VTRM RENEWABLE ENERGY 2 MONITORING REPORT

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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 fourth verification of VTRM Renewable Energy 2 which covers the period from 01/01/2022 to 31/12/2022. Total GHG emission reductions generated in this monitoring period is 249,042 tCO2e.

The audit history of the project is presented in the table below:

Table 1 – Audit history of the project

Audit Type	Period	Program	VVB Name	Number of years
Validation	25-July-2019	Verified Carbon Standard	Earthood Services Private Limited	
Verification	02-August-2017 – 28-February-2020	Verified Carbon Standard	Earthood Services Private Limited	0.58 years (7 months)
Verification	01-March-2019 – 30-September-2020	Verified Carbon Standard	RINA Services s.p.A.	1.58 years (19 months)

Audit Type	Period	Program	VVB Name	Number of years
Verification	01-October-2020 – 31-December-2021	Verified Carbon Standard	RINA Services s.p.A	1.25 years (15 months)
Verification	01-January-2022 – 31-December-2022	Verified Carbon Standard	RINA Services s.p.A.	1 year
Total				4.4 years

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	AUREN ENERGIA S.A.[1]
Contact person	Alexsandro Antonio Cota
Title	Executive Sustainable Manager
Address	8501, Dra. Ruth Cardoso Av., 2nd Floor, São Paulo/SP, Brazil
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1.4 Other Entities Involved in the Project

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

[1] VTRM Energia Participações S.A. changed its name. The current name of the company is Auren Energia S.A.

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 1 – UTM geographical Coordinates of the Power Plants[2]

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

[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	Geographical Coordinates	
	Latitude	Longitude
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 it is not seeking registration under any other GHG programs.

1.10 Other Forms of Credit and Supply Chain (Scope 3) Emissions

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 2 project has developed several sustainable development contributions through actions including: (I) supporting families in social vulnerability through the construction of agroecological backyards to promote sustainable agriculture for food production; (II) construction of systems for capturing and storing drinking water; (III) promoting initiatives to ensure the availability of clean and affordable energy; (IV) distributing personal protective equipment for 8 municipalities as a measure to increase the capacity to deal

with the COVID-19 pandemic situation; (V) Training school principals and professionals from the municipal education departments also considering the society mobilization and awareness regarding the value of education; (VI) developing programs that seek to promote and stimulate new economic activities in the semiarid region communities, including production and sales of food products and sheep and goat breeding; (VII) To build and to upgrade education facilities to provide safe, gender sensitive, nonviolent, inclusive and effective learning environments for all; (VIII) investing in education to Ensure that all youth and a substantial proportion of adults in the region, both men and women, achieve literacy and numeracy; (IX) supporting and developing municipal institutions to ensure children and adolescents rights and protection.

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

.

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[3]	Implemented activities to decrease	No additional agroecological backyards was implemented in 2022. However, during 2022, maintenance activities were developed to agroecological backyards implemented in the last years	**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	No contributions during this monitoring period.	**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.

[3] 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	65 teachers awarded with initiatives to improve public education.	**458 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.

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.

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
7	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 222,225 tCO_2e.	The project achieved **1,705,236 tCO2e** over the lifetime. 1,456,194 tCO2e was achieved in the first three monitoring period already verified. At this current monitoring period, the project avoided 249,042 tCO_2e during the whole monitored period.

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
8	2.1.1	Prevalence of undernourishment	Implemented activities to decrease	"Redes Incubação - Vila do Mel (Grupo Garapa)", "ReDes Projeto - Mulheres Fortes" and "ReDes Projetos - Ovinos e Caprinos" are three projects developed to promote and stimulate new economic activities in the semiarid region communities. The activities include production and sales of food products and sheep and goat breeding. 92 families in situations of social vulnerability received technical aid to improve their productive and economic activities helping 368 people.	**368 people from 92 families,** in situations of social vulnerability, received technical aid to improve their productive and economic activities in Curral Novos do Piauí and Betânia do Piauí (PI).

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
9	4.a	User-defined indicator: Number of education facilities built or upgraded	Implemented activities to increase.	Build and upgrade education facilities that are friendly to children with disability and provide safe, gender sensitive, nonviolent, inclusive and effective learning environments for all. Upgrade on two education facilities "Escola Municipal Ulisses Guimarães" and "Escola Municipal Antonio Secundino", improving infrastructure for 556 children.	**Two schools** upgraded impacting **556** children.

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
10	4.6	User-defined indicator: Number of adults achieving literacy and numeracy	Implemented activities to increase.	Ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy. In 2022, 22 teachers participated in educational qualification for this specific public. Results are expected to happen in 2023. 60 vacancies are expected to open for students in 2023.	In 2022, **22 teachers qualified**. Zero adults achieved literacy and numeracy. Results are expected to happen in 2023.

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
11	16.6	User-defined indicator: number of organizations trained.	Implemented activities to increase.	"VIA Rede de Proteção" is a project that envisions supporting and developing municipal institutions that ensure children and adolescents rights and protection. The project focus on strengthening the Municipal Council for the Rights of Children and Adolescents to be more efficient, accountable, and transparent. 21 organizations and over 60 people from 2 municipal councils took part on the project and evolved their management maturity levels.	**21 institutions and 60 people** were trained and participated of meetings of this project.

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 form the Portuguese *Agência Nacional de Energia Elétrica*). The average lifetime of the equipment is 20 years[4].

Table 2 – 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%
Ventos de São Vicente 14	29.4	15.30	52.0%

[4] 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.

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

3.2 Deviations

3.2.1 Methodology Deviations

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

3.2.2 Project Description Deviations

In this monitoring period, there are a deviation from the monitoring plan. The measurement points where the net electricity generation supplied by the project plant/unit to the grid is measured was changed in 12/04/2022. This change happened because the company Simões Transmissora de Energia Elétrica S.A took over the operation of the 230kV sector of the connection substation Curral Novo do Piauí II.

With this change, the meters used for measurement of net electricity generation supplied by the project plant/unit to the grid were also changed. They are now located in the 230kV transmission line.

This deviation does not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario, and the project remains in conformance with the applied methodology.

3.3 Grouped Projects

Not applicable. There are no new instances in 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 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	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	$EG_{facility,y}$
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 in the 230kV transmission line
Description of measurement methods and procedures to be applied	Electricity Meters

<table>
<tr><td>Frequency of monitoring/recording</td><td>Continuous measurement and at least monthly recording</td></tr>
<tr><td>Value monitored</td><td>
<table>
<tr><th>Year</th><th>$EG_{facility,y}$</th></tr>
<tr><td>01 Jan 2022 - 31 Dec 2022</td><td>798,500</td></tr>
<tr><td>TOTAL</td><td>798,500</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>
Until 11/04/2022, the measurement of net electricity supplied to the grid by the project happened through two meters (one principal and one rear) located in the substation CNP2. These meters have the following characteristics and information:

Meters information until 11/04/2022
<table>
<tr><th>Data</th><th>Principal Meter 01</th><th>Rear Meter 01</th></tr>
<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 - 2021</td><td>05/02/2021</td><td>05/02/2021</td></tr>
</table>
In 12/04/2022, the measurement point, and the meters were changed as described in item 3.2.2 of this MR. They are now located in the transmission line. Information regarding meters used after 11/04/2022 are provided as follows:

Meters information after 12/04/2022
<table>
<tr><th>Data</th><th>Principal Meter 01</th><th>Rear Meter 01</th></tr>
<tr><td>Serial Number</td><td>MW-1608A513-02</td><td>MW-1608A554-02</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 - 2021</td><td>05/02/2021</td><td>05/02/2021</td></tr>
</table>
</td></tr>
</table>

	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 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.
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_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 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, W_{OM} = 0.75 and W_{BM} = 0.25. As VTRM Renewable Energy 2 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
Frequency of monitoring/recording	Annually
Value monitored	<table><tr><th>Year</th><th>$EF_{Grid,CM,y}$</th></tr><tr><td>01-Jan-2022 – 31-Dec-2022</td><td>0.3119</td></tr></table>
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:

- $EG_{facility,y}$ - 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. Auren Energia Generation Operating Center (Centro de Operação da Geração da

Auren Energia – COG, in Portuguese) is responsible for measurement activities. It collects and storages all measurement data.

Data is collected in real time and is available at web platform. Commercial team is responsible for monitoring and analysing EGfacility,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.

Until 11/04/2022, the measurement of net electricity supplied to the grid by the project happened through two meters (one principal and one rear) located in the substation Curral Novo do Piauí II (CNP2). From 12/04/2022, the measurement point, and the meters were changed as described in item 3.2.2 of this MR. They are now located in the 230kV transmission line.

These meters which register net electricity supplied to the grid (EGfacility,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 :

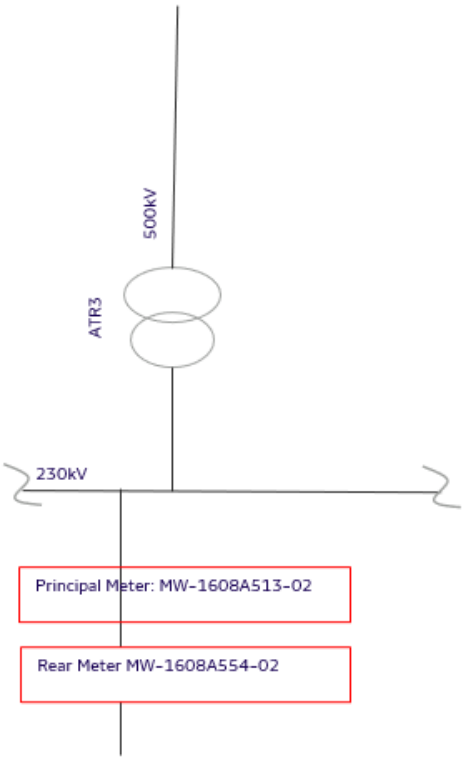

Figure 1 – Project measurement scheme

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:

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

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** 2 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-January-2022 to 31-December-2022) was measured according to monitored plan. $EG_{facility,2022}$ = 798,500

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 CO_2 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 ($EF_{grid,OM\text{-}DD,y}$) 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 ($EF_{grid,OM\text{-}DD,y}$) 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

$EF_{grid,OM\text{-}DD,y}$. As consequence it is calculated ex-post. The $EF_{grid,OM\text{-}DD,y}$ 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:

$EF_{grid,OM\text{-}DD,y}$ = Dispatch data analysis operating margin CO_2 emission factor in year y (tCO_2/MWh)

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

$EF_{EL,DD,h}$ = CO_2 emission factor for power units in the top of the dispatch order in hour h in year y (tCO_2/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 electricity

The Brazilian DNA published $EF_{EL,DD,h}$ parameter for determination of $EF_{grid,OM\text{-}DD,y}$ 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 ($EG_{PJ,h}$), $EF_{grid,OM\text{-}DD,y}$ was calculated as follows:

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

Year	*EFgrid,OM,y (tCO_2e/MWh)*
2022	0.4069

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 latest CO_2 build margin emission factor published by Brazilian DNA is from 2022 as follows:

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

Year	$EFgrid,BM,y$
2022	0.0270

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:

$$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y}$$ **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*
2022	0.4069	0.0270	0.75	0.25	0.3119

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 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 (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)
Year 2022 (01-January-2022– 31-December-2022)	*249,042*	*0*	*0*	*249,042*
Total	*249,042*	*0*	*0*	*249,042*

Table 9 –Ex-ante emission reductions x Achieved emission reductions (tCO_2e)

Ex-ante emissions reductions /removals	Achieved emissions reductions /removals	Percent difference	Justification for the difference
439,950 tCO2e	249,042 tCO2e	-43.3%	Achieved emissions reductions were 43.3% lower than ex ante estimated due to the fact that $Eg_{facility,y}$ and $EF_{grid,CM}$ achieved were lower than estimated as follows. $Eg_{facility,y}$ ex ante estimated was 1,060,590 MWh[5] per year. $EG_{facility,2022}$ was 798,500 MWh. Therefore $EG_{facility}$ achieved was 24.7% lower than estimated.

[5] Pages 36 and 37 of the Joint Project Description & Monitoring Report.

			$EF_{grid,CM}$ ex ante estimated was related to 2018 which was 0.4385 tCO2/MWh[6] and $EF_{grid,CM}$ of 2022 was 0.3119. Therefore, $EF_{grid,CM}$ achieved was 28.8% lower than estimated.

[6] Page 38 of the Joint Project Description & Monitoring Report.

APPENDIX 1: EVIDENCE FOR SUSTAINABLE DEVELOPMENT CONTRIBUTIONS

Evidence for historic sustainable development contributions 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 program “Bem Viver” 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.

Description	Evidence	Evidence
Images of activities carried out with teachers from public schools of "Program for Valuing Education" (PVE).	 	 

Target 2.1.1: Photos of “Redes Incubação – Vila do Mel”, “ Redes Projeto – Mulheres Fortes” and “Redes Projeto – Ovinos e Caprinos”.

Description	Evidence	Evidence
Photos of activities carried out in projects “Redes Incubação – Vila do Mel”, “ ReDees Projeto – Mulheres Fortes” and “ReDes Projetos – Ovinos e Caprinos	 	 

Target 4.a: Photos of schools where facilities were upgraded impacting 556 children.

Description	Evidence	Evidence
Photos of schools where facilities were upgraded to be friendly to children with disabilities.		

Target 16.6: Photos of meetings with institutions of “VIA Rede de Proteção” project.

Description	Evidence	Evidence
Photos of meetings with institutions of “VIA Rede de Proteção” project