

VTRM RENEWABLE ENERGY

Document Prepared By Waycarbon Soluções Ambientais e Projetos de Carbono Ltda

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1 PROJECT DETAILS

1.1 Summary Description of the Project and its Implementation Status

VTRM Renewable Project (hereinafter referred as VTRM Renewable Energy) is a grouped project that consists on the implantation and operation of wind power plants (WPPs) in Brazil. All WPPs will supply clean electricity to the Brazilian National Interconnected System (SIN).

VTRM Renewable Energy will reduce greenhouse gases (GHG) emissions, avoiding electricity generation through fossil fuels sources. Clean and renewable electricity supply will bring an important contribution to environmental sustainability, reducing the GHG emissions that would occur in the absence of this project.

The baseline scenario is the same scenario existing before the start of implementation of the project activity, which is: “the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin calculations according to “Tool to calculate the emission factor for an electric system””.

The initial project activity instance is a complex called Ventos do Araripe III Complex, composed by fourteen wind power plants. These WPPs, their installed capacity, main technology employed (numbers and model of wind power turbines (WPTs)), location, and operation starting date are presented in table.

The estimated annual average GHG emission reductions is **652,150 tCO₂** and total GHG emission reductions for the crediting period is **6,521,501 tCO₂**.

The total GHG emission reductions generated in this monitoring period is **876,160 tCO₂e**.

Table 01: Initial Project Activity Instances of VTRM Renewable Energy

WPPs	Installed Capacity	Main Technology Employed	Location (City/State)	Operation Starting Date ¹ (dd/mm/yyyy)
Ventos do Araripe III Complex	358.8 MW	156 WPTs (with 2.3 MW)	Araripina/PE, Simões/PI and Curral Novo/PI	09/12/2016
Ventos de Santo Estevão I	25.3	11 WPTs with 2.3 MW each	Araripina/PE	23/06/2017
Ventos de Santo Estevão II	25.3	11 WPTs with 2.3 MW each	Araripina/PE	18/05/2017
Ventos de Santo Estevão III	29.9	13 WPTs with 2.3 MW each	Araripina/PE	09/12/2016
Ventos de Santo Estevão IV	29.9	13 WPTs with 2.3 MW each	Araripina/PE	03/10/2017
Ventos de Santo Estevão V	27.6	12 WPTs with 2.3 MW each	Araripina/PE	13/12/2016
Ventos de São Virgílio I	29.9	13 WPTs with 2.3 MW each	Simões/PI	30/08/2017
Ventos de São Virgílio II	29.9	13 WPTs with 2.3 MW each	Simões/PI and Curral Novo/PI	10/02/2017
Ventos de São Virgílio III	20.7	9 WPTs with 2.3 MW each	Araripina/PE	29/09/2017
Ventos de Santo Onofre IV	27.6	12 WPTs with 2.3 MW each	Araripina/PE	14/06/2017
Ventos de Santo Augusto I	18.4	8 WPTs with 2.3 MW each	Araripina/PE	18/02/2017
Ventos de Santo Augusto II	27.6	12 WPTs with 2.3 MW each	Araripina/PE	29/12/2016
Ventos de Santo Augusto VI	29.9	13 WPTs with 2.3 MW each	Araripina/PE	24/03/2017

¹ Operation starting date of each plant can be cross-checked with ANEEL Dispatches that authorizes each plant to start operation.

WPPs	Installed Capacity	Main Technology Employed	Location (City/State)	Operation Starting Date¹ (dd/mm/yyyy)
Ventos de Santo Augusto VII	18.4	8 WPTs with 2.3 MW each	Araripina/PE	04/03/2017
Ventos de Santo Augusto VIII	18.4	8 WPTs with 2.3 MW each	Araripina/PE	24/12/2016

1.2 Sectoral Scope and Project Type

The sectoral scope applied is sectoral scope 1 – Energy (Renewable/Non-Renewable). VTRM Renewable Energy is a grouped project.

1.3 Project Proponent

Table 02: Project Proponents

Organization name	VTRM ENERGIA PARTICIPAÇÕES S.A.
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1.4 Other Entities Involved in the Project

Not applicable.

1.5 Project Start Date

According to the VCS Standard, version 3.7, the project start date is the date on which the project began generating GHG emission reductions or removals. Therefore, the project start date of VTRM Renewable Energy is 09/12/2016 (dd/mm/yyyy) (*Operation Starting Date of the First Turbine of the Complex Ventos do Araripe III as defined by ANEEL Dispatch 3216, issued at 08/12/2016*).

1.6 Project Crediting Period

The project crediting period shall be a maximum of ten years which may be renewed at most twice. The first crediting period of the project will be from 09/12/2016 to 08/12/2026.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Table 03: Project Scale

Project Scale	
Project	
Large project	X

Table 04: Estimated GHG Emission Reductions

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
2016	7,107
2017	528,551
2018	623,694
2019	675,590
2020	675,590
2021	675,590
2022	675,590
2023	675,590
2024	675,590
2025	675,590
2026	633,019
Total estimated ERs	6,521,501
Total number of crediting years	10
Average annual ERs	652,150

1.8 Description of the Project Activity

The project activity is a grouped project formed by the installation of greenfield grid-connected renewable energy power generation. All project instances of the project activity should include greenfield wind power plants.

The baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new

generation sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”.

The clean and renewable electricity delivered to Brazilian Interconnected System by the project provides an important contribution to environmental sustainability by reducing carbon dioxide emissions that otherwise would have occurred in the absence of the project. The project activity reduces GHG emissions avoiding electricity generation from fossil fuel sources, which would be generated (and emitted) in the absence of the project.

The emission reduction provided by the project is calculated according version 19.0 of the Large-Scale Consolidated Methodology ACM0002 – Grid-connected electricity generation from renewable sources (hereafter called ACM0002 Methodology).

Table below shows some technical characteristics of the plants. Installed capacity is evidenced by Operation License of each WPP. Plan Load Factor, by report issued on 23/10/2017 (dd/mm/yyyy) by engineering company AWS TruePower. Number of turbines and individual capacity (Source: Operation License of each Plant) are again presented in table 05 to summarize technical characteristics. The average lifetime of the equipment is 20 years².

Table 05: Technical Characteristics of VTRM Renewable Energy

WPPs	Installed Capacity (MW)	Plant Load Factor (%)	WPTs
Ventos de Santo Estevão I	25.3	47.3%	11 WPTs with 2.3 MW each
Ventos de Santo Estevão II	25.3	46.6%	11 WPTs with 2.3 MW each
Ventos de Santo Estevão III	29.9	46.1%	13 WPTs with 2.3 MW each
Ventos de Santo Estevão IV	29.9	48.0%	13 WPTs with 2.3 MW each
Ventos de Santo Estevão V	27.6	49.4%	12 WPTs with 2.3 MW each
Ventos de São Virgílio I	29.9	47.7%	13 WPTs with 2.3 MW each
Ventos de São Virgílio II	29.9	50.7%	13 WPTs with 2.3 MW each
Ventos de São Virgílio III	20.7	49.9%	9 WPTs with 2.2 MW each
Ventos de Santo Onofre IV	27.6	51.3%	12 WPTs with 2.3 MW each

² ANEEL (2009). Manual de Controle Patrimonial do Setor Elétrico. Annex of Normative Resolution nº 367/2009, 02 June 2009. Available at: http://www.aneel.gov.br/cedoc/aren2009367_2_primeira_Ver.pdf. Last access on November 27, 2018.

WPPs	Installed Capacity (MW)	Plant Load Factor (%)	WPTs
Ventos de Santo Augusto I	18.4	47.5%	8 WPTs with 2.3 MW each
Ventos de Santo Augusto II	27.6	48.4%	12 WPTs with 2.3 MW each
Ventos de Santo Augusto VI	29.9	49.7%	13 WPTs with 2.3 MW each
Ventos de Santo Augusto VII	18.4	49.9%	8 WPTs with 2.3 MW each
Ventos de Santo Augusto VIII	18.4	48.8%	8 WPTs with 2.3 MW each

1.9 Project Location

Coordinates of each plant of Ventos do Araripe III Complex are presented as follows:

- Ventos de Santo Estevão I: LAT 315.569 / LONG 9.143.661 (UTM)
- Ventos de Santo Estevão II: LAT 316.754 / LONG 9.144.168 (UTM)
- Ventos de Santo Estevão III: LAT 318.340 / LONG 9.143.710 (UTM)
- Ventos de Santo Estevão IV: LAT 319.391 / LONG 9.140.103 (UTM)
- Ventos de Santo Estevão V: LAT 322.191 / LONG 9.140.116 (UTM)
- Ventos de São Virgílio I: LAT 310.771 / LONG 9.1386.47 (UTM)
- Ventos de São Virgílio II: LAT 316.605 / LONG 9.139.075 (UTM)
- Ventos de São Virgílio III: LAT 310.200 / LONG 9.142.579 (UTM)
- Ventos de Santo Onofre IV: LAT 310.245 / LONG 9.142.098 (UTM)
- Ventos de Santo Augusto I: LAT 315.154 / LONG 9.144.770 (UTM)
- Ventos de Santo Augusto II: LAT 314.649 / LONG 9.139.381 (UTM)
- Ventos de Santo Augusto VI: LAT 315.149 / LONG 9.147.550 (UTM)
- Ventos de Santo Augusto VII: Lat 314.976 / LONG 9.146.227 (UTM)
- Ventos de Santo Augusto VIII: Lat 308.651 / LONG 9.158.924 (UTM)

1.10 Conditions Prior to Project Initiation

VTRM Renewable Energy activity is a grouped project that will install grid-connected greenfield wind power plants in Brazil. All wind power plants (WPPs) will supply clean electricity to the Brazilian National Interconnected System (SIN).

Prior to the implementation of the project activity, no wind power plant was operational in the location where project instances are and will be implemented. The baseline scenario is the same as the conditions existing prior to project initiation as described at section 2.4.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

VTRM Renewable Energy activity has all licenses necessary to build and operate entrepreneurship. The most relevant local laws and regulations related to VTRM Renewable Energy correspond to the environmental laws and National Agency of Electric Energy (ANEEL) approval. The environmental licensing is a legal obligation prior to the installation of any entrepreneurship or activity potentially pollutant or degrading to the environment in Brazil. The Brazilian licensing process presents as an important characteristic the community participation on decision through Public Audiences.

Operation Licenses of each wind power plant are valid. Their number and expiration date are showed below. ANEEL Dispatch that authorizes each Special Purpose Company (SPCs) to construct and operate each plant are also presented.

- Ventos de Santo Estevão I: Operation License N° 03.17.04.001303-8 / Expiration Date: 16/04/2021. ANEEL Dispatch 451, issued in 01/09/2014.
- Ventos de Santo Estevão II: Operation License N° 03.17.04.001300-7 / Expiration Date: 16/04/2021. ANEEL Dispatch 452, issued in 01/09/2014.
- Ventos de Santo Estevão III: Operation License N° 03.16.11.005145-1/ Expiration Date: 24/11/2020. ANEEL Dispatch 453, issued in 01/09/2014.
- Ventos de Santo Estevão IV: Operation License N° 03.17.07.002272-7/ Expiration Date: 17/07/2021. ANEEL Dispatch 181, issued in 08/05/2015.
- Ventos de Santo Estevão V: Operation License N° N° 03.16.11.005144-4/ Expiration Date: 24/11/2020. ANEEL Dispatch 454, issued in 01/09/2014.
- Ventos de São Virgílio I: Operation License D000246/17 / Expiration Date: 31/05/2021. ANEEL Dispatch 169, issued in 07/05/2015.
- Ventos de São Virgílio II: Operation License D000677/16/ Expiration Date: 18/11/2020. ANEEL Dispatch 390, issued in 19/08/2015.
- Ventos de São Virgílio III: Operation License D000247/17/ Expiration Date: 31/05/2021. ANEEL Dispatch 170, issued in 07/05/2015.

- Ventos de Santo Onofre IV: Operation License D000075/17/ Expiration Date: 14/02/2021. ANEEL Dispatch 180, issued in 08/05/2015.
- Ventos de Santo Augusto I: Operation License D000068/17/ Expiration Date: 10/02/2021. ANEEL Dispatch 423, issued in 14/08/2014.
- Ventos de Santo Augusto II: Operation License D000678/16/ Expiration Date: 18/11/2020. ANEEL Dispatch 424, issued in 14/08/2014.
- Ventos de Santo Augusto VI: Operation License D000076/17/ Expiration Date: 14/02/2021. ANEEL Dispatch 460, issued in 02/09/2014.
- Ventos de Santo Augusto VII: Operation License D000077/17/ Expiration Date: 14/02/2021. ANEEL Dispatch 427, issued in 21/08/2014.
- Ventos de Santo Augusto VIII: Operation License D000679/17/ Expiration Date: 18/11/2020. ANEEL Dispatch 461, issued in 02/09/2014.

1.12 Ownership and Other Programs

1.12.1 Project Ownership

For each plant, it was created a Special Purpose Company (SPC) due to tax reasons. A Holding called Ventos de São Estevão Holding S.A is the owner of all SPCs. VTRM Energia Participações S.A (VTRM) is the only shareholder of this holding.

The Financial Statement of Ventos de São Estevão Holding S.A shows that VTRM owns Ventos de São Estevão Holding S.A (Pages 08 and 09). It also shows that Ventos de São Estevão Holding S.A owns each Special Purpose Company that owns each plant (page 10). This financial statement is audited by PwC and it was issued at August 15, 2018.

Therefore, VTRM is the owner of the project.

1.12.2 Emissions Trading Programs and Other Binding Limits

Not applicable. The project is not included in any other emission trading program or mechanism.

1.12.3 Other Forms of Environmental Credit

Not applicable. The project has not sought or received any other form of GHG-related environmental credit, including renewable energy certificate.

1.12.4 Participation under Other GHG Programs

Not applicable. The project was not registered and is not seeking registration under any other GHG programs

1.12.5 Projects Rejected by Other GHG Programs

Not applicable. The project was not rejected by any other GHG programs.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

VTRM Renewable Energy is a grouped project. This project is formed by grid-connected greenfield wind power plants located in Brazil. The project applies Consolidated Methodology ACM0002 – Grid-connected electricity generation from renewable sources, version 19.0.

The eligibility criteria for inclusion of new instances of each project activity are:

1. Meet the applicability conditions of Consolidated Methodology ACM0002 – Grid-connected electricity generation from renewable sources. This shall be evidenced by the document of inclusion of each new instance.
2. As the new project instances have to be greenfield projects, the baseline scenario shall be the one given by the Consolidated Methodology ACM0002 – Grid connected electricity generation from renewable sources, version 19.0, which is “the baseline scenario is electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in “TOOL07: Tool to calculate the emission factor for an electricity system”.
3. New project instances must be greenfield wind power plants connected to the grid. This shall be evidenced by Environmental Licenses (Previous License, Installation License or Operation License).
4. New project instances must be located in Brazil (Geographic area of the project). This shall be evidenced by Environmental Licenses (Previous License, Installation License or Operation License).
5. Each new project instances must face financial constraints and demonstrate additionality using investment analysis method. The financial analysis for each instance will be compared to an appropriated benchmark scenario and shall be evidenced by additionality analysis in the document of inclusion of each new instance. The steps of the Methodological Tool for the Demonstration and Assessment of additionally (version 07.0.0) must be followed:

Step 0: Demonstration whether the proposed project activity is the first-of-its-kind;

Step 1: Identification of alternatives to the project activity;

Step 2: Investment analysis;

Step 3 Barriers analysis; and

Step 4 Common practice analysis

The conditions of the Investment Analysis Tool (version 09.0) and the Common Practice Tool (version 03.1) must also be meet.

6. Each new project instance should detail its own monitoring report with sufficient technical, financial, geographic and other relevant information to demonstrate compliance with the applicable set of eligibility criteria and enable sampling by the validation/verification body. This shall be evidenced by the document of inclusion of each new instance
7. Have a start date that is the same as or later than the grouped project start date (09/12/2016) This shall be evidenced by legal documents related to the operational starting date of the new

project instance (Operation License, ANEEL Dispatch or other legal document that shows the operational starting date of the new project instance);

8. Have evidence of the new project instance ownership. The project owner of the new project instance shall provide evidence of having ownership over new project instance. This shall be evidenced by legal documents that proof ownership over the new project instance.

Leakage Management

Not applicable. According ACM0002, no leakage emissions are considered. The emissions potentially arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport etc.) are neglected.

Commercially Sensitive Information

Not applicable. No commercially sensitive information has been excluded from the public version of this project

Sustainable Development

VTRM Renewable Energy contributes to the sustainable development once contributing to the economic growth without compromising the future generations, respecting the concept of Sustainable Development, established by Brundtland Report, elaborated by the World Commission on Environment and Development. This report defines the term “sustainable development” as “the development that satisfies the present necessities, without compromising the capacity of future generations of supplying their own necessities.

Through the following actions, VTRM Renewable Energy contributes to the sustainable development of its region and country:

- It reduces greenhouse gas emissions (CO₂) from the Brazilian Interconnected System;
- It generates extra income for the landowners, while they can continue using the area for other activities, thus it increases and diversifies the lands productivity;
- Besides generating income for the landowners, it stimulates the regional economy by increasing tax revenues for the local government and direct and indirect job opportunities for local workers and service suppliers. The resulting economic stimulus will improve capital stock in the region, which can allow investment in the infrastructure, productive capacity and consequently the satisfaction of the population's basic needs. Thus, it can promote a virtuous cycle in the local economy;
- The described economic stimulus goes along with a general improvement of the local infrastructure such as road, electricity transmission system and stimulus for education;
- It will use equipment which have a domestic content and therefore induce the development of national technology and improvement of domestic know-how. By promoting the establishment and growth of the necessary industry equipment and services, the project will contribute to the increasing availability of wind generation technology, which will, consequently, reduce maintenance costs and risks of the technology in the country;
- The project operation requires services from skilled operators and maintenance staff and therefore stimulates the development of a proficient tertiary sector in the region, thus creating opportunities for education, professionalization and employment;

- It is an important complement and diversification to the run-of-river hydroelectric generation. As Brazil's hydro and wind regimes are largely complementary, their combination allows to partially compensate the lack of hydropower storage capacity with minimal installation of thermal power generation units, while still providing enough energy security based on a portfolio of these complementary renewable sources.

Further Information

Not applicable.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

The methodology applied to the Project is ACM0002: "Grid-connected electricity generation from renewable sources" (version 19.0)³. This methodology also refers to the following tools:

- (a) TOOL01: Methodological Tool "Tool for the demonstration and assessment of additionality", version 07.0.0;
- (b) TOOL07: Methodological Tool "Tool to calculate the emission factor for an electricity system", version 07.0;
- (c) TOOL24: Methodological Tool "Common Practice", version 03.1;
- (d) TOOL27: Methodological Tool "Investment Analysis", version 08.0

2.2 Applicability of Methodology

In this section, project proponents show how the project activity meets each of the ACM0002 applicability condition: "Grid-connected electricity generation from renewable sources" (version 19.0).

Applicability Condition 01:

ACM0002 methodology is applicable to grid-connected renewable energy power generation project activities that:

- (a) Install a greenfield power plant;
- (b) Involve a capacity addition to (an) existing plant(s);
- (c) Involve a retrofit of (an) existing operating plants/units;
- (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or

³ Available on the UNFCCC CDM website.

- (e) Involve a replacement of (an) existing plant(s)/unit(s).

VTRM Renewable Energy is a grouped project that involves greenfield wind power plants. Therefore, option “a” is applied.

Applicability Condition 02:

The methodology is applicable under the following conditions:

- (a) The project activity may include renewable energy power plant/unit of one of the following types: hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;
- (b) In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.

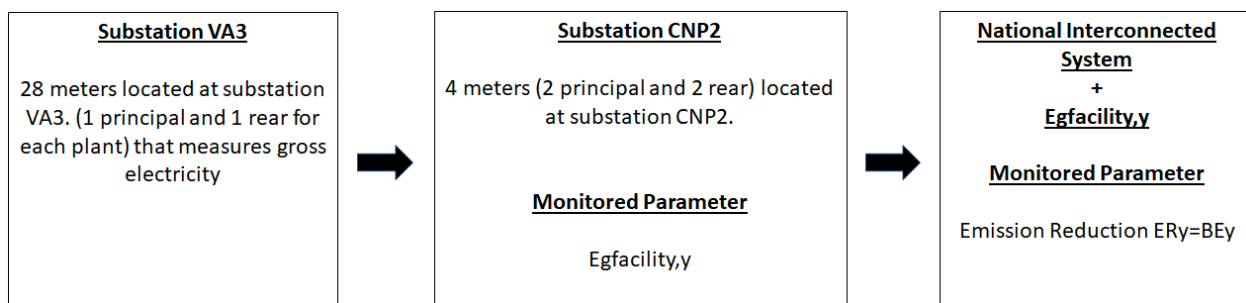
VTRM Renewable Energy is a grouped project that involves greenfield wind power plants. Therefore, option “a” is applied. All other applicability conditions of ACM0002 methodology are not applied to VTRM Renewable Energy once the project involves greenfield wind power plants.

2.3 Project Boundary

Table 06: Project Boundaries

Source		Gas	Included?	Justification/Explanation
Baseline	CO ₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO ₂	Yes	Main emission source
		CH ₄	No	Minor emission source
		N ₂ O	No	Minor emission source
		Other	Not applicable	Not applicable
Project	There is no project emission	CO ₂	No	According to ACM0002: “Grid-connected electricity generation from renewable sources”, There is no project emissions for wind power plants.
		CH ₄	No	
		N ₂ O	No	
		Other	Not applicable	

The diagram below shows the physical locations of the various installations or management activities taking place as part of the initial project instances.



2.4 Baseline Scenario

According to VCS Standard, Version 3.7, the determination of baseline scenario of a Grouped project is based upon the initial project activity instances. The initial project activity instances are those that are included in the project description at validation and shall include all project activity instances currently implemented on the issue date of the project description.

If the project activity is the installation of a Greenfield power plant, the baseline scenario is electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in “TOOL07: Tool to calculate the emission factor for an electricity system”.

2.5 Additionality

The demonstration of additionality follows the CDM Tool “Tool for the demonstration and assessment of additionality”, version 07.0.0.

The tool provides a step-wise approach to demonstrate and assess the additionality of a project activity.

These steps are:

- Step 0 Demonstration whether the proposed project activity is the first-of-its-kind;
- Step 1 Identification of alternatives to the project activity;
- Step 2 Investment analysis;
- Step 3 Barriers analysis; and
- Step 4 Common practice analysis

Step 0. Demonstration whether the proposed project activity is the first-of-its-kind

This step is not applied once the proposed project activity is not the first-of-its-kind.

Step 2. Identification of alternatives to the project activity consistent with current laws and regulations

Define realistic and credible alternatives to the project activity(s) through the following Sub-steps:

Sub-step 1a. Define alternatives to the project activity:

The realistic alternatives to the project activity are:

- (a) P1: The project activity not implemented as a CDM project;
- (b) P2: The continuation of the current situation, that is to use all power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance. The additional power generated under the project would be generated in existing and new grid-connected power plants in the electricity system; and

Sub-step 1b. Consistency with mandatory laws and regulations:

The Brazilian Regulatory Framework provides autonomy to the economic agents about the investments to be done in the electric sector. Both scenarios identified are in compliance with mandatory legislation and regulations.

A brief description of Brazilian Regulatory is presented in this section. The Brazilian Regulatory Framework went through important structural and conceptual changes over the past 2 decades, resulting in three different electricity regulatory models: the state-based model (until 1995); the free market model (1995 to 2003) and the new model, implemented in 2004 and valid up to date. Under the state-owned model, the energy sector was dominated by almost exclusively state-owned and verticalized companies that covered the segments of generation, transmission and distribution. During the period of state monopoly, the major part of the currently existing generation capacity has been built, mostly consisting of large hydropower plants with important energy reservation capacity.

From 1995 on, due to lack of capacity to further finance the necessary investments for the expansion in energy generation, transmission and distribution, the government initiated a partial privatization process, structured by four main pillars: i) creation of a competitive environment (free market), with a gradual elimination of the captive consumers; ii) partial dismantling of the state owned verticalized companies by dividing and privatizing the segments of generation, transmission and distribution; iii) allowing free access to the transmission lines for generators and consumers; and iv) placing the operation and planning responsibilities to the private sector.⁴

The adoption of the free market model allowed the participation of private entities and the implementation of the Concession Law (Law No 8,987 of February 13, 1995) and promoted the construction of some renewable plants in Brazil.

Unfortunately, the model did not provide the investment in generation capacity needed to satisfy the growing demand and it resulted in an energy crisis in 2001, when energy consumption of consumers and industry was rationed, and Brazil's economic development was badly hit. As a response to this crisis, a new regulatory framework was put in place in 2004, resulting in a more active role of Brazil's government by virtually suspending the privatization process initiated in the 1990's and centralizing the functions of electricity planning at national government level,⁵ while promoting private sector investments to fund the required expansion in generation capacity. This new regulatory model provided a more efficient mechanism of power procurement between generators and distributors, primarily by creating two parallel electricity trading environments: the Regulated Contracting Environment, referred to as ACR (*Ambiente*

⁴ Aguiar F.L. *Modelo Institucional do Setor Elétrico Brasileiro*, 2007, available at http://www.realestate.br/images/File/arquivosPDF/DST_FernandoAguiar.pdf, last access on March 5, 2010

⁵ For further information, please refer to *Moody's Global Infrastructure – Regulatory Environment Improves for Brazilian Electric Utilities*, August 2008

de Contratação Regulada), where energy is finally contracted based on the lowest tariffs defined by a regulated auctioning process, and the Free Contracting Environment, referred to as ACL, or *Ambiente de Contratação Livre*) (ACL).⁶

As mentioned previously, economic agents are free to decide about the investments to be done in the electric sector, respecting Regulatory framework. Therefore, it does not exist either restrictions nor impositions to the project activity and to its alternatives. Alternatives to the project activity (P1 and P2) are plausible and consistent with mandatory laws and regulations.

Step 2. Investment analysis

According to the “*Tool for the demonstration and assessment of additionality*”, project participants shall determine whether the proposed project activity is not:

- (a) The most economically attractive or financially;
- (b) Economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs);

The investment analysis follows the CDM “Methodological tool Investment analysis”, version 08.0.

To conduct the investment analysis, the following steps must be used:

Sub-step 2a. Determine appropriate analysis method

The project generates other economic and financial benefits, in addition to revenues from the CDM. Thus, the benchmark analysis will be used for the investment analysis of the project activity.

Sub-step 2b – Option III. Apply benchmark analysis

Financial indicator identification

It will be used the equity internal rate of return (IRR) as financial indicator of the project, because it is one of the indicators most commonly used and appropriate in the investment analysis of infrastructure projects. The equity IRR calculation follows what it is indicated by the CDM “Methodological Tool Investment Analysis”, version 08.0.

Benchmark identification

The CDM “Methodological Tool Investment Analysis, version 08.0. provided and published by UNFCCC, supplies default values for expected return on equity for different project types and host countries. For electricity generation projects developed in Brazil, the expected return on equity, in real terms, is **11.87%**. This expected return will be used as the benchmark of the project activity.

Sub-step 2c. Calculation and comparison of financial indicators

Input parameters used in the investment analysis, together with a description of how the values for these parameters were obtained, are presented in this section. As recommended by *CDM project standard for programmes of activities*, version 01.0, paragraph “g”, item “iv”, the additionality of the initial project instances of this grouped project is assessed by using the actual values, applicable at the time of this Joint Project Description & Monitoring Report elaboration.

All negotiations with main suppliers of the project (CAPEX and OPEX) considered all fourteen wind power plants together as a complex⁷. Following this strategy, project owners could obtain synergy and scale.

⁶ For further information, please refer to Section B.5.

Consequently, the project could reach better (lower) prices for CAPEX and OPEX. The main reason for creating one Special Purpose Companies (SPCs) for each plant is related to lower taxes using presumed profit tax system.

For VCS additionality analysis, the financial analysis was carried out considering the complex. This is a conservative approach once it assumes lower costs and scale obtained.

The cash flow of Ventos do Araripe III is fully presented to the DOE (Designated Operational Entity) that will perform validation and to any entity linked to the VCS that request it for proving the project additionality.

Before presenting the main inputs taken into consideration in the equity cash flow, it is important to describe some comments on the assumptions adopted in the investment analysis that considered orientations of the CDM Executive Board (EB).

General Features of the Investment Analysis and calculation of the Financial Indicator

- **Assessment Period:** The cash flow considers an economic plant lifetime of 20 years which is in line with the operational lifetime of the wind turbines. This agrees with the provisions of the CDM Methodological Tool Investment Analysis, version 08.0. item 6, which defines that the IRR calculation must preferably reflect the expected operational lifetime of the project activity.
- **The value of the assets of the project activity at the end of the assessment period:** As the assessment period covers the whole 20 year expected operational lifetime of the project, no residual value should be considered.
- **Depreciation:** the period of assets depreciation is also 20 years according to guidance from the Manual of Power Sector Asset Control (Manual de Controle Patrimonial do Setor Elétrico, page 209), published by ANEEL⁸. Because it is an accounting item which does not involve disbursements, depreciation was not considered for purposes of equity IRR calculation.
- **Financial Analysis:** Financial analysis is presented for Ventos do Araripe III that composes the initial project instances. New project instances inclusion requirements shall also present financial analysis discussion.
- **Equity IRR Calculation:** The purpose of Equity IRR is to determine the final return to the initial equity investment. Aligned with item 14 of the CDM Methodological Tool Investment Analysis, version 08.0, the Equity IRR calculation considers only the amount of equity investment as a cash outflow, once the debt service cost (interest and principal) is already considered as an expense which shall not be counted twice.
- **Operational Starting Date:** The cash flow considered that all plants of the complex started operation at the same time. Despite there are differences of few months between operational starting date of the plants as presented at table 01, as all plants have the same assessment period (20 years), this assumption was taken because it simplifies the financial model. It is also a conservative assumption once it considers the that revenues related to the full amount of electricity generated by all plants happen since the first month of the cash flow. This assumption contributes for a higher IRR.

⁷Most of contracts correspond to the complex, such as the contract for the supply of substations, transformers, capacitors bank, transmission lines and reclosers.

⁸ Source: ANEEL (2009). Manual de Controle Patrimonial do Setor Elétrico. Annex of Normative Resolution nº 367/2009, 02 June 2009. Available at: http://www.aneel.gov.br/cedoc/aren2009367_2_primeira_Ver.pdf. Last access on 10 November 2011.

- **Nature of the Cash Flow:** The equity cash flow has been performed in real terms, i.e. without considering the impact of inflation.

Sectoral Policies E-

In its twenty second meeting and referring to its decisions from EB 16 (CDM Executive Board Meeting 16), the CDM Executive Board reaffirmed that national and/or sectoral policies and circumstances are to be taken into account on the establishment of a baseline scenario, without creating perverse incentives that may impact host Parties' contributions to the ultimate objective of the Convention. Accordingly, the Board agreed to define E- policy as:

“National and/or sectoral policies or regulations that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (e.g. public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs)”

Further the Board agreed that such policies should be addressed as follows:

E- Policies “that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) need not be taken into account in developing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place).”

Accordingly, the Additionality Tool includes a footnote to the calculation of financial indicators in investment analysis which states that the inclusion of subsidies in investment analysis is subject to the guidance on such policies.

The importance of this concept has been reinforced by the CMP 5 in Copenhagen affirmed that *“it is the prerogative of the host country to decide on design and implementation of policies to promote low greenhouse gas emitting technologies; and the Executive Board shall ensure that its rules and guidelines do not create perverse incentives for emission reduction efforts.”*

Some current Brazilian energy regulations effectively offer a set of regulatory and economic incentives that aim at promoting renewable electricity sources to guarantee country's electricity expansion based on renewable and low carbon emitting technologies.

The existence of these incentives requires their adequate treatment in the additionality assessment and specifically in the investment analysis. For this purpose the following paragraphs identify and discuss the relevant regulations and define their treatment according to the rules and principles defined by EB 22.

Policy E- - Reduction of the Distribution/Transmission Fee (TUSD/TUST-G) for Complementary Renewable Energy sources.

Through Resolution N°77, of 18 August 2004⁹, ANEEL established a discount of 50% of the applicable distribution/transmission fee (TUSD/TUST-G) for complementary renewable energy projects, such as wind power generation projects, with installed capacity injected in the grid lower or equal to 30,000 kW.

This sectoral policy was established on 18 Aug 2004, and therefore after 11 November 2001. Thus it represents a *“comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies”* and classifies as E- policy. Accordingly, the incentive shall not be considered for the baseline scenario and the investment analysis, taking into consideration the *“hypothetical situation without the national and/or sectoral policies or regulations being in place”*.

⁹ ANEEL (2004). Normative Resolution n° 77, 18 August 2004. Available at: <http://www.aneel.gov.br/cedoc/ren2004077.pdf>. Last accessed: September 2011.

Assumptions used in the Cash Flow

After discussion about some assumptions according to CDM “Methodological tool Investment analysis”, version 08.0., the inputs used in the project cash flow are presented below:

Table 07: Financial Assumptions

Item	Description	Unit	Values
Installed Capacity	Installed Capacity, as evidenced by Operation License of each entrepreneurship.	MW	• Complexo do Araripe III: 358.8 MW • WPP Santo Estevão I: 25.3 • WPP Santo Estevão II: 25.3 • WPP Santo Estevão III: 29.9 • WPP Santo Estevão IV: 29.9 • WPP Santo Estevão V: 27.6 • WPP São Virgílio I: 29.9 • WPP São Virgílio II: 29.9 • WPP São Virgílio III: 20.7 • WPP Santo Onofre IV: 27.6 • WPP Santo Augusto I: 18.4 • WPP Santo Augusto II: 27.6 • WPP Santo Augusto VI: 29.9 • WPP Santo Augusto VII: 18.4 • WPP Santo Augusto VIII: 18.4
Electricity generated for sale	It was considered the the plant load factor of each plant supplied by independent report issued by engineering company AWS TruePower, issued in October 23, 2017.	MWh/year	• Complexo do Araripe III: 1,529,112 • WPP Santo Estevão I: 104,830 • WPP Santo Estevão II: 103,278 • WPP Santo Estevão III: 120,746 • WPP Santo Estevão IV: 125,723 • WPP Santo Estevão V: 119,437 • WPP São Virgílio I: 124,937 • WPP São Virgílio II: 132,795 • WPP São Virgílio III: 90,484 • WPP Santo Onofre IV: 124,031 • WPP Santo Augusto I: 76,562 • WPP Santo Augusto II: 117,019 • WPP Santo Augusto VI: 130,176 • WPP Santo Augusto VII: 80,430 • WPP Santo Augusto VIII: 78,657
Electricity Price	It was considered the electricity price contracted through ANEEL auctions.	R\$/MWh	• WPP Santo Estevão I: 120.48 • WPP Santo Estevão II: 121.49 • WPP Santo Estevão III: 120.48 • WPP Santo Estevão IV: 142.99

			- WPP Santo Estevão V: 120.47 - WPP São Virgílio I: 142.99 - WPP São Virgílio II: 136.99 - WPP São Virgílio III: 142.99 - WPP Santo Onofre IV: 142.99 - WPP Santo Augusto I: 120.47 - WPP Santo Augusto II: 120.48 - WPP Santo Augusto VI: 120.47 - WPP Santo Augusto VII: 120.48 - WPP Santo Augusto VIII: 120.47
Investment and Operational Costs			
Item	Description	Unit	Values
Investment (CAPEX)	Budgeted according to contracts established with (I) Wind Turbine Generators Supplier (GE); (II) Civil Works (Cortez Engenharia); (III) Medium Voltage Power Grid (Construtora Sucesso); (IV) Substation Construction (Siemens); (V) Transformers supply (Siemens); (VI) Capacitors Banks Supply (Siemens); (VII) Transmission Line Construction (Sadesul) and (VIII) Reclosers Supply (Siemens)	R\$	Complexo do Araripe III: 1,609,389,871 - WPP Santo Estevão I: 114,478,257 - WPP Santo Estevão II: 113,548,729 - WPP Santo Estevão III: 135,065,198 - WPP Santo Estevão IV: 134,397,188 - WPP Santo Estevão V: 120,806,735 - WPP São Virgílio I: 132,145,938 - WPP São Virgílio II: 133,169,563 - WPP São Virgílio III: 93,647,052 - WPP Santo Onofre IV: 123,664,194 - WPP Santo Augusto I: 83,532,588 - WPP Santo Augusto II: 123,473,302 - WPP Santo Augusto VI: 132,839,071 - WPP Santo Augusto VII: 85,681,624 - WPP Santo Augusto VIII: 82,940,426
O&M Costs	Budgeted according to Full Service Agreement between each Wind Power Plant and Supplier (GE Power and Water). The cost is the same for each plant per year.	R\$/year/WTG	Year 01: 58,700 Year 02: 103,600 Year 03: 123,700 Year 04: 159,000 Year 05: 179,600 Year 06: 182,300 Year 07: 159,000 Year 08: 177,000 Year 09: 177,000 Year 10: 177,000 Year 11: 180,100 Year 12: 180,100 Year 13: 180,100 From Year 14: 180,000
TUST	According to ANEEL Technical Note 162/2015-SGT/ANEEL. Technical. E-Policy definitions was used	R\$/KWinstalled. month	- WPP Santo Estevão I: 4.673 - WPP Santo Estevão II: 4.673 - WPP Santo Estevão III: 4.673 - WPP Santo Estevão IV: 4.673

	for this item.		- WPP Santo Estevão V: 4.673 - WPP São Virgílio I: 5.272 - WPP São Virgílio II: 5.348 - WPP São Virgílio III: 5.270 - WPP Santo Onofre IV: 5.272 - WPP Santo Augusto I: 4.672 - WPP Santo Augusto II: 4.673 - WPP Santo Augusto VI: 4.673 - WPP Santo Augusto VII: 4.672 - WPP Santo Augusto VIII: 4.672
ANEEL Supervision Taxes	Budgeted according to Decree 2,410, November 28, 1997, and ANEEL Dispatch Nº 88, 13/01/2017. It is calculated over 0.5% of the installed capacity.	R\$/KWinstalled.year	639.06
Land Lease	Budgeted according to land lease agreements (1.5% of the project gross revenue).	R\$/year	2,954,869
Insurance	Evidenced by Insurance Policy 03.51.1.001591	R\$/year	953,552
Contingencies	It was considered the cost of 0.1% on assets value of the enterprise. Among these expenses are included CCEE taxes, ONS taxes and other expenses.	%	0.1% over CAPEX
Loan Conditions			
Item	Description	Unit	Values
BNDES Direct - Loan	Direct Loan signed with BNDES on February 24, 2017.	R\$	472,290,000
Nominal Interest Rates – BNDES Direct Loan	Interest Rates established in BNDES Direct Loan. BNDES Loan is subdivided in sub-loans with different interest rates. To simplify financial model, it was adopted one unique interest rate. The lowest interest rate was used, following a conservative approach.	%/year	TJLP + 2.45%
BNDES Indirect Loan -	BNDES Indirect Loan signed with Banks Bradesco and Santander on, 28, 2017.	R\$	570,900,000
Nominal Interest Rates – BNDES Indirect Loan	Interest Rates established in BNDES Indirect Loan. The credit is subdivided in sub-loans with different interest rates. For simplify financial model, it was adopted one unique interest rate. The lowest interest rate was used, following a	%/year	TJLP + 5.55%

	conservative approach.		
Amortization Period	Budgeted according to Direct Loan signed with BNDES on February 24, 2017. BNDES Indirect Loan predicts lower amortization period. To simplify the model and being conservative, a unique amortization period was adopted.	Years	16
Leverage of the project	Evidenced by Loan Contracts signed with BNDES and Banks Bradesco and Santander	%	64.8%
TJLP	Interest Rate of Long Term – Basic Cost for Loan Supplied by BNDES.	%	6.5
Inflation rate	To transform nominal interest rate in real interest rate, it was considered the inflation index meta (IPCA) published by Brazil Central Bank ¹⁰ .	%	4.5
Taxes			
Item	Description	Unit	Values
PIS/COFINS	Budgeted as applicable Brazilian Law 10,637, Law 10,833 and Normative Instruction 247.	%	3.65% on gross revenue
Income Tax	Budgeted as applicable Brazilian law of presumed profit (Law 9,718)	%	15% on 8% gross revenue
Income Tax	Budgeted as applicable Brazilian law of presumed profit (Law 9,718)	%	10% on income above 8% of gross revenue
Social contribution	Budgeted as applicable Brazilian Law 9,249 and Law 9,430	%	9% on 12% of gross revenue

Investment analysis results

The Equity Internal Rate of Return, in real terms, resulting of the cash flow based on the assumptions is presented in the table below:

Table 10 – Project Indicators X Benchmark

Equity IRR	Benchmark
3.72%	11.87%

¹⁰ Source: <http://www.bcb.gov.br/Pec/metase/TabelaMetaseResultados.pdf>

The investment analysis was conducted according to option III of the “Tool for the demonstration and assessment of additionality” and the result shows that project’s financial indicator is less favourable than the benchmark. Consequently it can be concluded, that the project activity cannot be considered as financially attractive

Sub-step 2d. Sensitivity analysis

The main variables that can affect the project’s finances are (i) revenues of the project; (ii) CAPEX and (iii) O&M costs.

The sensitivity analysis considers only those scenarios that contribute to increase economic and financial attractiveness of the project aiming to confirm how solid the analysis of sub-steps 2b and 2c are. Table below presents how changes in the main parameters affect equity IRR.

Table 08– Sensitivity Analysis

REVENUES VARIATION	
Projected Situation	Equity IRR
0%	3.72%
10%	6.76%
28.2%	11.87%
CAPEX VARIATION	
Projected Situation	Equity IRR
0%	3.72%
-10%	6.21%
-22.3%	11.87%
O&M COSTS VARIATION	
Projected Situation	Equity IRR
0%	3.72%
-10%	4.14%
-100%	7.65%

Discussion about likelihood of each scenario is presented as follows.

Project Revenues:

The wind power project’s revenue depends solely on two factors: the electricity generated and the electricity sales price, which will be discussed individually. They are in effect related, once uncertainties and variations in the electricity generation have an impact on the commercial conditions, electricity pricing and thus revenues and fines.

Electricity of the project’s plants were already sold in the Auction promoted by CCEE and the price is already established according auction results. The power purchase agreements are valid for the entire assessment period (20 years). Therefore, no variation on price is expected.

With regards to the volume of energy generated, the project is subject to significant variations and uncertainties. The quantity of electricity sold is very close to plant load factors of the plants. To reach the benchmarking would be necessary an increase of 28.2% of the electricity generated.

In this respect, it is important to note that generation monitoring reports published by Brazil's National Interconnected System Operator¹¹ (Operador Nacional do Sistema Elétrico – ONS) shows that the average deviation from electricity expected (based on plant load factors) and real electricity generated of all plants of the Brazilian interconnected System (2018 data) is 5.9%.

Based on these data we can conclude that increased revenues more than 10% due to electricity overproduction is not likely or an expected scenario.

Looking at the data mentioned above, it is noticed that it is unlikely that the scenario of revenue generation over 10% predicted in the sensitivity analysis will happen.

CAPEX

CAPEX represents the most important investment of the enterprise. At the time of this VCS Project Description Elaboration, CAPEX was already contracted, and the plants already built. Thus, CAPEX reduction scenario is very unlikely. To reach the benchmark, it would be necessary a reduction of 22.3% in the CAPEX. An impossible scenario,

O&M Costs

The result of the sensitivity analysis shows that an 10% reduction in O&M Costs when compared to the base case assumption would not materially affect the Project's return. Even if the O&M cost was disregarded (O&M Cost = 0), Equity IRR would not reach the benchmarking.

Thus, it is unlikely that these items may undergo changes that contribute with an increase in the economic and financial attractiveness that is not covered by the variation range between 0 and 10%. Therefore the variation range between 0 and 10% cover more than the probable scenarios.

The tool for demonstration and assessment of additionality indicates that: If after the sensitivity analysis it is concluded that the proposed project activity is unlikely to be the most financially attractive or is unlikely to be financially attractive, then proceed to Step 4 (Common practice analysis)."

This way, as the sensitivity analysis showed that the proposed activity is unlikely to be financially/economically attractive, it must proceed to Step 4 (Common Practice Analysis).

Step 3. Barrier analysis

This is step will not be considered. **Continue to step 04.**

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:

The common practice analysis follows the step-wise approach suggested by CDM tool Common practice, version 03.1. Each step and respective result are presented below:

- Step 1: calculate applicable capacity or output range as +/-50% of the total design capacity or output of the proposed project activity.

Outcome: The installed capacity of Ventos do Araripe III Complex is 358.8 MW. Therefore, the capacity range applicable is from 179.4 MW to 538.2 MW.

¹¹ ONS Report "Boletim Mensal de Geração Eólica", available at: http://ons.org.br/AcervoDigitalDocumentosEPublicacoes/Boletim_Eolica_jul_2018.pdf.

- Step 2: identify similar projects (both CDM and non-CDM) which fulfil all of the following conditions:

- (a) The projects are located in the applicable geographical area;
- (b) The projects apply the same measure as the proposed project activity;
- (c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;
- (d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;
- (e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;
- (f) The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.³

Outcome:

To develop this step, the following procedure was applied:

1. All operational plants connected to the Grid. Source were identified at ANEEL database¹².
2. Selection of renewable plants (applying the same measure).
3. After that, only renewable plants that begun to operate before 09/12/2016 (Start date of the Project Activity) were selected.
4. Only plants with the capacity output calculated on STEP 1 were selected (179.4MW to 538.2 MW)
5. For Wind Power Plants, it was used database supplied by ABEEÓLICA. Through this database, It could be identified Wind Power Plants Complexes. Theses complexes groups several plants under the same umbrella. So, they could be compared to the Ventos do Araripe III Wind Power Plant Complex. At ANEEL database, plants of each complex were presented individually.

The outcome is presented at the table below:

¹² ANEEL, 2018. Available at: <http://www2.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.cfm>

Table 09: Outcome – Step 02

Number	Energy Source	Plant	Operational Starting Date	Installed Capacity (MW)
1	Biomass	CMPC (Antiga Aracruz Unidade Guaíba)	01/12/1971	250,99
2	Biomass	Suzano Mucuri (Antiga Bahia Sul)	01/03/1992	214,08
3	Biomass	Aracruz	01/05/2002	210,40
4	Biomass	Eldorado Brasil	12/09/2013	226,00
5	Biomass	Suzano Maranhão	04/04/2014	254,84
6	Biomass	Klabin Celulose	29/07/2016	330,00
7	Hydro Power Plant	Aimorés	30/07/2005	330,00
8	Hydro Power Plant	Amador Aguiar I (Antiga Capim Branco I)	21/02/2006	240,00
9	Hydro Power Plant	Peixe Angical	27/06/2006	498,75
10	Hydro Power Plant	Irapé	20/07/2006	399,00
11	Hydro Power Plant	Amador Aguiar II (Antiga Capim Branco II)	09/03/2007	210,00
12	Hydro Power Plant	São Salvador	06/08/2009	243,20
13	Hydro Power Plant	Salto Pilão	11/12/2009	191,89
14	Hydro Power Plant	Serra do Facão	13/07/2010	212,58
15	Hydro Power Plant	Dardanelos	09/08/2011	261,00
16	Hydro Power Plant	Governador Jayme Canet Júnior - GJC (Antiga Mauá)	23/11/2012	361,00
17	Hydro Power Plant	Simplício	05/06/2013	333,70
18	Hydro Power Plant	Garibaldi	24/09/2013	191,90
19	Hydro Power Plant	Santo Antônio do Jari	17/09/2014	392,95
20	Hydro Power Plant	Ferreira Gomes	04/11/2014	252,00
21	Hydro Power Plant	Cachoeira Caldeirão	05/05/2016	219,00
22	Hydropower Plant	Ilha dos Pombos	01/01/1924	187,17
23	Hydropower Plant	Nilo Peçanha	01/01/1953	380,03
24	Hydropower Plant	Marechal Mascarenhas de Moraes (Antiga Peixoto)	01/04/1957	476,00
25	Hydropower Plant	Paulo Afonso II	24/10/1961	443,00
26	Hydropower Plant	Jacuí	01/01/1962	180,00
27	Hydropower Plant	Três Marias	01/01/1962	396,00
28	Hydropower Plant	Paulo Afonso I	30/12/1964	180,00
29	Hydropower Plant	Funil	20/03/1970	216,00
30	Hydropower Plant	Boa Esperança (Antiga Castelo Branco)	02/10/1970	237,30
31	Hydropower Plant	Chavantes	30/11/1970	414,00
32	Hydropower Plant	Jaguara	01/01/1971	424,00
33	Hydropower Plant	Governador Pedro Viriato Parigot de Souza (Capivari/Cachoeira)	03/09/1971	260,00
34	Hydropower Plant	Passo Fundo	30/03/1973	226,00
35	Hydropower Plant	Porto Colômbia	29/06/1973	320,00
36	Hydropower Plant	Mascarenhas	21/09/1973	198,00

Number	Energy Source	Plant	Operational Starting Date	Installed Capacity (MW)
37	Hydropower Plant	Volta Grande	22/04/1974	380,00
38	Hydropower Plant	Promissão (Mário Lopes Leão)	28/07/1975	264,00
39	Hydropower Plant	Apolônio Sales (Antiga Moxotó)	15/04/1977	400,00
40	Hydropower Plant	Itaúba	01/01/1979	500,40
41	Hydropower Plant	Nova Avanhandava (Rui Barbosa)	19/12/1982	347,40
42	Hydropower Plant	Rosana	20/05/1987	354,00
43	Hydropower Plant	Balbina	20/02/1989	249,75
44	Hydropower Plant	Samuel	17/07/1989	216,75
45	Hydropower Plant	Taquaruçu (Escola Politécnica)	12/11/1992	525,00
46	Hydropower Plant	Nova Ponte	01/01/1994	510,00
47	Hydropower Plant	Corumbá I	31/10/1996	375,00
48	Hydropower Plant	Miranda	30/05/1998	408,00
49	Hydropower Plant	Igarapava	31/12/1998	210,00
50	Hydropower Plant	Manso	29/11/2000	210,00
51	Hydropower Plant	Cana Brava	22/05/2002	450,00
52	Hydropower Plant	Funil	30/12/2002	180,00
53	Hydropower Plant	Itapebi	18/02/2003	462,01
54	Wind Power Plant	União dos Ventos	01/04/2014	234,70
55	Wind Power Plant	Alto Sertão I	01/07/2014	294,40
56	Wind Power Plant	Alto Sertão II	01/10/2014	386,10
57	Wind Power Plant	Asa Branca	01/12/2014	241,00
58	Wind Power Plant	Ventos de Santa Joana	01/07/2015	468,60
59	Wind Power Plant	Morrinhos	01/11/2015	180,00
60	Wind Power Plant	Ventos de Santa Brígida	01/12/2015	181,90
61	Wind Power Plant	Calango	01/01/2016	180,00
62	Wind Power Plant	Itarema	01/01/2016	207,00
63	Wind Power Plant	Ventos de São Clemente	01/05/2016	216,09

- Step 3: within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number N_{all} .

Outcome: Six (6) plants were identified as CDM Project (Hydro Power Plant Ferreira Gomes and Wind Power Plants Alto Sertão I, Alto Sertão II, Asa Branca, Calango and União dos Ventos Complex). Therefore $N_{all} = 57$.

- Step 4: within similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number N_{diff} .

Outcome: Forty-Six (46) plants are hydro power plants, Six (6) are Biomass Plants, therefore $N_{diff} = 52$.

Step 5: calculate factor $F=1-N_{diff}/N_{all}$ representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.

Outcome: $F = 1 - 52/57 = 0.0877$.

According to the Tool, the project activity is a “common practice” within a sector in the applicable geographical area if the factor F is greater than 0.2 and $N_{all}-N_{diff}$ is greater than 3.

: $F = 0.0877$ and $N_{all}-N_{diff} = 5$, therefore, the project activity is not a common practice.

After following all steps, it can be concluded that the project is additional.

2.6 Methodology Deviations

Not applicable. There is no methodology deviation in this project.

3 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

Baseline emissions include only CO₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

Equation 01

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$$

Where:

- BE_y = Baseline emissions in year y (t CO₂/yr)
- $EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)
- $EF_{grid,CM,y}$ = Combined margin CO₂ emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” (t CO₂/MWh)

If the project activity is the installation of a Greenfield power plant, then:

$$EG_{PJ,y} = EG_{facility,y}$$

Equation 02

Where:

- $EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)
- $EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr)

Calculation of Combined margin CO₂ emission factor for grid connected power generation in year ($EF_{grid,CM,y}$)

According to the “Tool to calculate the emission factor for an electricity system”, version 07.0, Project participants shall apply the following six steps:

- (a) **Step 1:** Identify the relevant electricity systems;
- (b) **Step 2:** Choose whether to include off-grid power plants in the project electricity system (optional);
- (c) **Step 3:** Select a method to determine the operating margin (OM);
- (d) **Step 4:** Calculate the operating margin emission factor according to the selected method;
- (e) **Step 5:** Calculate the build margin (BM) emission factor;
- (f) **Step 6:** Calculate the combined margin (CM) emission factor.

In this section, project participants describe how these six steps are applied to this project:

- (a) **Step 1:** Identify the relevant electricity systems;

According to the tool, “if the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used. If such delineations are not available, project participants should define the project electricity system and any connected electricity system and justify and document their assumptions in the CDM-PDD”.

Brazilian DNA defined in 2008, through the resolution nº 8, that the National Interconnected System should be considered a unique electricity system and that this configuration is valid for calculating the CO₂ emission factors used to estimate the greenhouse gases emissions reductions electricity generation CDM projects.

- (b) **Step 2:** Choose whether to include off-grid power plants in the project electricity system (optional);

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.

Option II: Both grid power plants and off-grid power plants are included in the calculation.

The option I was chosen for the project activity, once the operation margin and build margin emission factor calculated by the Brazilian DNA or alternatively calculated by the project developer are based on data of plants connected to the grid.

- (c) **Step 3:** Select a method to determine the operating margin (OM);

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

- (a) Simple Operation Margin; or
- (b) Simple adjusted Operation Margin; or
- (c) Dispatch data analysis Operation Margin; or
- (d) Average Operation Margin.

The method chosen for the calculation of operation margin emission factor for the project is the dispatch data analysis operation margin method.

- (d) **Step 4:** Calculate the operating margin emission factor according to the selected method;

The method chosen for the calculation of the operation margin emission factor of this project was the dispatch data analysis.

The calculation of the Operation Margin emission factor follows the method by dispatch data analysis (EF_{grid,OM-DD,y}) and it is calculated and defined by the Brazilian DNA in accordance with the dispatch data supplied by ONS - National System Operator.

According to the “tool to calculate the emission factor for an electricity system”, for the dispatch data analysis OM it must be used the year in which the project activity displaces grid electricity and the emission factor must be updated annually during monitoring. This way, data are ex-post.

Step 5: Calculate the build margin emission factor

In terms of data vintage, project participants can choose between one of the following two options:

Option 1. For the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2. For the first crediting period, the build margin emission factor shall be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emission factor shall be calculated ex-ante, as described in option 1 above. For the third crediting period, the built margin emission factor calculated for the second crediting period should be used.

The option that was chosen by project participants was Option 2.

(f) **Step 6:** Calculate the combined margin (CM) emission factor.

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following methods:

- (a) Weighted average Combined Margin; or
- (b) Simplified Combined Margin.

This Project uses option (a) to calculate the combined margin emission factor. The combined margin emission factor is calculated according to the following equation:

$$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y}$$

Equation 03

Where:

$EF_{grid,BM,y}$ = Build margin CO₂ emission factor in year y (tCO₂/ MWh)

$EF_{grid,OM,y}$ = Operating margin CO₂ emission factor in year y (tCO₂/ MWh)

W_{OM} = Weighting of operating margin emissions factor (%)

W_{BM} = Weighting of build margin emissions factor (%)

The “*Tool to calculate the emission factor for an electricity system*” recommends that the following default values should be used for W_{OM} and W_{BM} :

- Wind and Solar power generation project activities: $W_{OM} = 0.75$ and $W_{BM} = 0.25$ for the first crediting period and for subsequent crediting periods.
- All other projects: $W_{OM} = 0.5$ and $W_{BM} = 0.5$ for the first crediting period, and $W_{OM} = 0.25$ and $W_{BM} = 0.75$ for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.

This way, for the first crediting period of this project, it was adopted the following weights: $W_{OM} = 0.75$ and $W_{BM} = 0.25$.

3.2 Project Emissions

According to ACM0002: “Grid-connected electricity generation from renewable sources” (version 19.0), for most renewable energy power generation project activities, $PE_y = 0$. This is applied to grid-connected wind power plants as the enterprises of VTRM Renewable Energy.

3.3 Leakage

No other leakage emissions are considered. The emissions potentially arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport etc.) are neglected.

3.4 Estimated Net GHG Emission Reductions and Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Equation 06

Where:

ER_y	=	Emission reductions in year y (t CO ₂ e/yr)
BE_y	=	Baseline emissions in year y (t CO ₂ /yr)
PE_y	=	Project emissions in year y (t CO ₂ e/yr)

Baseline Emissions Calculations

As presented on section 3.1, the baseline emissions are calculated as follows:

Equation 01

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$$

Where:

BE_y	=	Baseline emissions in year y (t CO ₂ /yr)
$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)
$EF_{grid,CM,y}$	=	Combined margin CO ₂ emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO ₂ /MWh)

As **VTRM Renewable Energy** just comprises greenfield wind power plants, then:

$$EG_{PJ,y} = EG_{facility,y}$$

Equation 02

At this document, project proponents are also requesting verification of the period 09/12/2016 to 31/07/2018. Therefore, for this period the real electricity supplied to grid was used in the emission reduction estimation.

For the period 01/08/2018 to 08/12/2026, $EG_{facility,y}$ was estimated as the product between Installed Capacity of Each Plant, Plant Load Factor and the number of hours per year (8,760 hours per year). Table below shows the estimation of $EG_{facility}$ for this period.

Table 10: EG_{facility} Estimation

WPPs	Installed Capacity (MW) (A)	Plant Load Factor (%) (B)	EG_{facility,y} Estimation C = A x B x 8,760 (MWh)
Ventos de Santo Estevão I	25.3	47.3%	104,830
Ventos de Santo Estevão II	25.3	46.6%	103,278
Ventos de Santo Estevão III	29.9	46.1%	120,746
Ventos de Santo Estevão IV	29.9	48.0%	125,723
Ventos de Santo Estevão V	27.6	49.4%	119,437
Ventos de São Virgílio I	29.9	47.7%	124,937
Ventos de São Virgílio II	29.9	50.7%	132,795
Ventos de São Virgílio III	20.7	49.9%	90,484
Ventos de Santo Onofre IV	27.6	51.3%	124,031
Ventos de Santo Augusto I	18.4	47.5%	76,562
Ventos de Santo Augusto II	27.6	48.4%	117,019
Ventos de Santo Augusto VI	29.9	49.7%	130,176
Ventos de Santo Augusto VII	18.4	49.9%	80,430
Ventos de Santo Augusto VIII	18.4	48.8%	78,657
Total			1,529,112

To calculate the combined margin emission factor, the following equation is used.

$$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y}$$

Equation 3

Where:

EF_{grid,BM,y} = Build margin CO₂ emission factor in year y (tCO₂/ MWh)

EF_{grid,OM,y} = Operating margin CO₂ emission factor in year y (tCO₂/ MWh)

W_{OM} = Weighting of operating margin emissions factor (%)

W_{BM} = Weighting of build margin emissions factor (%)

For this first crediting period of the project, WOM = 0.75 and WBM = 0.25.

As VTRM Renewable Energy uses Dispatch data analysis OM method for operating margin emission factor, EF_{grid,OM,y} is calculated ex post.

For ex-ante emission reductions estimations from 01/01/2017 to 08/12/2026 (dd/mm/yyyy), EF_{grid,OM,y} and EF_{grid,BM,y} for 2017 were used. This is the latest information available.

For emission reduction estimation of the period 09/12/2016 to 31/12/2016 (dd/mm/yyyy), EF_{grid,OM,y} and EF_{grid,BM,y} for 2016 were used. For both years, these parameters were calculated by Brazilian DNA¹³.

The values are

$$\text{EF}_{\text{grid,OM},2016} = 0.6228 \text{ tCO}_2\text{e/MWh}$$

$$\text{EF}_{\text{grid,BM},2016} = 0.1581 \text{ tCO}_2\text{e/MWh};$$

$$\text{EF}_{\text{grid,OM},2017} = 0.5881 \text{ tCO}_2\text{e/MWh}$$

$$\text{EF}_{\text{grid,BM},2017} = 0.0028 \text{ tCO}_2\text{e/MWh}$$

Applying these values to Equation 03,

$$\text{EF}_{\text{grid,CM},2016} = 0.75 \times 0.6228 + 0.25 \times 0.1581 = 0.5066 \text{ tCO}_2\text{e/MWh}.$$

$$\text{EF}_{\text{grid,CM},2017} = 0.75 \times 0.5881 + 0.25 \times 0.0028 = 0.4418 \text{ tCO}_2\text{e/MWh}$$

Applying $E_{\text{GPJ},2016} = 14,028 \text{ MWh/year}$ (real electricity generation supplied to the grid between 09/12/2016 to 31/12/2016) to equation 02, $BE_{2016} = 14,028 \times 0.5066 \text{ tCO}_2\text{e/MWh} = 7,107 \text{ tCO}_2\text{e (in 2016)}$

Applying $E_{\text{GPJ},2017} = 1,196,308 \text{ MWh/year}$ (real electricity generation supplied to the grid between 01/01/2017 to 31/12/2017) to equation 02, $BE_{2017} = 1,196,308 \text{ MWh} \times 0.4418 \text{ tCO}_2\text{e/MWh} = 528,551 \text{ tCO}_2\text{e (in 2017)}$

Applying $E_{\text{GPJ},2018}(\text{until } 31/07/2018) = 770,684 \text{ MWh/year}$ (real electricity generation supplied to the grid between 01/01/2018 to 31/07/2018) to equation 02, $BE_{2017} = 770,684 \text{ MWh} \times 0.4418 \text{ tCO}_2\text{e/MWh} = 340,502 \text{ tCO}_2\text{e (in 2018)}$

Applying estimation of annual E_{GPJy} to equation 02, $BE_y = 1,529,112 \text{ MWh} \times 0.4418 \text{ tCO}_2\text{e/MWh} = 675,590 \text{ tCO}_2\text{e/year}$.

As this project does not present any emission nor leakage, net emission reduction is equal to baseline emissions as presented in the table below.

¹³ Source: MCTI, 2017. <http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/index.html>. Accessed on October, 2017.

Table 11: Emission Reduction Estimation

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)
2016	7,107	0	0	7,107
2017	528,551	0	0	528,551
2018	623,694	0	0	623,694
2019	675,590	0	0	675,590
2020	675,590	0	0	675,590
2021	675,590	0	0	675,590
2022	675,590	0	0	675,590
2023	675,590	0	0	675,590
2024	675,590	0	0	675,590
2025	675,590	0	0	675,590
2026	633,019	0	0	633,019
Total	6,521,501	0	0	6,521,501

4 MONITORING

4.1 Data and Parameters Available at Validation

Table 12: Data and Parameters Available at Validation

Data / Parameter	The percentage share of total installed capacity of the specific technology
Data unit	%
Description	The percentage share of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country
Source of data	ANEEL
Value applied	10.4%
Justification of choice of data or description of measurement methods and procedures applied	Data provided by ANEEL ¹⁴
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	The total installed capacity of the technology
Data unit	MW
Description	The total installed capacity of the technology in the host country
Source of data	ANEEL
Value applied	12,537,943
Justification of choice of data or description of measurement methods	Data provided by ANEEL ¹⁵

¹⁴ ANEEL Management Information Report, March/2018. Available at: <http://www.aneel.gov.br/documents/656877/14854008/Boletim+de+Informa%C3%A7%C3%B5es+Gerenciais+-+1%C2%BA+trimestre+2018/01298785-3069-c0e7-d9c8-a2cca07cddd9>. Accessed on September/2018.

¹⁵ Source: ANEEL, 2017. <http://www.aneel.gov.br/documents/656877/14854008/Boletim+de+Informa%C3%A7%C3%B5es+Gerenciais+2%C2%BA+trimestre+de+2017/6f1fac17-8146-4a17-508a-567419d35fae>

and procedures applied	
Purpose of Data	Calculation of baseline emissions
Comments	

4.2 Data and Parameters Monitored

Table 13: Data and Parameters Monitored

Data / Parameter	$EG_{\text{facility},y}$
Data unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr)
Source of data	Meters at substation Curral Novo do Piauí 2 (CNP2)
Description of measurement methods and procedures to be applied	Electricity Meters
Frequency of monitoring/recording	Continuous measurement and at least monthly recording
Value applied	1,529,112 MWh (for a complete year)
Monitoring equipment	At the substation CNP2, there are four meters (two principal and two rear) that register net electricity supplied to the grid by all initial project instances. New project instances will have at least two meters to register net electricity supplied to the grid. Class, precision and calibration procedures of the meters shall follow ONS and National Authorities Guidelines and Procedures.
QA/QC procedures to be applied	The uncertainty level for these data is low. The electricity supplied to the grid is monitored by the project participants directly from the meters. Project proponents have an outsourced agent hired that support measurement data collection. Commercial team cross-checks monthly data collected from the meters available at outsourced agent's web platform and data provided by CCEE's Website (Electric Power Commercialization Chamber).

	Meters are calibrated according to National Operator of the System (ONS) Procedures.
Purpose of data	Calculation of baseline emissions
Calculation method	Four specific meters are located in the Substation CNP2 that registers net electricity generated by all plants to the Grid. No calculation is necessary.
Comments	CCEE - Entity responsible for measurements, accounting and settlement on Brazilian electric energy market.

Data / Parameter	$EF_{Grid,CM,y}$
Data unit	tCO ₂ e/MWh
Description	Combined margin emission factor for the grid in year y
Source of data	The combined margin emission factor will be calculated using the procedures of the "Tool to calculate the emission factor for an electricity system", version 07.0. $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ data will be supplied by Brazilian Designated National Authority of the CDM (Brazilian DNA). The combined margin emission factor used on the Project will be calculated based on data of National Interconnected System supplied by Brazilian DNA.
Description of measurement methods and procedures to be applied	As per the "Tool to calculate the emission factor for an electricity system". For this the first crediting period of the project, WOM = 0.75 and WBM = 0.25. As VTRM Renewable Energy uses Dispatch data analysis OM method for operating margin emission factor, $EF_{grid,OM,y}$ is calculated ex post. For the first crediting period, the build margin emission factor shall be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available For ex-ante emission reductions estimations from 01/01/2017 to 08/12/2026 (dd/mm/yyyy), $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ for 2017 were used. This is the latest information available.

	For emission reduction estimation of the period 09/12/2016 to 31/12/2016 (dd/mm/yyyy), EF _{grid,OM,y} and EF _{grid,BM,y} for 2016 were used. For both years, these parameters were calculated by Brazilian DNA
Frequency of monitoring/recording	Annually
Value applied	0.5066 tCO ₂ e/MWh for 2016. 0.4418 tCO ₂ e/MWh from 2017 to the end of the crediting period.
Monitoring equipment	Not applicable
QA/QC procedures to be applied	As per the “Tool to calculate the emission factor for an electricity system”.
Purpose of data	Calculation of baseline emissions
Calculation method	As per the “Tool to calculate the emission factor for an electricity system”. Dispatch Data Analysis for OM Operating Margin Emission Factor. Data supplied by Brazilian CDM DNA will be used.
Comments	More information was described on item 3.

4.3 Monitoring Plan

Monitoring has the objective of measuring the emission reductions achieved by the project. The monitoring plan follows the Monitoring Methodology of consolidated baseline methodology for grid-connected electricity generation from renewable sources ACM0002, version 19.0. All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. All measurements will be conducted with calibrated measurement equipment according to Brazilian industry standards. The main parameters that will be monitored are:

- $EG_{\text{facility},y}$ - Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr);
- Combined margin emission factor for the grid in year y ($EF_{\text{Grid,CM},y}$)

New project instances should present their monitoring reports when requesting inclusion in this Grouped Project. Monitoring Report should follow Monitoring Methodology of consolidated baseline methodology for grid-connected electricity generation from renewable sources ACM0002, version 19.0, and Brazilian Electricity Standards.

Monitoring of EG_{facility,y}

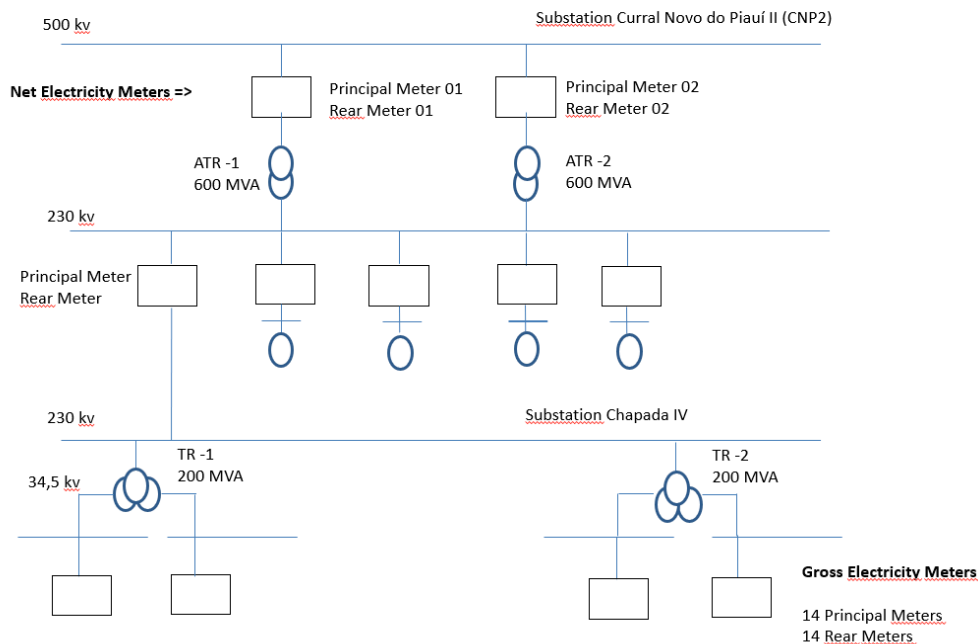
Operation and Maintenance (O&M) team is responsible for the operation and maintenance activities of the plants. An outsourced company is responsible for measurements activities. At the time of this project elaboration, the outsourced company is called Way2. This company is responsible to collect and storage all measurement data. Data is collected in real time and is available at web platform of Way2.

Commercial team is responsible for monitoring and analysing EG_{facility,y} information. It monitors data available at Way2 and cross-check it with information provided by Chamber of Electricity Commercialization (CCEE). If non-conformities are identified, an email is sent to outsourced company. The non-conformity is analyzed and if the problem is in the internal control, corrections are made. Up to now, no non-conformity has happened.

Each plant has two measurement instruments (meters) located in the plant. One is the principal meter and the second is a rear. These meters register gross electricity generated by each plant.

At substation Curral Novo do Piauí II (CNP2), there are four meters (two principal and two rear) that register net electricity supplied to the grid (EG_{facility,y}) by all 14 plants that compose the initial project instances. ONS Grid Procedures (Sub-module 12.3) defines the calibration frequency and other maintenance procedures. All meters of the plants are calibrated according to Brazilian Standards.

Diagram below shows the measurement scheme of the initial project instances:



It is important to say that net electricity supplied to the grid impacts directly the revenues of the plants once electricity is the main product of the project. Therefore, a straight control is performed about this information. Periodically, the Information Technology Area accomplishes an insurance backup for all plant data through backup tape.

Monitoring of $EF_{Grid,CM,y}$

The Combined margin emission factor for the grid in year y is calculated by consulting company hired by project proponents. Calculations follows Tool to calculate the emission factor for an electricity system, version 07.0 as described on section 02. Data supplied by Brazilian CDM DNA will be used.

5 SAFEGUARDS

5.1 No Net Harm

As it will be discussed in item 5.2, the environmental impact assessment is part of the environmental licensing, which is a legal obligation in Brazil. Before construction phases, some impacts were identified at the Environmental Impact Assessment (EIA) and monitoring programs were designed to mitigate these impacts. The Environmental Basic Program gives detail of actions taken to mitigate socio-economic impacts.

At this section, project proponents present just the negative environmental and social impacts identified at the Environmental Impact Assessment and actions planned to mitigate them. It is worthwhile to highlight that main impacts of the project were identified as positive impacts but are not mentioned in this section.

The negative impacts for all plants are presented below. All of them were classified as low or medium impacts. None was classified as high impact.

- Noise during pre-construction, construction and operational activities
- Dust generation during construction;
- Soil vibration during Geotechnical studies;
- Risk of soil contamination during construction;
- Increase of soil erosion;
- Increasing of traffic of vehicles in the region;
- Risk of incidents with animals and people during construction activities;
- Impacts on the original landscape;
- Loss of vegetal coverage;
- Decrease of animal's habitats;
- Risks with accidents with birds during operational phase;
- Increase of organic waste generation;
- Change on the dynamics of the ecosystem;
- Impacts on archeological heritage;
- Tension over population related to job creation;
- Decrease of jobs after construction phase;
- Impacts on the community's quality of life;

To mitigate these impacts, several actions were planned in the Environmental Basic Project (PBA). The main actions are presented as follows:

➤ Environmental Plan During Construction:

- Construction Signaling Program;
- Local Workers Training Program;
- Program of Workers Protection and Safety;
- Protection Program of Permanent Preservation Areas;
- Program of Rational Vegetal Suppression;
- Erosion Monitoring and Prevention;
- Wastewater Monitoring Program;
- Waste Management Program;
- Degraded Areas Program.

➤ Environmental Management Plan:

- Monitoring Plan of Pre-Construction Environmental;
- Social Communication Plan;
- Environmental Education Program;
- Fauna Rescue Program;
- Fauna Monitoring Program;
- Water Quality Monitoring Program;
- Noise Monitoring Program;
- Monitoring Program of Environmental and Social indicators of the region;
- Monitoring Program of Violence Indicators;
- Health Monitoring Program of communities;
- Program for creation of a Committee of families impacted by the project;
- Monitoring plan of land structure of the direct impacted area.

➤ Special Plans:

- Plan for Archeological Identification, Rescue and Monitoring;
- Plan for Paleontological Identification, Rescue and Monitoring;

- Soil Vibration Monitoring Program;
- Demobilization Plan.

5.2 Environmental Impact

The environmental licensing is a legal obligation prior to the installation of any entrepreneurship or activity potentially pollutant or degrading to the environment in Brazil. The Brazilian licensing process presents as an important characteristic the social participation in decision making through Public Meetings as part of the process.

The obligation of environmental licensing in Brazil is shared by State Environmental Organs and by Ibama – Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (Brazilian Institute of Environment and Renewable Natural Resources), as part of SISNAMA – Sistema Nacional de Meio Ambiente (National Environmental System).

State Environmental Secretary of Pernambuco is responsible for environmental licensing of Wind Power Plants Santo Estevão I, Santo Estevão II, Santo Estevão III, Santo Estevão IV and Santo Estevão V. State Environmental Secretary of Piauí is responsible for environmental licensing of Wind Power Plants São Virgílio I, São Virgílio II, São Virgílio III, Santo Augusto I, Santo Augusto II, Santo Augusto VI, Santo Augusto VII, Santo Augusto VIII and Santo Onofre IV.

The process of environmental licensing has three different phases: Prior Licensing, Installation Licensing and Operation Licensing. Prior License (PL) does not authorize the installation of the project. It approves the environmental viability of the project and authorizes its location and technological conception. Besides, it establishes the conditions to be considered in the development of the executive project. The Installation License (LI) authorizes the start of the entrepreneurship construction. The deadline for this license is established by the timetable of the project construction, which cannot be superior to 6 (six) years.

The Operation License (LO) must be requested before the entrepreneurship begins its operation, since it is this document that authorizes its start up. Its issuance is conditioned to an inspection to verify whether all the demands and technical details described in the project approved were developed. It is also verified if they are according to what is expected in the LP and LI. During the licensing process, some entities as Federal Entities Historic Heritage Management (Órgãos Federais de Gestão do Patrimônio Histórico – IPHAN), Indigenous National Foundation (FUNAI), Traditional Quilombolas Communities (Fundação Palmares), Health National Foundation (FUNASA), among others.

To subsidize the LO phase, the entrepreneur elaborates a group of reports, describing the execution of the environmental programs and mitigating measures expected in the phases of LP and LI.

At the time of this Project Description elaboration, all plants have licenses operation issued. The number and validity of each License Operation was presented on section 1.11.

Potential negative impacts of the plants and actions planned to mitigate them were presented on section 5.1. In this section, we also present positive impacts of the projects identified on Environmental Impact Assessment.

- Increase of economic activities in the region (Commerce and Services);
- Increase in taxes collection;
- Direct and Indirect jobs generation, including local workers during construction;

- It improves local infrastructure;
- Additional income to land owners;
- Renewable Energy Supply to National Interconnected System;
- Mitigation of environmental and social impacts;
- GHG Emission Reduction from the Brazilian energy matrix.

5.3 Local Stakeholder Consultation

The public audience is one of the phases of the environmental impact assessment and one of the main channels of community participation at a local level before project construction. This procedure consists on presenting to the interested parties the environmental assessment report, clarifying doubts and collecting criticisms and suggestions on the entrepreneurship and the areas to be affected.

Public audience notice is published in Diário Oficial da União (Union's Official Journal) and in a regional or local large circulation newspaper, radios and banners. Date, hour and place of the event must be presented. The place where public audiences happen must be easily accessed by the interested parties.

During the licensing process, Environmental Impact Assessment of the projects were submitted to public audience. The minute of public audience registers comments and doubts raised by population about the plants of the project. It also registers answers provided by the team responsible for the project. Questions raised during public audience were answered by entrepreneur team and they are dully registered by minute of public audiences. These questions did not any cause any change in the project. The minute of public audience is supplied to DOE.

There are mechanisms for on-going communication with local stakeholders. Through several channels, entrepreneurs communicate to stakeholders. The Social Communication Plan establishes a space of relationship between the community and the social actors involved with the enterprise and the entrepreneur, in order to allow a dialogue and the resolution of possible conflicts.

5.4 Public Comments

The project was published for public comments as indicated by VCS rules and it did not receive any comment.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Table 14: Data and Parameters Monitored

Data / Parameter	$EG_{\text{facility},y}$
Data unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr)
Value applied:	$EG_{\text{facility},2016} = 14,028$ $EG_{\text{facility},2017} = 1,196,308$ $EG_{\text{facility},2018} = 770,684$ Values of Eg_{facility} per month are presented below: December/2016: 14,028 MWh 2017 January/2017: 24,322 MWh February/2017: 19,187 MWh March/2017: 24,057 MWh April/2017: 66,489 MWh May/2017: 85,268 MWh June/2017: 129,391 MWh July/2017: 168,454 MWh August/2017: 148,057 MWh September/2017: 182,284 October/2017: 178,535 MWh November/2017: 91,521 December/2017: 78,738 MWh 2018 January/2018: 82,962 MWh February/2018: 47,108 MWh March/2018: 44,880 MWh April/2018: 96,341 MWh

	May/2018: 155,125 MWh June/2018: 161,213 MWh July/2018: 183,052 MWh
Comments	The uncertainty level for these data is low. The electricity supplied to the grid is monitored by project participants directly from the meters. Project proponents have an outsourced agent hired that support measurement data collection. Commercial team cross-checks monthly data collected from the meters available at outsourced agent's web platform and data provided by CCEE's Website (Electric Power Commercialization Chamber). Information about theses meters are presented as follows: Principal Meter 01 Serial Number: MW – 1410A004-01 Type: ION 8650 Class: D Supplier: Schneider Electric Calibration date: 13/12/2014 Principal Meter 02 Serial Number: MW – 1410A005-01 Type: ION 8650 Class: D Supplier: Schneider Electric Calibration date: 13/12/2014 Rear Meter 01 Serial Number: MW – 1401A151-01 Type: ION 8650 Class: D Supplier: Schneider Electric Calibration date: 17/07/2014 Rear Meter 02 Serial Number: MW – 1401A427-01 Type: ION 8650 Class: D Supplier: Schneider Electric Calibration date: 17/07/2014 Meters are calibrated according to National Operator of the System (ONS) procedures. During monitoring, from dec/2016 to sep/2017, values of EGfacility

	collected directly from meters by outsourced agent presented significantly differences (higher than 3%) from data provided by CCEE. For these months, conservatively, the lowest values were used. From oct/2017 to July/2018, differences were not significant (less than 3%), but this procedure was also adopted. The lowest values were used.
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Data / Parameter	EF _{Grid,CM,y}
Data unit	tCO ₂ e/MWh
Description	Combined margin emission factor for the grid in year y
Value applied:	0.5066 tCO ₂ e/MWh to 2016. 0.4418 tCO ₂ e/MWh from 2017 to 2018.
Comments	Calculated as per the "Tool to calculate the emission factor for an electricity system". For this project, WOM = 0.75 and WBM = 0.25 is used. As VTRM Renewable Energy uses Dispatch data analysis OM method for operating margin emission factor, EF_{grid,OM,y} and EF_{Grid,BM,y} calculated and published by Brazilian DNA. For EF_{Grid,CM,y} calculation, the following values were used: 2016 EF_{grid,OM,2016} = 0.6228 tCO₂e/MWh, EF_{grid,BM,2016} = 0.1581 tCO₂e/MWh; 2017 EF_{grid,OM,2017} = 0.5881 tCO₂e/MWh ; and EF_{grid,BM,2017} = 0.0028 tCO₂e/MWh For the period from 01/01/2018 to 31/07/2018, data of 2017 was also used, once these are the latest data available. All values were supplied by Brazilian DNA and are published at the Ministry of Science, Technology, Innovation and Communication website.

6.2 Baseline Emissions

As presented on section 3.1, the baseline emissions are calculated as follows:

Equation 01

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$$

Where:

- | | | |
|------------------|---|---|
| BE_y | = | Baseline emissions in year y (t CO ₂ /yr) |
| $EG_{PJ,y}$ | = | Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr) |
| $EF_{grid,CM,y}$ | = | Combined margin CO ₂ emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” (t CO ₂ /MWh) |

As **VTRM Renewable Energy** just comprises greenfield wind power plants, then:

$$EG_{PJ,y} = EG_{facility,y}$$

Equation 02

Where:

- | | | |
|-------------------|---|--|
| $EG_{PJ,y}$ | = | Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr) |
| $EG_{facility,y}$ | = | Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr) |

Considering that:

- $EG_{facility,2016} = 14,028 \text{ MWh}$
- $EG_{facility,2017} = 1,196,308 \text{ MWh}$
- $EG_{facility,2018} = 770,684 \text{ MWh}$
- $EF_{grid,CM,2016} = 0.5066 \text{ tCO}_2\text{e}$
- $EF_{grid,CM,2017} = 0.4418 \text{ t CO}_2\text{e}$
- $EF_{grid,CM,2018} = EF_{grid,CM,2017} = 0.4418 \text{ tCO}_2\text{e}$

Applying $E_{GPJ,2016} = 14,028 \text{ MWh}$ to equation 02, $BE_{2016} = 14,028 \text{ MWh} \times 0.5066 \text{ tCO}_2\text{e/MWh} = 7,107 \text{ tCO}_2\text{e}$ (in 2016)

Applying $E_{GPJ,2017} = 1,196,308 \text{ MWh/year}$ to equation 02, $BE_{2017} = 1,196,308 \text{ MWh} \times 0.4418 \text{ tCO}_2\text{e/MWh} = 528,551 \text{ tCO}_2\text{e}$ (in 2017)

Applying $E_{GPJ,2018}$ (until 31/07/2018) = 770,684 MWh/year to equation 02, $BE_{2017} = 770,684 \text{ MWh} \times 0.4418 \text{ tCO}_2\text{e/MWh} = 340,502 \text{ tCO}_2\text{e}$ (in 2018)

Total $BE_{2016-2018}$ = $BE_{2016} + BE_{2017} + BE_{2018} = 7,107 \text{ tCO}_2\text{e} + 528,551 \text{ tCO}_2\text{e} + 340,502 \text{ tCO}_2\text{e} = 876,160 \text{ tCO}_2\text{e}$

6.3 Project Emissions

There are no project emissions for this type of project activity according to ACM0002 – Grid-connected electricity generation from renewable sources, version 19.0. Therefore, $PE_y = 0$.

6.4 Leakage

There is no leakage according to ACM0002 – Grid-connected electricity generation from renewable sources, version 19.0.

6.5 Net GHG Emission Reductions and Removals

Table 15: GHG Emission Reduction

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
Year 2016	7,107	0	0	7,107
Year 2017	528,551	0	0	528,551
Year 2018	340,502	0	0	340,502
Total	876,160	0	0	876,160