



Verified Carbon Standard

VTRM RENEWABLE ENERGY 2 MONITORING REPORT

Document Prepared by Waycarbon Soluções Ambientais e Projetos de Carbono Ltda

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

VTRM Renewable Energy 2 Project (hereinafter referred as VTRM Renewable Energy 2) 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 2 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 2 grouped project is a complex called Ventos do Piauí Complex, composed by seven wind power plants. Power plants, installed capacity, quantity of wind turbine generators (WTG), location and operation start-up are presented in Table 1.

This Monitoring Report refers to the third verification of VTRM Renewable Energy 2 which covers the period from 01/10/2020 to 31/12/2021. Total GHG emission reductions generated in this monitoring period is 450,765 tCO₂e

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

Wind Power Plant	Installed Capacity (MW)	Nr. WTGs	Operation Startup	Location ¹
Ventos do Piauí Complex	205.8	98	02/08/2017	Curral Novo do Piauí - PI
Ventos de São Vicente 08	29.4	14	06/10/2017	Curral Novo do Piauí - PI
Ventos de São Vicente 09	29.4	14	06/12/2017	Curral Novo do Piauí - PI
Ventos de São Vicente 10	29.4	14	17/11/2017	Curral Novo do Piauí - PI
Ventos de São Vicente 11	29.4	14	09/11/2017	Curral Novo do Piauí - PI
Ventos de São Vicente 12	29.4	14	29/08/2017	Curral Novo do Piauí - PI
Ventos de São Vicente 13	29.4	14	19/09/2017	Curral Novo do Piauí - PI
Ventos de São Vicente 14	29.4	14	02/08/2017	Curral Novo do Piauí - PI

1.2 Sectoral Scope and Project Type

Scope 1 – Energy (Renewable/Non-Renewable). VTRM Renewable Energy 2 is a grouped project.

1.3 Project Proponent

Organization name	VTRM ENERGIA PARTICIPAÇÕES S.A.
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¹ Operation startup is according to authorizations issued through ANEEL Ordinances. Available at: <https://biblioteca.aneel.gov.br/index.html>

Organization name	Waycarbon Soluções Ambientais e Projetos de Carbono Ltda
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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

02-August-2017

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 2 is 02-August-2017, i.e. the operation startup of the first WTG of the Complex Ventos do Piauí as can be checked in ANEEL Ordinance nr. 2,328 issued on 01-August-2017.

1.6 Project Crediting Period

02-August-2017 – 01-August-2027

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 Piauí Complex are located in Curral Novo do Piauí, state of Piauí, 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 Plants²

Wind Power Plant	Geographical Coordinates	
	Latitude	Longitude
Ventos de São Vicente 08	320175	9114007
Ventos de São Vicente 09	317215	9113418
Ventos de São Vicente 10	319490	9114621
Ventos de São Vicente 11	319809	9115824
Ventos de São Vicente 12	321711	9112988
Ventos de São Vicente 13	322396	9115011
Ventos de São Vicente 14	325482	9116524

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.

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

1.10 Other Forms of Credit

Not applicable. The project has not sought or 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 2 project has brought many co-benefits including:

- The project supports 108 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 842,201 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 Piauí state 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 KPI³ (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	82 agroecological backyards implemented to promote sustainable agriculture in situations of social vulnerability.	108 agroecological backyards implemented benefiting 108 families 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	331,380 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.	842,201 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.

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 contribution during this monitoring period. ⁵	393 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 6 municipalities where the project operates.
4	6.1	6.1.1 Proportion of population using safely managed drinking water services	Implemented activities to increase	No contribution during this monitoring period.	24 people (6 families) were benefited by the provision of systems for storing and capturing drinking water , helping needy communities in the vicinity of the operations.

⁵ The number of teachers benefited by PVE is 393 teachers which is the total number of public school teachers in the cities involved. However, when a teacher is replaced by another one, the new teacher is also benefited by the program. However, the company just control the number of teachers covered.

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	No contribution during this monitoring period.	96 people (23 families) were positively impacted with the provision of sanitation systems, including hand-washing facility with soap and water, helping with basic sanitation for needy communities in the vicinity of the operations.
6	7.1	7.1.1 Proportion of population with access to electricity	Implemented activities to increase	No contribution during this monitoring period.	28 people were positively impacted. These people received 7 solar energy systems in line with ODS 7 which aims at reliable, sustainable, and modern energy sources in Curral Novo city.
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 450,765 tCO ₂ e.	The project achieved 1,456,194 tCO ₂ e over the lifetime. 1,005,429 tCO ₂ e was achieved in the first two monitoring period already verified. At this current monitoring period, the project avoided 450,765 tCO₂e during the whole monitored period.

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 that the 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.

- Change in the air quality caused by vehicle circulation, earth moving and operation of the machines;
- Noise generation related to civil works, earthworks, suppression of vegetation and other processes, during both implementation and operation phases, changing local acoustic conditions;
- Alteration of the surface layer of the soil caused by the removal of vegetation, with direct soil exposure to sunlight and rain, and the rotation of the material with earthmoving and excavation services
- Geomorphological change with the regularization of the area;
- Intensification of erosive processes by soil waterproofing and increased of surface runoff;
- Alteration in the recharge of the aquifer by the increase of the surface runoff caused by the suppression of the vegetation;
- Change in surface water flow due to decreased drainage flow;
- Pressure on water resources;

- Vegetation suppression will directly result in damage to the vegetation cover and the reduction of local biodiversity;
- The deforestation action will result in alteration of the landscape by loss of biotic potential;
- Temporary disturbance of fauna caused by noise emission;
- Intervention in permanent preservation areas;
- Risks with accidents with birds and bats during operational phase;
- Tension over population related to job creation;
- Increased risk of accidents due to higher vehicle traffic in the region;
- Higher heavy equipment circulation might lead to the degradation of roadways, especially during the rainy season, which can increase the risk of accidents;
- Risk of incidents with people during construction activities;
- Impacts on archeological heritage caused by land moving;
- Decrease of jobs after construction phase
- Impacts on the original landscape

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

- Environmental Plan for Construction;
- Noise Monitoring Program;
- Control and Deforestation Program;
- Degraded Areas Recovery Program;
- Program for the Protection of Permanent Preservation Areas;
- Rational Deforestation Program;
- Wildlife Monitoring Program;
- Environmental Education Program;
- Wildlife Protection and Management Program;
- Social Communication Program;

- Civil Works Signaling Program;
- Worker Protection and Workplace Safety Program;
- Archaeological Heritage Management Plan;
- Program for Paleontological Identification, Monitoring and Rescue;
- Environmental Program for Construction;
- Program for Technical Training and Use of Manpower.

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 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. 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 public audience notice was published in a regional large circulation newspaper, radios and banners. Date, hour and place of the event were presented in advance.

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.

Public audiences for the seven WPPs were held in the 3 cities identified as directly or indirectly affected by the project activity:

Curral Novo do Piauí/PI: January 19th, 2016;

Betânia do Piauí/PI: January 20th, 2016;

Paulistana/PI: January 21th, 2016.

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 2 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 2 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 2 grouped project is Ventos do Piauí Complex. The complex is operational since 02-August-2017.

Table below presents the main technical characteristics of power plants according to the Brazilian Power Regulatory Agency (ANEEL from the Portuguese *Agência Nacional de Energia Elétrica*). The average lifetime of the equipment is 20 years⁶.

Table 4 – Technical Description of Ventos do Piauí Power Plants

Wind Power Plant	Installed Capacity (MW)	Assured Energy (MW-ave)	Plant Load Factor (%)
Ventos de São Vicente 08	29.4	15.20	51.7%
Ventos de São Vicente 09	29.4	15.20	51.7%
Ventos de São Vicente 10	29.4	15.20	51.7%
Ventos de São Vicente 11	29.4	15.00	51.0%
Ventos de São Vicente 12	29.4	15.00	51.0%
Ventos de São Vicente 13	29.4	15.40	52.4%

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 São Vicente 14	29.4	15.30	52.0%

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	8.8%
Justification of choice of data or description of	Data provided by Electricity National Agency – ANEEL, available at the registered VCS Project Description.

measurement methods and procedures applied	
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	14,390,293
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	$EG_{\text{facility},y}$							
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 monitored	<table border="1"> <thead> <tr> <th>Year</th> <th>$EG_{\text{facility},y}$</th> </tr> </thead> <tbody> <tr> <td>01 Oct 2020 - 31 Dec 2020</td> <td>190,146</td> </tr> <tr> <td>01 Jan 2021 - 31 Dec 2021</td> <td>824,797</td> </tr> </tbody> </table>	Year	$EG_{\text{facility},y}$	01 Oct 2020 - 31 Dec 2020	190,146	01 Jan 2021 - 31 Dec 2021	824,797	
Year	$EG_{\text{facility},y}$							
01 Oct 2020 - 31 Dec 2020	190,146							
01 Jan 2021 - 31 Dec 2021	824,797							

	TOTAL	1,014,943																								
Monitoring equipment	<p>At the substation CNP2, there are two meters (one principal and one rear) that register net electricity supplied to the grid by the project.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Data</th> <th style="width: 35%;">Principal Meter 01</th> <th style="width: 35%;">Rear Meter 01</th> </tr> </thead> <tbody> <tr> <td>Serial Number</td> <td>MW – 1608A545-02</td> <td>MW – 1608A683-02</td> </tr> <tr> <td>Type</td> <td>ION 8650</td> <td>ION 8650</td> </tr> <tr> <td>Class</td> <td>D</td> <td>D</td> </tr> <tr> <td>Accuracy</td> <td>0.20%</td> <td>0.20%</td> </tr> <tr> <td>Supplier</td> <td>Schneider Electric</td> <td>Schneider Electric</td> </tr> <tr> <td>Calibration 2016 -</td> <td>21/09/2016</td> <td>23/09/2016</td> </tr> <tr> <td>Calibration 2021 -</td> <td>05/02/2021</td> <td>05/02/2021</td> </tr> </tbody> </table> <p>Class, precision and calibration procedures of the meters follow ONS and National Authorities Guidelines and Procedures.</p>		Data	Principal Meter 01	Rear Meter 01	Serial Number	MW – 1608A545-02	MW – 1608A683-02	Type	ION 8650	ION 8650	Class	D	D	Accuracy	0.20%	0.20%	Supplier	Schneider Electric	Schneider Electric	Calibration 2016 -	21/09/2016	23/09/2016	Calibration 2021 -	05/02/2021	05/02/2021
Data	Principal Meter 01	Rear Meter 01																								
Serial Number	MW – 1608A545-02	MW – 1608A683-02																								
Type	ION 8650	ION 8650																								
Class	D	D																								
Accuracy	0.20%	0.20%																								
Supplier	Schneider Electric	Schneider Electric																								
Calibration 2016 -	21/09/2016	23/09/2016																								
Calibration 2021 -	05/02/2021	05/02/2021																								
QA/QC procedures to be applied	<p>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.</p> <p>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).</p> <p>According to procedures from the National Operator of the Electric System applied to the monitoring period, meters should be calibrated in 2-year frequency. From 2017 onwards, ONS Grid Procedures establishes calibration in a 5-year period.</p>																									
Purpose of the data	Calculation of baseline emissions																									
Calculation method	This parameter is measured by the meters. 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 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 and procedures to be applied	<p>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.</p> <p>As VTRM Renewable Energy 2 uses Dispatch data analysis OM method for operating margin emission factor, EF_{grid,OM,y} is calculated ex post.</p> <p>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</p>								
Frequency of monitoring/recording	Annually								
Value monitored	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 60%;">Year</th> <th style="width: 40%;">EF_{Grid,CM,y}</th> </tr> </thead> <tbody> <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> </tbody> </table>			Year	EF _{Grid,CM,y}	01-Oct-2020 – 31-Dec-2020	0.3649	01-Jan-2021 – 31-Dec-2021	0.4624
Year	EF _{Grid,CM,y}								
01-Oct-2020 – 31-Dec-2020	0.3649								
01-Jan-2021 – 31-Dec-2021	0.4624								
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 the data	Calculation of baseline emissions								

Calculation method	As per the “Tool to calculate the emission factor for an electricity system” using Dispatch Data Analysis for OM Operating Margin Emission Factor.
Comments	Detailed description for the calculation choices is presented in section 5.

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:

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

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

Operation and Maintenance (O&M) team is responsible for the operation and maintenance activities of the plants. Votorantim Energia Generation Operating Center (Centro de Operação da Geração da Votorantim Energia – COG, in Portuguese) is responsible for measurement activities. It collects and stores all measurement data.

Data is collected in real time and is available at web platform. Commercial team is responsible for monitoring and analysing $EG_{\text{facility},y}$ information. It monitors data provided by COG and cross-check it with information provided by Chamber of Electricity Commercialization (CCEE). 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. Substation CHAPADINHA (34.5 to 230kV), which the WPPs included in this project activity are connected to, has individual measuring equipment for each facility connected. This substation can also include energy generated by facilities outside the boundary project.

At substation Curral Novo do Piauí II (CNP2), there are two meters (one principal and one rear) that register net electricity supplied to the grid ($EG_{\text{facility},y}$) by all 7 plants that compose the initial project instance. These meters can also include energy generated by facilities outside the project boundary. The total amount dispatched to the SIN monitored by these meters will be prorated between each

project facility according to the proportional amount of electricity generation measured in the electrical substation for each facility.

ONS Grid Procedures (Sub-module 6.16) 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 VTRM Renewable Energy 2 :

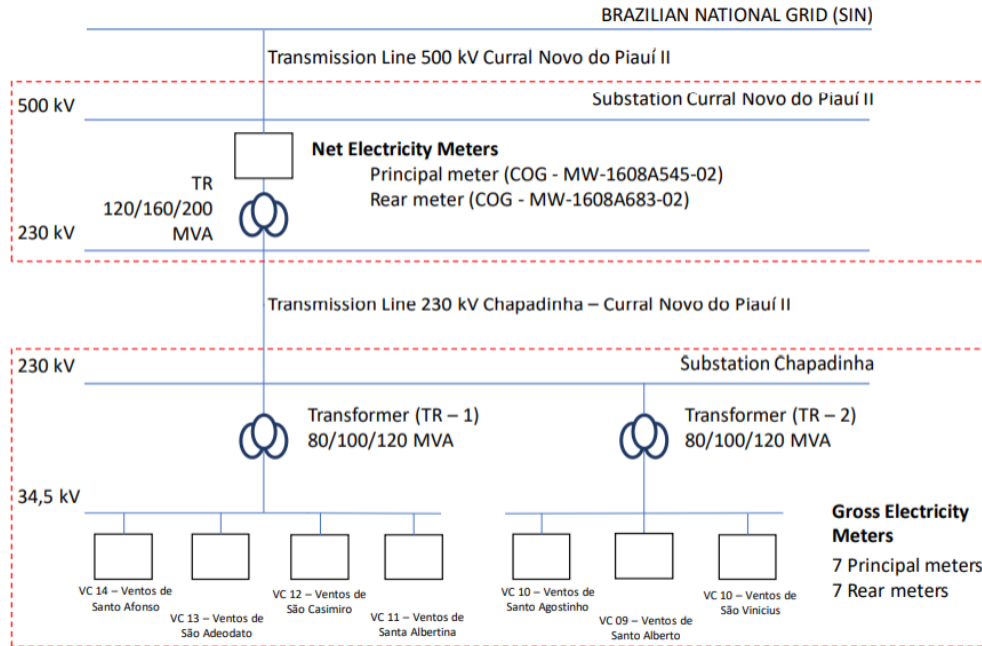


Figure 1 – Project measurement scheme

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:

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

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)

As **VTRM Renewable Energy 2** just comprises greenfield wind power plants, then:

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

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		58,422.44
February		26,147.35
March		43,437.85
April		55,696.25
May		91,041.11
June		87,752.24
July		107,322.66
August		111,394.73
September		95,904.27
October	71,526.57	72,236.06
November	63,637.41	38,972.59
December	54,982.05	36,469.97
Total	190,146.02	824,797.52

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 ($EF_{grid,OM,y}$) 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 analysis operation margin method.

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.

The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) 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

EF_{grid,OM-DD,y}. As consequence it will be calculated ex-post. The EF_{grid,OM-DD,y} will be 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:

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

EG_{PJ,h} = Electricity displaced by the project activity in hour h of the year y (MWh)

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

EG_{PJ,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 EF_{EL,DD,h} parameter for determination of EF_{grid,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 (EF_{EL,DD,h}) and hourly electricity generation of the project activity (EG_{PJ,h}), EF_{grid,OM-DD,y} was calculated as follows:

Table 5 – Operating Margin Emission Factor (tCO₂e/MWh)

Year	EF _{grid,OM,y} (tCO ₂ e/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 that was chosen by project participants was Option 2.

The CO₂ build margin emission factors published by Brazilian DNA are as follows:

Table 6 –Build Margin Emission Factor (tCO_{2e}/MWh)

Year	<i>EF_{grid,BM,y}</i>
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 ($EF_{grid,CM,y}$) 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:

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

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 $W_{BM} = 0.25$.

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 (tCO₂e/MWh)

Year	<i>EF_{grid,OM,y}</i> (tCO ₂ e/MWh)	<i>EF_{grid,BM,y}</i>	<i>W_{OM}</i>	<i>W_{BM}</i>	<i>EF_{grid,CM,y}</i>
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, P_{Ey} = 0. This is applied to grid-connected wind power plants as the enterprises of VTRM Renewable Energy 2.

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 (tCO₂e)

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)
2020 (from 01/10/2020 to 31/12/2020)	69,384			69,384
2021	381,381			381,381
Total	450,765			450,765

6 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
<p>Agroecological backyards of the program “Bem Viver” in the semi-arid region.</p>		

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

Description	Evidence	Evidence
<p>Sign of donation’s term of individual protection equipment.</p> <p>Delivery of donation of individual protection equipment to Picos and Simões municipalities.</p>		

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
<p>Images of online activities carried out by teachers, municipality education profession and mobilizers during the COVID-19 pandemic, 2021.</p>	