurement methods and procedures applied	The amount of wood used in the baseline was measured in volume unit. This datum was used for unit conversion
Purpose of 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
Comments	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	BF_y
Data unit	Tonnes of wood per tonnes of ceramic pieces produced
Description	Consumption of non-renewable biomass per tonnes of ceramic devices produced in year y
Source of data	Historical data from ceramic owner.
Value applied	0.2965
Justification of choice of data or description of measurement methods and procedures applied	The value was based on the historical situation at the site of the project activity prior to the implementation of the project. 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 parameter can not be updated because the historical situation does not exist anymore as a result of the CDM project activity⁵⁸. The value was employed to calculate the real amount of wood displaced to maintain the ceramic production in the baseline scenario.
Purpose of Data	The purpose of the data is to provide the consumption of non-renewable biomass per tonnes of ceramic units produced in a year in the baseline scenario.

⁵⁸ Methodological Tool: "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period". Available at: <http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-11-v3.0.1.pdf>. Last visit on: January, 2018.

Comments	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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4.2 Data and Parameters Monitored

Data / Parameter	NCV_{biomass}
Data unit	TJ/tonne of wood
Description	Net Calorific Value of non-renewable woody biomass that is substituted
Source of data	AMS-I.E.: Switch from non-renewable biomass for thermal applications by the user - Version 7.0. Available at: https://cdm.unfccc.int/methodologies/DB/9LFOR81TCT5FLI1AJYP46CQY8O2J79 Last visit on: February 15 th , 2018. The value informed in the applied methodology is based on IPCC default for wood fuel.
Value applied	0.015 TJ/Tonne
Justification of choice of data or description of measurement methods and procedures applied	The sources of data is the IPCC default for wood fuel, as recommended in the applied methodology.
Purpose of Data	This value provides the energy generated by the amount of wood that would be used in the absence of the project.
Comments	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	PR_y
Data unit	Tonnes of ceramic devices
Description	Production of ceramic devices
Source of data	Controlled by the project proponent.

Description of measurement methods and procedures to be applied	The amount of ceramic pieces produced is monitored by counting the total production of one year, based on data from last crediting period. This parameter will be monitored by the project proponent (meaning the ceramic owner). The amount will be acquired by counting the total production of the period considered for the ceramic factory and data will be aggregated on a monthly and yearly basis.
Frequency of monitoring/recording	Annually.
Value applied	62,368
Monitoring equipment	No monitoring equipment is used to determine this parameter. Production is counted by trained personnel on <i>Lopes</i> ceramic.
QA/QC procedures to be applied	The ceramic has 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.
Purpose of data	This parameter is used to calculate baseline emissions and the total energy produced 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 tonnes produced. It was rechecked according to the biomass employed in the ceramic kilns.
Comments	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	$Q_{renbiomass}$
Data unit	Tonnes per year
Description	Amount of renewable biomass utilized
Source of data	Data will be monitored through all the receipts and invoices of biomass received by the ceramic company.
Description of measurement methods	The amount of biomass 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 m ³ , therefore it is necessary the conversion to tonnes through the specific gravity of biomass

and procedures to be applied

described below. In addition, the wood from sustainable management was converted to m³ from st as described below.

The following table presents the conversion factor for Native wood from Forest Management and the specific value in order to convert m³ to tonnes:

Conversion factor from “m ³ stereo” to ‘m ³ ’	
Native wood from forest management	0.339

Biomass	Specific gravity (tonnes/m ³)
<i>Algaroba</i> Wood	0.760
Coconut husk	0.500
Sugar cane bagasse	0.150
Cashew tree residues	0.420
<i>Aveloz</i> wood	0.560
Native wood from Forest Management	0.913
Sawdust	0.245
Residues from tree pruning	0.590
Eucalyptus wood from reforestation	0.510

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: https://ainfo.cnptia.embrapa.br/digital/bitstream/CNPF-2009-09/33614/1/pag-99_106.pdf Last visit on: 02/01/2018. - Coconut husk PINHEIRO, G. F.; RENDEIRO, G.; PINHO J. T. Densidade Energética de Resíduos Vegetais. 2006. Available at: https://www.lippel.com.br/dados/download/02-05-2014-15-30Densidade-Energetica-de-Residuos-Vegetais.pdf. Last visit on: 02/01/2018. - Sugar cane bagasse TEIXEIRA, F.A; PIRES, A.V; NASCIMENTO, P.V.N. Bagaço de cana-de-açúcar na alimentação de bovinos. REDVET - Revista Eletrotécnica de Veterinária 1695-7504, 2007, volume VIII, n.06. Available at: http://www.veterinaria.org/revistas/redvet/n060607/060708.pdf. Last visit on: 02/01/2017 - Cashew tree residues 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. - Aveloz wood F.L.O. NANG'AYO; M.G. HILL; D.J. WRIGHT. Potential hosts of <i>Prostephanus truncatus</i> (Coleoptera: Bostrichidae) among native and agroforestry trees in Kenya. Bulletin of Entomological Research (2002) 92, 499–506 - Native wood from forest management Considered to be the same as for native firewood. Please check parameter p wood on section 4.1 of the VCS PD for more information.- Sawdust - Sawdust M. A. Brand, UNIPLAC; V. J. da Costa, UNIPLAC; A. Durigon e M. Amorin, TRACTEBEL ENERGIA. Determinação das Propriedades Energéticas de Resíduos de Madeira em Diferentes Períodos de Armazenamento Available at: http://www.tractebelenergia.com.br/wps/wcm/connect/304a87b4-66c9-4dbc-9494-
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	b4e6896c4328/numero3.pdf?MOD=AJPERES&CACHEID=304a87b4-66c9-4dbc-9494-b4e6896c4328>. Last visit on: 02/01/2018. - Residues from tree pruning This value was obtained by the average value between the specific gravity of each type of tree pruning (mango, jaca fruit and sirigüela wood) BARROSO, et. al. Consumption of firewood and production of waste of wood in Federal District, 2009. VALADARES, L.B. Propriedades da madeira e do carvão vegetal de Artocarpus heterophyllus Lamk, 2013. - Eucalyptus wood from reforestation 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 4, Table 4.13. Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_04_Ch4_Forest_Land.pdf. Value for Eucalyptus robusta was considered. Last visit on: 22/02/18.																				
Frequency of monitoring/recording	Monthly																				
Value applied	The applied value was based on the last Crediting period: <table border="1"> <thead> <tr> <th colspan="2">J L Silva Ceramic</th></tr> <tr> <th>Biomass</th><th>Q_{renbiomass}</th></tr> </thead> <tbody> <tr> <td>Algaroba wood</td><td>2,054.01</td></tr> <tr> <td>Coconut husk</td><td>157.05</td></tr> <tr> <td>Sugar cane bagasse</td><td>609.30</td></tr> <tr> <td>Cashew tree residues</td><td>1,224.95</td></tr> <tr> <td>Aveloz wood</td><td>233.11</td></tr> <tr> <td>Native wood from forest management</td><td>530.74</td></tr> <tr> <td>Sawdust / Forest residues</td><td>144.87</td></tr> <tr> <td>Residues from tree pruning</td><td>986.57</td></tr> </tbody> </table>	J L Silva Ceramic		Biomass	Q_{renbiomass}	Algaroba wood	2,054.01	Coconut husk	157.05	Sugar cane bagasse	609.30	Cashew tree residues	1,224.95	Aveloz wood	233.11	Native wood from forest management	530.74	Sawdust / Forest residues	144.87	Residues from tree pruning	986.57
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Sawdust / Forest residues	144.87																				
Residues from tree pruning	986.57																				

	It is expected the usage of other types of biomasses, such as <i>Eucalyptus</i> wood since its renewable origin can be verified. The amount of each biomass and type of biomass employed may change according to its availability.
Monitoring equipment	No monitoring equipment is used to determine this parameter.
QA/QC procedures to be applied	The ceramic has monthly records of the quantity of biomass acquired. It will be rechecked according to the receipts of purchase.
Purpose of data	This parameter will be used to : a. Compare the total energy produced in the current credit period to the thermal energy that would be necessary according to the VCS PD estimates (QA/QC table); b. Demonstrate that the Project fits in small scale category for biomass renewable energy projects (capacity <45MWth); Calculation of leakage emissions due to competing use of biomass.
Calculation method	The energy generated by the amount of renewable biomass will be calculated based on the Net Calorific Value of each biomass, as can be seen on the VCUs Estimatives Calculation spreadsheet. Values in the receipts from biomass providers may be described in m³ or in tonnes, therefore if the receipts are in m³ it is necessary the conversion to tonnes through the specific gravity of each biomass.
Comments	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	Origin of Renewable Biomass
Data unit	Not applicable
Description	Renewable origin of the biomass
Source of data	Controlled by the project proponent
Description of measurement methods and procedures to be applied	This information will be given by the biomasses providers. The biomasses (algarroba wood, coconut husk, sugar cane bagasse, cashew tree residues, aveloz wood, native wood from forest management, sawdust / forest residues, residues from tree pruning

	and eucalyptus wood) are considered renewable as fulfilling the options described in the methodology applied.
Frequency of monitoring/recording	Each monitoring period.
Value applied	Not applicable.
Monitoring equipment	No monitoring equipment was used to determine this parameter.
QA/QC procedures to be applied	The biomasses were considered renewable as they were in accordance with the definition given by the Annex 18 of the 23 rd meeting of the Executive Board from the Clean Development Mechanism ⁵⁹ .
Purpose of data	The objective of this data is monitoring the origin of the different types of biomasses utilized in the project.
Calculation method	Not applicable.
Comments	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 ₂ e
Description	Leakage resulted from the non-renewable biomass
Source of data	Monitored
Description of measurement methods and procedures to be applied	The sources of leakages predicted in the applied methodology will be monitored. Scientific articles, official statistical data, regional and national surveys will be assessed in order to ensure that there was no leakage from non-renewable biomass (or to estimate the leakage). Please see Section 3.3: "Leakage".
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	No monitoring equipment is used to determine this parameter

⁵⁹ CDM – Executive Board. Annex 18 definition of renewable biomass. EB 23. Available at: <http://cdm.unfccc.int/EB/023/eb23_repan18.pdf>. Last visited on December 19th, 2017.

QA/QC procedures to be applied	Data available regarding the ceramic industries fuel consumption will be used to monitor the leakage.
Purpose of 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.
Comments	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	$f_{NRB,y}$
Data unit	Percentage
Description	Fraction of woody biomass used in the absence of the project activity in year y that can be established as non-renewable biomass using survey methods or government data or approved default country specific fraction of non-renewable biomass (f_{NRB}) values available on the CDM website.
Source of data	Survey methods.
Description of measurement methods and procedures to be applied	The monitoring of this parameter will be based on national and international articles, databases and data monitored by the project developer such as project activities at the same region. The sources will provide information about the availability of woody biomass in the Caatinga biome.
Frequency of monitoring/recording	Annually.
Value applied	92.52
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 <i>Caatinga</i> biome

Purpose of data	The purpose of the data is to determine the fraction of biomass (wood) which would be used in the absence of the project activity in year y.
Calculation method	More detailed information in the VCU Estimatives spreadsheet.
Comments	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	Renewable biomass surplus																							
Data unit	tonnes or m³																							
Description	Amount of renewable biomass available																							
Source of data	Monitored																							
Description of measurement methods and procedures to be applied	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 databases every monitoring period. These sources will provide information about the biomass availability in the project activity's region. The bibliographic references are described on the section 3.3 “Leakage”.																							
Frequency of monitoring/recording	Annually																							
Value applied	<table><tr><th>Biomass surplus</th><th>Surplus</th><th>Year</th></tr><tr><td>Cashew tree residues</td><td>176,316 t</td><td>2013</td></tr><tr><td>Algaroba wood</td><td>1,9000,000 t</td><td>2007</td></tr><tr><td>Native wood from forest management</td><td>1,800,022.5 m³</td><td>2012</td></tr><tr><td>Coconut husk</td><td>2,335,091.5 t</td><td>2017</td></tr><tr><td>Sawdust / Forest residues</td><td>248,835.2 t</td><td>2016</td></tr><tr><td>Eucalyptus wood from reforestation</td><td>22,530,450 t</td><td>2017</td></tr></table>			Biomass surplus	Surplus	Year	Cashew tree residues	176,316 t	2013	Algaroba wood	1,9000,000 t	2007	Native wood from forest management	1,800,022.5 m³	2012	Coconut husk	2,335,091.5 t	2017	Sawdust / Forest residues	248,835.2 t	2016	Eucalyptus wood from reforestation	22,530,450 t	2017
Biomass surplus	Surplus	Year																						
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Sawdust / Forest residues	248,835.2 t	2016																						
Eucalyptus wood from reforestation	22,530,450 t	2017																						

	Residues from tree pruning	Undefined ⁶⁰	-
	Sugar cane bagasse	3,980,340 t	2016
	Aveloz wood	1,008,000 t	2008
	Detailed information in section 3.3 – LEAKAGE.		
Monitoring equipment	No monitoring equipment is used to determine this parameter.		
QA/QC procedures to be applied	Data available regarding the ceramic industry fuel consumption will be employed to monitor the leakage.		
Purpose of 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 will be compared to total biomass available.		
Comments	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:	$D_{f,m}$
Data unit:	Kilometer
Description:	Return trip road distance between the origin and destination of freight transportation activity f in monitoring period m
Source of data:	Records of vehicle operator or records by project participants
Description of measurement methods and procedures to be applied:	This parameter is record by the ceramic in a sheet with the distance between the ceramic and the biomass provider. Information in section 3.2 – Project Emissions
Frequency of monitoring/recording:	Annually

⁶⁰ Please view Section 3.3 (Pages 28 for more information about this type of biomass).

Value monitored:	To be monitored.
Monitoring equipment:	Determined once for each freight transportation activity f for a reference trip using the vehicle odometer or any other appropriate sources (e.g. on-line sources).
QA/QC procedures to be applied:	-
Purpose of the data	This parameter is used to calculate project emissions.
Calculation method:	Information in section 4.2 – Project Emissions
Any comment:	Values will be monitored at Monitoring Report.

Data Unit / Parameter:	FR_{f,m}
Data unit:	tonnes
Description:	Total mass of freight transported in freight transportation activity f in monitoring period m
Source of data:	Records by project participants or records by truck operators
Description of measurement methods and procedures to be applied:	This parameter is record by the ceramic in a sheet with the distance between the ceramic and the biomass provider. Information in section 3.2 – Project Emissions
Frequency of monitoring/recording:	Annually
Value monitored:	To be monitored.
Monitoring equipment:	Through a scale to know the weight of biomass.
QA/QC procedures to be applied:	-
Purpose of the data	This parameter is used to calculate project emissions.
Calculation method:	Information in section 3.2 – Project Emissions
Any comment:	Values will be monitored at Monitoring Report.

4.3 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 4.2 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 Qrenbiomass and PRy). These parameters are register by the ceramic factory employees 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. Ceramic personnel are also responsible to store invoices, receipts of sales and other documents related to purchase or acquisition of biomass.

Periodically, Sustainable Carbon will perform an analysis to verify if biomass and production data are being correctly filled in the monitoring spreadsheets. Analysis on production data will be performed by a series of comparisons between different measurement points of production (molding machine, kiln loading and kiln unloading or sales) to detect inconsistencies or suspicious data. For biomass data analysis it will consider 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 sources of leakages predicted in the applied methodology will be 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 shall 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 will be 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. Everaldo Lopes da Silva and Mrs Ivone Alexandre from Lopes Ceramic. Sustainable Carbon technical team (including those members described on Section 1.3) was also involved in the project development.

5 SAFEGUARDS

5.1 No Net Harm

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 using the ashes as fertilizer.

The burning of the new biomasses also emits particulate material and CO₂, as well as when using native wood. However, GHG emission reductions will be improved since they are renewable biomasses which have carbon neutral lifecycles.

5.2 Environmental Impact

Table 8. Summary of the environmental impacts

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

The project does not cause any additional negative impacts as all generated energy is a result of the best natural resources available. On the contrary, the project activity 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.

Environmental Laws related to the plant activities

The Environmental National Policy, Política Nacional do Meio Ambiente - PNMA, instituted by the Brazilian Law 6.938/81, 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). However, an EIA was not required for the project activity.

Besides that, as mentioned in the section 1.11, the CONAMA Resolution nº 237/97 establishes that ceramic companies must have an operational license as well as a clay extraction license, both emitted by competent municipal, state or federal authority, under a valid time, *Lopes* ceramic have an Operating License (LO Nº 03.16.10.004892-8) emitted by the Municipal Secretary of the Environment and valid until November 30th 2017. The new license was required at August 02nd 2017 and the protocol is nº 010388/2017. *Lopes* Ceramic does not have own clay pit. *JL Silva* purchase the clay from *E J de Franca - ME* whose main activity is the extraction and processing of clay. Lastly the business license of *Lopes* ceramic factory is nº 641 emitted by Lajedo Municipal Government valid until December, 31st 2017, the new license was already required.

5.3 Local Stakeholder Consultation

The formal stakeholder consultation was carried out during the validation of the project. Currently, the company's environmental management area is available to receive any kind of suggestions and comments from the community through telephone, e-mail or even personally.

5.4 Public Comments

Not applicable.