VTRM RENEWABLE ENERGY MONITORING REPORT

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CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

VTRM Renewable Energy project activity (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 included WPPs supply clean electricity to the Brazilian National Interconnected System (SIN from the Portuguese Sistema Interligado Nacional).

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

The baseline scenario is the same scenario existing before the implementation start 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 single and unique project activity instance included in VTRM Renewable Energy grouped project is a complex called Ventos do Araripe III Complex, composed by fourteen wind power plants. Power plants, installed capacities, quantities of wind turbine generators (WTG), locations and operation start-up are presented in Table 1.

This Monitoring Report refers to the third verification of VTRM Renewable Energy which covers the period from 01/10/2020 to 31/12/2021. Total GHG emission reductions generated in this monitoring period is 459,705 tCO2e.

Table 1 – Project Activity Instance: Ventos do Araripe III Complex

Wind Power Plant	Installed Capacity (MW)	Nr. WTGs	Operation Startup	Location[1]
Ventos do Araripe III Complex	**358.8**	**156**	**09/12/2016**	Araripina - PE Simões and Curral Novo do Pauí - PI
Ventos de Santo Estevão I	25.3	11	23/06/2017	Araripina - PE
Ventos de Santo Estevão II	25.3	11	06/05/2017	Araripina - PE
Ventos de Santo Estevão III	29.9	13	09/12/2016	Araripina - PE
Ventos de Santo Estevão IV	29.9	13	03/10/2017	Araripina - PE
Ventos de Santo Estevão V	27.6	12	13/12/2016	Araripina - PE
Ventos de São Virgílio I	29.9	13	30/08/2017	Simões - PI
Ventos de São Virgílio II	29.9	13	10/02/2017	Simões and Curral Novo do Piauí - PI
Ventos de São Virgílio III	20.7	9	29/09/2017	Simões - PI
Ventos de Santo Onofre IV	27.6	12	14/06/2017	Simões - PI
Ventos de Santo Augusto I	18.4	8	18/02/2017	Simões - PI
Ventos de Santo Augusto II	27.6	12	29/12/2016	Simões - PI
Ventos de Santo Augusto VI	29.9	13	24/03/2017	Simões - PI
Ventos de Santo Augusto VII	18.4	8	04/03/2017	Simões - PI
Ventos de Santo Augusto VIII	18.4	8	24/12/2016	Simões - PI

1.2 Sectoral Scope and Project Type

Scope 1 – Energy (Renewable/Non-Renewable). VTRM Renewable Energy is a grouped project.

1.3 Project Proponent

[1] Operation startup is according to authorizations issued through ANEEL Ordinances. Available at: <https://biblioteca.aneel.gov.br/index.html>

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1.4 Other Entities Involved in the Project

Not applicable. There are no other entities involved in the project.

1.5 Project Start Date

09-December-2016

According to the VCS Standard v4.0, the project starting 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-December-2016, *i.e.* the operation startup of the first WTG of the Complex Ventos do Araripe III as can be checked in ANEEL Ordinance nr. 3,216 issued on 08-December-2016.

1.6 Project Crediting Period

09-December-2016 – 08-December-2026

Duration: 10 years, 0 months

According to the VCS Standard v4.0, the project crediting period shall be a maximum of ten years which may be renewed at most twice.

1.7 Project Location

Wind power plants of Ventos do Araripe III Complex are located in Araripina (PE), Simões and Curral Novo do Piauí (PI), northeastern region of Brazil. Coordinates of each plant are presented as follows according to the Brazilian Power Regulatory Agency (ANEEL/SIGEL):

Table 2 – UTM geographical Coordinates of Ventos do Araripe III Power Plants[2]

Wind Power Plant	Location	Geographical Coordinates	
		Latitude	Longitude
Ventos de Santo Estevão I	Araripina - PE	321255	9143642
Ventos de Santo Estevão II	Araripina - PE	320284	9143197
Ventos de Santo Estevão III	Araripina - PE	317101	9145380
Ventos de Santo Estevão IV	Araripina - PE	324189	9145598
Ventos de Santo Estevão V	Araripina - PE	315470	9141884
Ventos de São Virgílio I	Simões - PI	313781	9149811
Ventos de São Virgílio II	Simões and Curral Novo do Piauí - PI	309448	9138340
Ventos de São Virgílio III	Simões - PI	317237	9139278
Ventos de Santo Onofre IV	Simões - PI	309831	9143957
Ventos de Santo Augusto I	Simões - PI	315254	9143755
Ventos de Santo Augusto II	Simões - PI	314913	9140526

[2] Location of the first WTG: datum SIRGAS 2000, UTM 24 S (MER -39). Available at: https://sigel.aneel.gov.br/Down/

Wind Power Plant	Location	Geographical Coordinates	
		Latitude	Longitude
Ventos de Santo Augusto VI	Simões - PI	315140	9146958
Ventos de Santo Augusto VII	Simões - PI	314800	9145704
Ventos de Santo Augusto VIII	Simões - PI	314992	9140684

1.8 Title and Reference of Methodology

The project applies the CDM methodology ACM0002: "Grid-connected electricity generation from renewable sources" (version 19.0). ACM0002 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.

1.9 Participation under other GHG Programs

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

1.10 Other Forms of Credit

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

1.11 Sustainable Development Contributions

In addition to the emission reduction provided by the project activity, VTRM Renewable Energy project has brought many co-benefits including:

- The project supports 41 families in social vulnerability through the construction of agroecological backyards to promote sustainable agriculture for food production;

construction of systems for capturing and storing drinking water; and by promoting initiatives to ensure the availability of clean and affordable energy;

- The project distributed **504,315** personal protective equipment for 8 municipalities as a measure to increase the capacity to deal with the COVID-19 pandemic situation and help to improve the project surroundings communities' health and the quality of life. The project has contributed for the improvement of children and adolescents' education in the Pernambuco and Piauí states by focusing on: Training school principals and professionals from the municipal education departments also considering the society mobilization and awareness regarding the value of education. This educational approach seeks to enhance one of the main Brazilian Education Ministry KPI[3] (IDEB) among the municipalities influenced by the project.

Table below shows the Sustainable Development Contributions and Appendix 1 presents the evidence for these contributions.

[3] https://www.gov.br/inep/pt-br/areas-de-atuacao/pesquisas-estatisticas-e-indicadores/ideb

Table 3: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1	2.1	User-defined indicator: Hunger reduction through the implementation and maintenance of agroecological backyards[4]	Implemented activities to decrease hunger	No contribution during this monitoring period.[5]	**41** agroecological backyards implemented benefiting 41 **families (166 people)** in situations of social vulnerability received agroecological backyards to promote sustainable agriculture.
2	3.d	User-defined indicator: number of personal protective equipment donated to combat COVID-19	Implemented activities to increase	109,310 **protective equipment** donated.	**504,315 personal protective equipment** donated in 8 Brazilian municipalities as a measure to combat the COVID-19 pandemic, helping the local people and needy municipalities around the operations.

[4] Contribution 2.1 in this table has been updated, compared to previous reporting periods, to more accurately reflect the project's contributions to the Sustainable Development Goals.

[5] During this monitoring period, the same 41 agroecological backyards were used by population affected.

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
3	4.c	User-defined indicator: number of teachers awarded with initiatives to improve public education	Implemented activities to increase	No contributions during this monitoring period.	**421 teachers** participated in the PVE "Program for Valuing Education" which seeks to improve public education based on management practices with social mobilization of communities and teachers in 2 municipalities where the project operates.
4	6.1	6.1.1 Proportion of population using safely managed drinking water services	Implemented activities to increase	“De Vento em Popa” Project, in the semi-arid region, has contributed with initiatives that worked to ensure the availability and sustainable management of drinking water for local communities in situations of social vulnerability, in the municipality of Araripina (Pernambuco State). One new system was built in this monitoring period benefiting one family with 4 people.	The company provided 17 systems for storing and capturing drinking water, benefiting 68 people, helping needy communities in the vicinity of the operations.

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
5	6.1	6.2.1 Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water	Implemented activities to increase	"De Vento em Popa" Project, in the semi-arid region, has contributed with initiatives that worked to ensure the availability of basic sanitation for local communities in situations of social vulnerability, in the municipality of Araripina (Pernambuco State). It has been 2 built sanitation systems, including hand washing facility with soap and water, benefiting 8 people of 2 families during this monitoring people.	The company provided 29 sanitation systems, including hand-washing facility with soap and water, helping with basic sanitation for needy communities in the vicinity of the operations. 116 people of 29 families were benefited.
6	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	The operation of this project activity during this monitoring period avoided 459,705 tCO_2e.	The project achieved **2,443,918** tCO2e in the first two monitoring period already verified.

2 SAFEGUARDS

2.1 No Net Harm

The environmental licensing comprises the environmental impact assessment, which is a legal requirement 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 proponent presents just the negative environmental and social impacts identified at the Environmental Impact Assessment and actions planned to mitigate them. It is worthwhile to highlight those 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.

2.2 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 of 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 cause any change in the project.

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.

During VTRM Renewable Energy validation, the project was published for public comments following VCS requirements and it did not receive any comment.

2.3 AFOLU-Specific Safeguards

Not applicable. VTRM Renewable Energy is not an AFOLU project type.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The single and unique project activity instance included in VTRM Renewable Energy grouped project is Ventos do Araripe III Complex. The complex is operational since 09-December-2016.

Table below presents the main technical characteristics of power plants according to the Brazilian Power Regulatory Agency (ANEEL form the Portuguese *Agência Nacional de Energia Elétrica*). The average lifetime of the equipment is 20 years[6].

Table 4 – Technical Description of Ventos do Araripe III Power Plants

Wind Power Plant	Installed Capacity (MW)	Assured Energy (MW-ave)	Plant Load Factor (%)
Ventos de Santo Estevão I	25.3	12.40	49.0%
Ventos de Santo Estevão II	25.3	11.90	47.0%
Ventos de Santo Estevão III	29.9	14.20	47.5%
Ventos de Santo Estevão IV	29.9	14.20	47.5%
Ventos de Santo Estevão V	27.6	13.60	49.3%
Ventos de São Virgílio I	29.9	15.20	50.8%
Ventos de São Virgílio II	29.9	16.70	55.9%
Ventos de São Virgílio III	20.7	9.20	44.4%
Ventos de Santo Onofre IV	27.6	13.60	49.3%
Ventos de Santo Augusto I	18.4	9.00	48.9%
Ventos de Santo Augusto II	27.6	14.10	51.1%

[6] ANEEL (2009). Manual de Controle Patrimonial do Setor Elétrico. Annex of Normative Resolution nr. 367/2009, June 2nd, 2009. Available at: http://www.aneel.gov.br/cedoc/aren2009367_2_primeira_Ver.pdf. Last access on December 15th, 2020.

Wind Power Plant	Installed Capacity (MW)	Assured Energy (MW-ave)	Plant Load Factor (%)
Ventos de Santo Augusto VI	29.9	16.00	53.5%
Ventos de Santo Augusto VII	18.4	9.40	51.1%
Ventos de Santo Augusto VIII	18.4	9.00	48.9%

During the monitoring period, there were no events that may impact the GHG emission reductions or removals and monitoring.

3.2 Deviations

2.1.1 Methodology Deviations

Not applicable. No methodology deviations are applied to the project during the monitoring period.

2.1.2 Project Description Deviations

Not applicable. No deviations are applied to the project during the monitoring period.

3.3 Grouped Projects

There are no new instances to this grouped project.

4 DATA AND PARAMETERS

4.1 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 Electricity National Agency – ANEEL, available at the registered VCS Project Description.
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 and procedures applied	Data provided by ANEEL, available at the registered VCS Project Description.
Purpose of Data	Calculation of baseline emissions
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{facility,y}$
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 monitored	

Year	$EG_{facility,y}$
01 Oct 2020 - 31 Dec 2020	244,037.40

01 Jan 2021 - 31 Dec 2021	801,602.66
TOTAL	**1,045,640.06**

Monitoring equipment

At the substation CNP2, there are four meters (two principal and two rear) that register net electricity supplied to the grid by the project.

Data	**Principal Meter 01**	**Rear Meter 01**
Serial Number	MW – 1410A004-01	MW – 1401A151-01
Type	ION 8650	ION 8650
Class	D	D
Accuracy	0.20%	0.20%
Supplier	Schneider Electric	Schneider Electric
Calibration Date (2014)	12/12/2014	13/07/2014
Calibration Date (2021)	05/02/2021	05/02/2021
Error Identified – 2021 Calibration Certificate	0.14%	0.14%

Data	**Principal Meter 02**	**Rear Meter 02**
Serial Number	MW – 1410A005-01	MW – 1401A427-01
Type	ION 8650	ION 8650
Class	D	D
Accuracy	0.20%	0.20%
Supplier	Schneider Electric	Schneider Electric
Calibration Date (2014)	12/12/2014	12/07/2014
Calibration Date (2021)	05/02/2021	05/02/2021
Error Identified – 2021 Calibration Certificate	0.11%	0.12%

Class, precision and calibration procedures of the meters 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). According to procedures from the National Operator of the Electric System (ONS) applied to the monitoring period, until 2016 meters should be calibrated in 2-year frequency. From 2017 onwards, ONS Grid Procedures establishes calibration in a 5-year period.
Purpose of the data	Calculation of baseline emissions
Calculation method	This parameter is measured by the meters. Discount in $EG_{facility,y}$ parameter was applied based on the highest value between the last calibration results and the maximum permissible error of equipment was applied for the uncovered period by calibrations (From 01/10/2020 to 28/02/2021, conservatively). A conservative approach was used. The maximum permissible error was applied to the period between 01/10/2020 and 28/02/2021, once the maximum permissible error is higher than the errors identified in the delayed calibration test (2021).
Comments	CCEE - Entity responsible for measurements, accounting and settlement on Brazilian electric energy market.

Data / Parameter	$EF_{Grid,CM,y}$
Data unit	tCO_2e/MWh
Description	Combined margin emission factor for the grid in year y
Source of data	The combined margin emission factor was determined by using procedures established in "Tool to calculate the emission factor for an electricity system", version 07.0. Data for the $EF_{grid,OM,y}$, calculation was made available by the Brazilian Designated National Authority of the CDM (the Brazilian DNA), as well as $EF_{grid, BM,y}$.
Description of measurement methods	As per the "Tool to calculate the emission factor for an electricity system". For this the first crediting period of the project, W_{OM} = 0.75 and W_{BM} = 0.25.

<table>
<tr><td>and procedures to be applied</td><td>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</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Annually</td></tr>
<tr><td>Value monitored</td><td><table><tr><th>Year</th><th>$EF_{Grid,CM,y}$</th></tr><tr><td>01-Oct-2020 – 31-Dec-2020</td><td>0.3649</td></tr><tr><td>01-Jan-2021 – 31-Dec-2021</td><td>0.4624</td></tr></table></td></tr>
<tr><td>Monitoring equipment</td><td>Not applicable</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>As per the “Tool to calculate the emission factor for an electricity system”.</td></tr>
<tr><td>Purpose of the data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Calculation method</td><td>As per the “Tool to calculate the emission factor for an electricity system” using Dispatch Data Analysis for OM Operating Margin Emission Factor.</td></tr>
<tr><td>Comments</td><td>Detailed description for the calculation choices is presented in section 5.</td></tr>
</table>

4.3 Monitoring Plan

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 are conducted with calibrated measurement equipment according to Brazilian industry standards. The main parameters monitored are:

- $EG_{facility,y}$ - 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 ($EF_{Grid,CM,y}$).

Monitoring of $EG_{facility,y}$ parameter:

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 backup meter. 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 6.16) defines the calibration frequency and other maintenance procedures.

When the VCS PD was registered, the calibration frequency required by ONS was a maximum of two years. The PDD registered stated that calibration frequency should follow ONS procedures. In December/2016, ONS procedure Sub-module 6.16 was updated, and it established that meter's calibration should happen each 5 (five) years. Therefore, from 2017 onwards, ONS Grid Procedures establishes calibration in a 5-year period.

Project participants presented calibrated the meters in 2014 (Principal Meters in December/2014 and Rear meters in July/2014) and in 2021 (February/2021). Therefore, a conservative approach was used. The maximum permissible error was applied to the period between 01/10/2020 and 28/02/2021, once the maximum permissible error is higher than the errors identified in the delayed calibration test (2021).

Diagram below shows the measurement scheme of VTRM Renewable Energy:

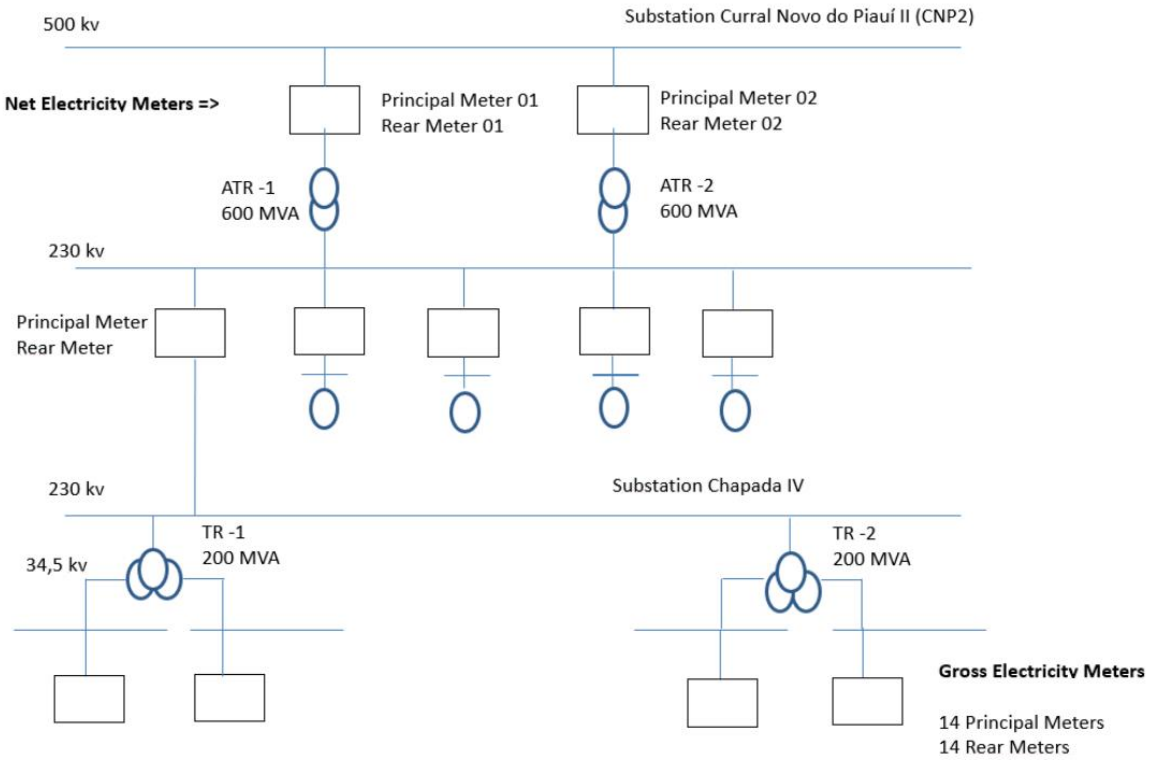

Figure 1 – Project measurement scheme

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. Data available by the Brazilian DNA is used.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The baseline emissions are calculated as follows:

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} \quad \textbf{Equation 01}$$

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:

$$EG_{PJ,y} = EG_{facility,y} \quad \textbf{Equation 02}$$

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)

Quantity of net electricity generation supplied by the project plant/unit to the grid

The net electricity dispatched to the grid during the monitoring period (01-October-2020 to 31-December-2021) is as follows according to monitored data.

Table 4 – Net electricity generation supplied by the project plant/unit to the grid (MWh)

Month	2020 (MWh)	2021 (MWh)
January		78,348.41
February		18,873.52
March		-
April		2,177.19
May		107,541.04
June		75,775.39
July		123,642.11
August		118,734.89
September		92,293.43
October	91,097.30	90,248.06
November	77,201.88	43,682.70
December	75,738.23	50,285.91
Total	**244,037.40**	**801,602.66**

Combined margin CO2 emission factor for grid connected power generation in year y

The CO2 emission factor of the grid is calculated by applying the following six steps of the "Tool to calculate the emission factor for an electricity system", version 07.0:

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". The

Brazilian Designated National Authority (DNA) defined in 2008, through the resolution nr. 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.

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.

Step 3: Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor (EFgrid,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 chosen method is the Dispatch data analysis operation margin.

Step 4: Calculate the operating margin emission factor according to the selected method;

The calculation of the Operation Margin emission factor follows the method by dispatch data analysis (EFgrid,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.

The dispatch data analysis OM emission factor (EFgrid,OM-DD,y) is determined based on the power units that are actually dispatched at the margin during each hour h where the project is displacing electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of EFgrid,OM-DD,y. As consequence it will be calculated ex-post. The EFgrid,OM-DD,y is calculated using the below formula:

$$EF_{grid,OM-DD,y} = \frac{\sum_{h} EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}}$$

Equation 03

Where:

EFgrid,OM-DD,y = Dispatch data analysis operating margin CO2 emission factor in year y (tCO2/MWh)

EGPJ,h = Electricity displaced by the project activity in hour h of the year y (MWh)

EFEL,DD,h = CO2 emission factor for power units in the top of the dispatch order in hour h in year y (tCO2/MWh)

EGPJ,y = Total electricity displaced by the project activity in year y (MWh)

h = Hours in year y in which the project activity is displacing grid electricity

y = Year in which the project activity is displacing grid electricit

The Brazilian DNA published EFEL,DD,h parameter for determination of EFgrid,OM-DD,y using option c) dispatch data analysis OM. Detailed information on the methods and data applied can be obtained at the DNA's website:

https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao

Considering hourly data from the Brazilian DNA (EFEL,DD,h) and hourly electricity generation of the project activity (EGPJ,h), EFgrid,OM-DD,y was calculated as follows:

Table 5 – Operating Margin Emission Factor (tCO_2e/MWh)

Year	*EFgrid,OM,y (tCO_2e/MWh)*
2020	0.4539
2021	0.5985

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 2 was chosen by project participants. The CO_2 build margin emission factors published by Brazilian DNA are as follows:

Table 6 –Build Margin Emission Factor (tCO_2e/MWh)

Year	*EFgrid,BM,y*
2020	0.0979
2021	0.0540

More information can be found at:https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/dados-e-ferramentas/fatores-de-emissao

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

The calculation of the combined margin (CM) emission factor (EFgrid,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:

$$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y} \quad \textbf{Equation 04}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/ MWh)

$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year *y* (tCO_2/ 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. Therefore, in accordance with the tool, the weights w_{OM} and w_{BM}, by default, are w_{BM} = 0.25 and w_{OM} = 0.75. The combined margin emission factor for each year of the monitoring period is as follows:

Table 7 –Combined Margin Emission Factor (tCO_2e/MWh)

Year	*EFgrid,OM,y (tCO_2e/MWh)*	*EFgrid,BM,y*	*W_{OM}*	*W_{BM}*	*EFgrid,CM,y*
2020	0.4539	0.0979	0.75	0.25	0.3649
2021	0.5985	0.0540	0.75	0.25	0.4624

5.2 Project Emissions

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

5.3 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.

5.4 Net GHG Emission Reductions and Removals

Table 8 –Net GHG Emission Reductions (tCO_2e)

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2020 (from 01/10/2020 to 31/12/2020)	*89,049*			*89,049*
2021	*370,656*			*370,656*
Total	***459,705***			***459,705***

APPENDIX I: EVIDENCE FOR SUSTAINABLE DEVELOPMENT CONTRIBUTIONS

Evidence for each contribution and required documents are provided below:

Target 2.1: Families in situations of social vulnerability received agroecological backyards to promote sustainable agriculture.

Description	Evidence	Evidence
Agroecological backyards of the “De Vento em Popa” in the semi-arid region.	 	
System for storing and capturing water for agriculture of the “De Vento em Popa” in the semi-arid region.	 	 

Target 3.d: User-defined indicator: number of personal protective equipment donated to combat COVID-19

Description	Evidence	Evidence
Sign of donation's term of individual protection equipment. Delivery of donation of individual protection equipment to Picos and Simões municipalities.		

Target 4.c: Photos of the PVE program that involves face-to-face training activities for education professionals and remote activities with students and education professionals, due to the COVID-19 pandemic.

Description	Evidence	Evidence
Images of online activities carried out by teachers, municipality education profession and mobilizers during the COVID-19 pandemic, 2021.	 	

Target 6.1: Families in situations of social vulnerability received systems for **storing and capturing drinking water and sanitation systems, including a hand-washing facility with soap and water.**

Description	Evidence	Evidence
Sanitation systems of the “De Vento em Popa” in the semi-arid region.		
System for capturing and storing drinking water of the “De Vento em Popa” in the semi-arid region.		

Target 13.0: Please refer to verified Monitoring report for the reporting period and validated Project Description: https://registry.verra.org/app/projectDetail/VCS/1812