Project design document form

(Version 10.1)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Energia dos Ventos I, II, III, IV and X CDM Project (JUN1184), Brazil
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	2.4
Completion date of the PDD	12/06/2019
Project participants	Energia dos Ventos I S.A.; Energia dos Ventos II S.A.; Energia dos Ventos III S.A.; Energia dos Ventos IV S.A.; Energia dos Ventos X S.A.
Host Party	Brazil
Applied methodologies and standardized baselines	Methodology ACM0002 "Grid-connected electricity generation from renewable sources " version 16.0
Sectoral scopes linked to the applied methodologies	1 - Energy Industries (renewable/non-renewable sources)
Estimated amount of annual average GHG emission reductions	200,274 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The project activity purpose is the construction of 5 onshore Wind Power Plants (WPPs) named *Goiabeira, Ubatuba, Santa Catarina, Pitombeira* and *Ventos de Horizonte* with final installed capacity of *23.1, 12.6, 18.9, 27.3 and 16.8 MW* respectively (they are Greenfield Power Plants). The plants will be managed respectively by the Energia dos Ventos I S.A.; Energia dos Ventos II S.A.; Energia dos Ventos III S.A.; Energia dos Ventos IV S.A. and Energia dos Ventos X S.A.[1], special purpose entities responsible for the power plants construction and operation.

So the "*Energia dos Ventos I, II, III, IV and X CDM Project (JUN1184), Brazil*" involves the construction of 5 new Wind Power Plants in the municipality of *Aracati*, in Ceará State, Brazil. The WPPs extents an area of 11.3897 km^2 on total.

The project activity main purpose is providing electric power to the Brazilian National Interconnected System - *SIN* (from Portuguese *Sistema Interligado Nacional*), displacing the thermal generation from fossil fuels for renewable energy generation.

Moreover, it improves the country electricity supply, contributing to environmental sustainability and increasing the renewable energy share in relation to total electricity consumption in Brazil.

Considering that the project activity forecasts the construction of 5 onshore Wind Power Plants, it represents low environmental impacts and contribute to efficient use of natural resources, avoiding environmental and social liabilities caused by natural resources exploitation through low efficiency approaches, which may cause significant impacts to the local populations (human, vegetable and animal).

Concerning project contribution for mitigating Greenhouse Gas emissions (GHG), the project activity reduces these gases avoiding thermoelectric fossil-fuelled plants operation (GHG reductions are estimated in 200,274 tCO_2e/year or 1,401,917 tCO_2e for the first 7 years). In absence of the project activity, fossil fuels would be burned in thermoelectric power plants connected to the grid to supply the electrical consumption of the country. This is considered the baseline scenario and the prior to WPPs operation scenario. The Project activity annually delivers to the SIN 456,726 MWh on renewable electricity.

The project activity initiative helps Brazil to meet its goals related to promoting sustainable development also aligned with CDM (Clean Development Mechanism) specific requirements for the host country, because:

- It contributes to environmental sustainability as reduce fossil energy use (non-renewable sources). Thus the project contributes to best use of natural resources and makes use of clean and efficient technologies;
- It increases local employment opportunities;
- It enhances local economy, reducing the amount of pollution released into the atmosphere and associated social costs related.

Moreover, the project diversifies electricity generation sources and decentralization bringing specific benefits such as:

[1] Energia dos Ventos I S.A.; Energia dos Ventos II S.A.; Energia dos Ventos III S.A.; Energia dos Ventos IV S.A.; Energia dos Ventos X S.A., are part of *Alupar Investimentos S.A* (hereafter referred to as Alupar), and were created after *Alupar* has won the bidding procedure by ANEEL 007/2011 for the concession of the wind potentials in Aracati City (Ceará, Brazil).

- Increased reliability, with shorter and less extensive interruptions;
- Better quality energy for the region;
- Less losses in transmission and distribution lines;
- Control energy reactive;
- Mitigation in transmission and distribution congestion.

The proposed CDM project activity is not a CPA that has been excluded from a registered CDM PoA as a result of erroneous inclusion of CPAs.

A.2. Location of project activity

WPPs are located in Aracati City, Ceará State, Brazil. The site's location coordinates are:

WPP Goiabeira	4º34'57.1" S and 37º42'55.8" W	-4.582528 S and -37.7155 W
WPP Ubatuba	4º39'1.3" S and 37º37'4.7" W	-4.650361 S and -37.617972 W
WPP Santa Catarina	4º35'4.4" S and 37º40'34.9" W	-4.584556 S and -37.676361 W
WPP Pitombeira	4º35'16.7" S and 37º38'53.1" W	-4.587972 S and -37.648083 W
WPP Ventos de Horizonte	4º36'27" S and 37º41'42.6" W	-4.6075 S and – 37.695167 W

Project activity location is illustrated in the figures below:

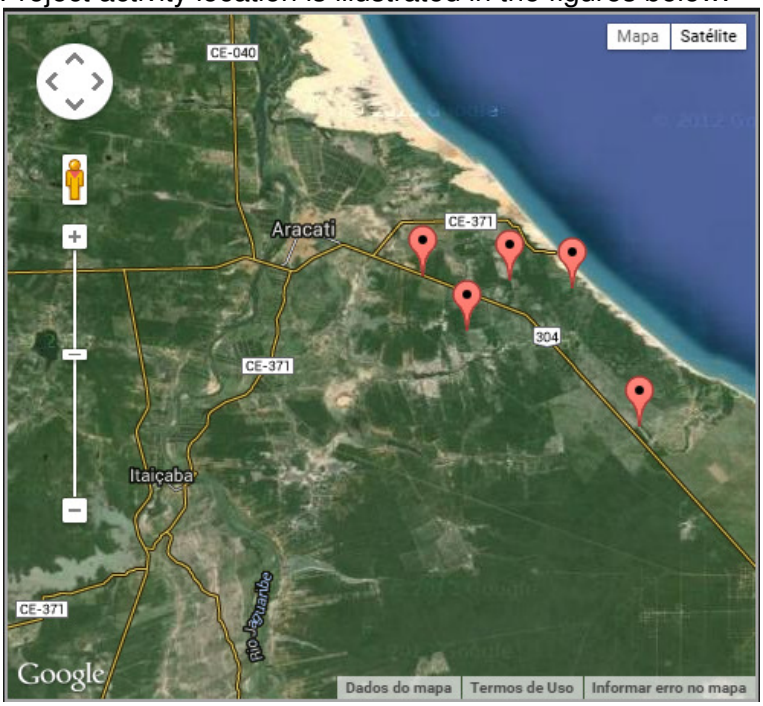

Figure 1: Location of the project activity

Figure 2: Location of the project activity

A.3. Technologies/measures

The Project Activity involves the construction of 5 Wind Power Plants called Goiabeira, Ubatuba, Santa Catarina, Pitombeira and Ventos de Horizonte with installed capacity of 23.1, 12.6, 18.9, 27.3 and 16.8 MW respectively. The fields are onshore near sea where can be expected maximum wind exposure.

Wind Turbines

The Wind technology for power generation had origin in developed countries and nowadays is well established in Brazil with most equipments being manufactured locally by foreign and also Brazilian companies.

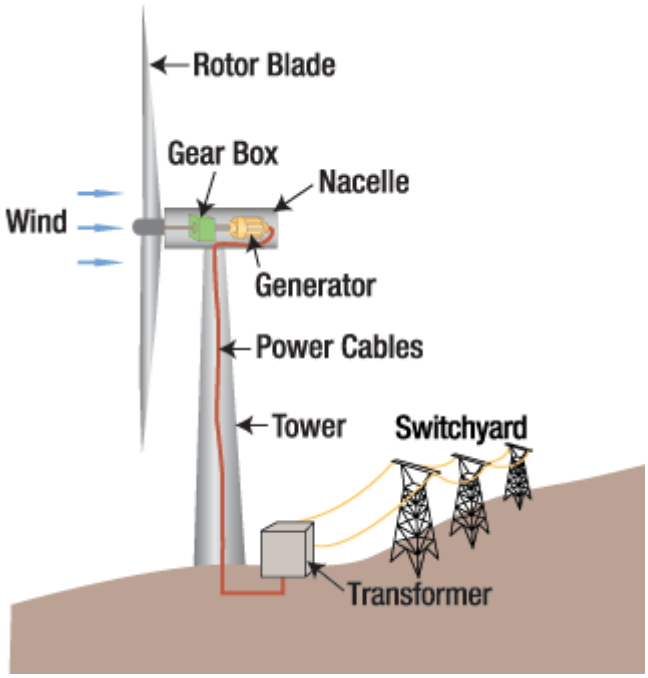

Figure 3: Wind Turbine - Source: http://energyinformative.org/windenergy

The diagram presents the basic layout of the wind turbine that moves by wind flows operating on this way a gearbox. The generator converts mechanical into electrical energy. The energy is then sent to transformers and finally transmitted by electrical cables.

Wind Power Plant	Installed Power MW	Assured Energy MW avg	Number of Towers
GOIABEIRA	23.1	11.957	11
UBATUBA	12.6	6.8766	6
SANTA CATARINA	18.9	9.5746	9
PITOMBEIRA	27.3	15.475	13
VENTOS DE HORIZONTE	16.8	8.2544	8

Each Power Unit shall be manufactured with 2.1 MW of installed capacity (Generator Capacity), since they are new equipments are expected 20 years of average lifetime in accordance with technical specifications.
The wind turbines shall be the model: **WEG AGW110 – 2.1MW**, with the following characteristics:

WEG AGW110-2.1MW	
Power Capacity	2.1 MW
Rotor Blade Diameter	110 m
Loftiness	120 m
Maximum Spin	14 rpm
Minimum Spin	6.5 rpm
Nominal Wind speed	11 m/s
Noise on the base	104 dBA

Table 1: Technical specifications

Transmission

The electricity generated by the 5 WPPs shall be delivered through transmission lines with 34.5 KV to **Pitombeira Substation** located in the site of WPP Pitombeira.

Through 2 other elevator transformers in Pitombeira Substation shall be elevated the voltage from 34.5 to 230 kV and a new transmission line in 230 kV (distance of 65 km), will be constructed in order to deliver the electricity from Pitombeira to Russas II Substation (the National Grid connection point).

Monitoring Equipments

The monitoring equipments are composed of electricity meters with precision of 99.8% located inside panels in Russas II substation.
The Panel in Russas II substation represents the 5 WPPs and must contain 2 bidirectional meters being one the principal and the other a backup. The panel must be sealed for safety and the readings (electricity's flow) will be made through encrypted channel with private access (more details in Section B.7.3).

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (Host)	Energia dos Ventos I S.A. (Private entity)	No
	Energia dos Ventos II S.A. (Private entity)	
	Energia dos Ventos III S.A. (Private entity)	
	Energia dos Ventos IV S.A. (Private entity)	
	Energia dos Ventos X S.A. (Private entity)	

A.5. Public funding of project activity

The project activity did not receive public funding from Parties included in Annex I

A.6. History of project activity

1. Confirmed that:
   (a) The proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA);
   (b) The proposed CDM project activity is not a project activity that has been deregistered.

2. Declare whether:
   (a) The proposed CDM project activity was a CPA that has been excluded from a registered CDM PoA – **Not Applicable.**
   (b) A registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) exists in the same geographical location as the proposed CDM project activity – **Not applicable.**

A.7. Debundling

Not applicable.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

This project activity applies the following methodology:
ACM0002: *Grid-connected electricity generation from renewable sources* - Version 16.0;
http://cdm.unfccc.int/methodologies/DB/EY2CL7RTEHRC9V6YQHLAR6MJ6VEU83

This methodology refers to the following approved methodological tools:

- *Tool to calculate the emission factor for an electricity system* - Version 05.0 http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v5.0.pdf
- *Tool for the demonstration and assessment of additionality* - Version 07.0.0 http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf
- *Methodological Tool Investment Analysis – Version 06.0* http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v1.pdf
- Methodological Tool Common Practice – Version 3.1 http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-24-v1.pdf

B.2. Applicability of methodologies and standardized baselines

As per UNFCCC's (United Nations Framework Convention on Climate Change) definitions, the project activity is according to the sectoral scope 1 that refers to energy industries (renewable or non renewable sources). The ACM0002 methodology is applicable to grid-connected renewable power generation project activities that complies with:

"This methodology is applicable to grid-connected renewable power generation project activities that
(a) Install a Greenfield power plant;
(b) Involve a capacity addition to (an) existing plant(s);
(c) Involve a retrofit of (an) existing operating plants/units;
(d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or
(e) Involve a replacement of (an) existing plant(s)/unit(s). "

In this case is applicable the alternative (a) since the installation of 5 new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity are considered Greenfield power plants installation.

The ACM0002 methodology is applicable to grid-connected renewable power generation project activities under following conditions:

(a) *The project activity may include renewable energy power plant/unit of one of the following types: hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;*

The project activity is the installation of 5 new wind power plants/units.

(b) *In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.*

Not applicable to the project activity.

The other conditions from ACM0002 not cited here refer to other technologies (hydro for example) not applicable to this proposed project activity.
Due to all above the methodology ACM0002 is applicable to the project activity.

B.3. Project boundary, sources and greenhouse gases (GHGs)

According to ACM0002 the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to. In this case, the Wind Power Plants will be connected to the SIN (National Interconnected System).

The greenhouse gases included in or excluded from the project boundary are presented below:

Source		GHG	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO_2	Yes	Main emission source.
		CH_4	No	Minor emission source.
		N_2O	No	Minor emission source.
Project activity	For geothermal power plants, fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam	CO_2	No	Not applicable to this project activity
		CH_4	No	Not applicable to this project activity
		N_2O	No	Not applicable to this project activity
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar	CO_2	No	Not applicable to this project activity
		CH_4	No	Not applicable to this project activity
		N_2O	No	Not applicable to this project activity

	thermal power plants and geothermal power plants			
	For hydro power plants, emissions of CH_4 from the reservoir	CO_2	No	Not applicable to this project activity
		CH_4	No	Not applicable to this project activity
		N_2O	No	Not applicable to this project activity

The diagram below shows the project boundary, main equipments, monitored parameters and gases included:

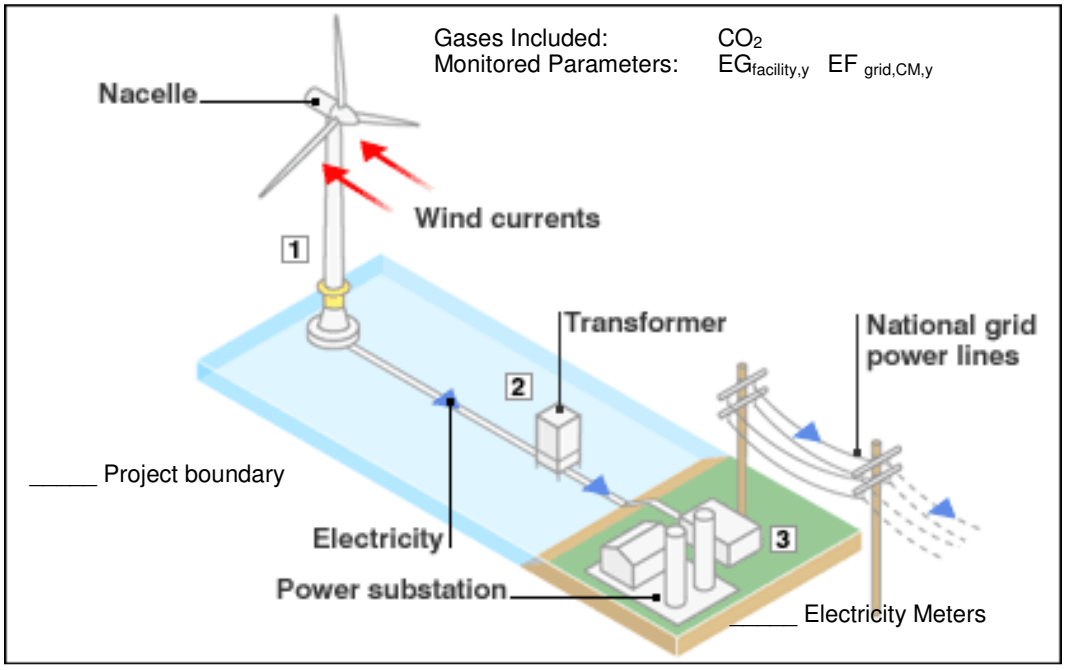

Figure 4: Diagram about project activity boundary, main equipments, monitored parameters and gases included.

B.4. Establishment and description of baseline scenario

According to ACM0002 for Greenfield power plant, the baseline scenario is the following:

"*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 generating sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".*

Due this the baseline emissions are:

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

Where:

BE_y =Baseline Emissions in year y (t CO_2/yr)

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

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)

The electricity generation from WPPs (greenfield power plants) provides the necessary MWh/yr for the baseline emission calculation.

Also, the project activity uses as source for the SIN Emission Factor calculation (Combined Margin) the Operating Margin and Build Margin coefficients provided by the Designated National Authority (DNA) of the host country (publicly available).

The CO_2 Emission Factor resulting from electricity generation verified in the SIN is calculated based on energy generation records from plants operated centrally by the National Electric System Operator – ONS (from Portuguese *Operador Nacional do Sistema Elétrico*).

The method used to make this calculation is the dispatch analysis. This information is necessary for renewable energy projects connected to the electricity grid and implemented in Brazil under the CDM.

The resultant data from ONS, Ministry of Mines and Energy (from portuguese *Ministério de Minas e Energia*), Ministry of Science,Technology and Innovation (from portuguese *Ministério da Ciência, Tecnologia e Inovação*), are available to the CDM project proponents. Thus, they can be applied in calculating ex-ante emissions avoided by the project activity, where the emission reduction will be *ex-post* calculated.

Further details of the development of the project baseline can be viewed through the link: http://www.mct.gov.br/index.php/content/view/307492.html .

B.5. Demonstration of additionality

This item was elaborated based on the latest version of "ACM0002 - Grid connected electricity generation from renewable sources" and the "Tool for the demonstration and assessment of additionality" prevailing the Methodology since this supersedes the Tool.

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

Not used

Step 1: Identification of alternatives to the project activity consistent with current laws and Regulations

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

The Project is the installation of 5 new grid connected wind power plants, the baseline scenario, according to the latest version of methodology ACM0002, is the following:

"Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the Tool to calculate the emission factor for an electricity system".

The selected methodology ACM0002 prescribes the baseline scenario, thus alternatives to the Project are not needed to be further identified as per paragraph 122 of CDM Validation and Verification Standard (VVS) version 09.0.

Outcome of Step 1a: Not necessary to identify realistic and credible alternative scenario(s) to the project activity

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

The implantation of WPPs Goiabeira, Ubatuba, Santa Catarina, Pitombeira and Ventos de Horizonte is in compliance with all regulations according to the following entities: National Electric System Operator – *ONS* (from Portuguese *Operador Nacional do Sistema Elétrico*), Brazilian Electricity Regulatory Agency – *ANEEL* (from Portuguese *Agência Nacional de Energia Elétrica*), SEMACE – Environmental Secretary of Ceará State (from Portuguese *Superintendência Estadual do Meio Ambiente do Estado do Ceará*), and CDM Executive Board. Their main functions into the national electric system are (except CDM Executive Board):

> **ONS** – Operates the national system, regulating generation activities of each agent according the demand of the country.
> **ANEEL** – Recognizes and controls all agents (generator and consumers) linked to the national electric system supervising the compliance of the parameters imposed by Brazilian Government to the energy sector players.
> **SEMACE –** Analyses the environmental aspects of enterprises to be installed in Ceará state and issues licenses (prior, installation and operation) to allow their implementation after all constraints have been met.

Outcome of Step 1b: The project activity complies with mandatory legislation and regulations taking into account the enforcement in the region or country and EB decisions on national and/or sectorial policies and regulations.

Step 2: Investment analysis
The investment analysis was performed in order to determine whether the proposed project activity is not:

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

For the proposed project activity, the investment analysis determinates if the proposed project activity is not economically/financially feasible without the revenues from the Certified Emission Reductions (CERs).

Sub-step 2a: Determine appropriate analysis method
In order to determine the appropriate analysis method, the following options are available to be used in the additionality analysis:

- Option I - Apply simple cost analysis,
- Option II - Apply investment comparison analysis,
- Option III - Apply benchmark analysis

According to the Tool, if the CDM project activity and the alternatives identified in Step 1 generate financial or economic benefits other than CDM related income, then the investment comparison analysis (Option II) or the benchmark analysis (Option III) must be used. The benchmark analysis will be applied, because it is the most appropriated for this type of activity in Brazil. Moreover, the Option II must be applied when there are credible alternative scenarios to the project activity. As there are no alternative to compare with the project's indicator (Internal Rate of Return) the Option III will be applied.

Therefore, the Option III was chosen.

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

The suitable financial indicator chosen for the proposed project activity is the **equity Internal Rate of Return (IRR)**. This financial indicator is most appropriate for this type of project because it is the effective compound rate of annualized return that can be obtained on invested capital.

The analysis of the financial/economic indicator is based on parameters that are standard in the Brazilian energy market and around the world, considering the specific characteristics of the project type – investments in energy generation projects.

The benchmark analysis is performed comparing the equity IRR with a benchmark. The established benchmark for this comparison is the Cost of Equity (r_e), extracted from the Methodological Tool Investment Analysis. The details are described below:

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

r_e – Cost of Equity

The cost of equity was calculated in the Methodological Tool Investment Analyses version 6, was based on parameters that are standard in the market and valid, in real terms, for long term returns.

So considering the Table 1 inside the Appendix of the Tool, for Host Country Brazil Group 1 (which includes Energy Industries) the reference value for the **Cost of Equity** (our Benchmark) is **10.65.**

Below, the table 2 summarizes the reference values to the project activity IRR and the equity value used as benchmark (both post-tax).

Table 2: Comparative table between project activity IRR and the project benchmark (real terms)

Benchmark Cost of Equity	**Equity IRR**
10.65	2.24

The cash-flow was elaborated for the project activity's exploitation period (20 years[2]), getting an Internal Return Rate (IRR) equal 2.24, without revenues of Certified Emissions Reductions (CERs). All calculations are well described in the spreadsheet "*Analise_Fin_EV_v2_TR.xls"* attached to this PDD.

The cash flow has as main input values the following:

Table 3: Main Inputs Values of cash flow

Parameter	**WPPs**	**Sources**
Investment (R$)	308,221,000	EPE Public Qualification, ANEEL Auction Notice
Assured Energy (MWaverage)	45.4	Reports from ANEEL/EPE
Energy Price (R$/MWh)	107.70	ANEEL Auction Result
Operation and Maintenance (R$/year) 1- 5 years	R$ 8,378,240	Third party offer
Operation and Maintenance (R$/year) 6- 10 years	R$ 12,181,520	Third party offer
Operation and Maintenance (R$/year) 11- 20 years	R$ 14,606,800	Third party offer

The equity IRR is below the benchmark. The analysis shows that the project is not economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs).

The CERs are highly significant instruments for entrepreneurs in overcoming barriers, improving investment quality and hence stimulating future investments in clean energy generation.

[2] 20 years is the total exploitation period granted by Ministry of Mines and Energy and also the expected lifetime of each wind power turbine.

The complete Input Values contained in the cash flow are listed below[3]:

ITEM	VALUE	UNIT
Total Investment	**308,221,000.00**	R$ - Real
Equity	**(112,500,665.00)**	R$ - Real
Debt	**(195,720,335.00)**	R$ - Real
Debt Interest	**4.67%**	per year
Debt Period	**16**	years
Inflation	**4.5%**	%
Long Term Interest (Brazilian TJLP)	**6.0%**	%
Installed Power	**89.2**	MW
Assured Energy	**45.4**	MWavg
Net Generated electricity	**397,704**	MWh/year
Average Energy Price	**107.70**	R$/MWh
Operation	**20**	years
PIS - Social Contribution Program	**0.65%**	on gross revenue
COFINS - Social Security Financing Transfers	**3.00%**	on gross revenue
IR - Income Taxes	**15%**	on base value
CSLL - Social Contribution on Net Profit	**9%**	on base value
Aditional IR	**10%**	on base value
Annual Operation and Maintenance (O&M) Years 1 - 5	**8,378,240.00**	R$/year
Annual Operation and Maintenance (O&M) Years 6 - 10	**12,181,520.00**	R$/year
Annual Operation and Maintenance (O&M) Years 11 - 20	**14,606,800.00**	R$/year
TUST	**TUST sheet**	R$/year
TFSEE - ANEEL Fiscalization fee	**172,035.58**	R$ / year
TUSDg	**2.003**	R$/kW month
Depreciation	**5.0%**	per year
Residual	**450,000**	R$ - Real

Sub-step 2d: Sensitivity analysis

To better understand the investment barrier was also performed a **sensitivity analysis** in which were varied the following parameters: (1) Energy Price, (2) Investment, (3) Assured Energy (Plant Load Factor) and (4) Operation and Maintenance costs, in order to check the financial impact of these on the project.

A **Breakeven Point Analysis** was performed in order to discuss the occurrence likelihood for these scenarios.

The table 4 presents the main results of the analysis.

Table 4: WPPs sensitivity analysis.

Parameter	Original Value	10% of deviation	Breakeven point	% of deviation
Investment (R$)	308,221,000	277,398,900	224,723,931.10	-27.10%
Assured Energy (MWaverage)	45.4	49.94	54.68	+20.40%
Energy Price (R$/MWh)	107.70	118.47	129.71	+20.40%
Operation and Maintenance (R$/year) 1- 5 years	**R$ 8,378,240**	R$ 7,540,416	R$ 2,203,477.12	-73.70%
Operation and Maintenance (R$/year) 6- 10 years	**R$ 12,181,520**	R$ 10,963,368.00	R$ 3,203,739.76	-73.70%

[3] Spreadsheet "*Analise_Fin_EV_v2_TR.xls"* - in the spread *"Assumptions*"

Operation and Maintenance (R$/year) 11- 20 years	**R$ 14,606,800**	R$ 13,146,120.00	R$ 3,841,588.40	-73.70%

Facing the variations above described, it is possible to verify that for all analyzed parameters the breakeven point overcome the variation margin of 10% determined by CDM as sensitivity indicator. Therefore, fluctuations of this amplitude would not lead project activity´s IRR to reach or overcome the considered benchmark.

The project activity has taken in consideration the CERs sales revenues for the implantation. These financial benefits generated in strong currency (euro or dollar) bring to the project a better security against monetary depreciations.

Facing the explanations, information and evidences provided by the PPs, the project activity IRR is under the established benchmark (cost of equity), evidencing that project activity is not economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs). The CDM benefits were the key point to go ahead and to implement the project activity, improving its financial attractiveness.

Therefore, the project activity is financially additional.

Outcome of Step 2: After the sensitivity analysis, it is concluded that the proposed CDM project activity is unlikely to be financially/economically attractive (as per Step 2c).

Step 3: Barrier analysis
Not necessary. As concluded in the sensitivity analysis the project activity is not financially attractive.

Step 4: Common practice analysis
The following stepwise approach clearly demonstrates the project activity not represent the common practice.

Sub-step 4a: The proposed CDM project activity(ies) applies measure(s) that are listed in the definitions section of the Tool

The latest version of the "Tool for common practice - version 03.1" available on the UNFCCC website shall be applied.

The list of all Power Plants operating in the country is made available in the ANEEL website[4].

> **STEP 1:** *Calculate applicable capacity or output range as +/-50% of the total design capacity or output of the proposed project activity.*

The projects to be considered in the analyses must have installed capacity between 44.60 MW (50% below the Project Activity) and 133.80 MW (50% above of the Project Activity installed capacity, which is 89.20 MW[5].

> **STEP 2:** *Identify similar projects (both CDM and non-CDM) which fulfill all of the following conditions:*
>
> *(a) The projects are located in the applicable geographical area;*
> *(b) The projects apply the same measure as the proposed project activity;*

[4] http://www.aneel.gov.br/area.cfm?idArea=37&idPerfil=2

[5] More conservative value since includes more similar projects than the option with 98.70 MW of installed capacity.

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

In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project.

In a conservative approach, was considered the entire host country as a default.

The plants identified in Step 1 that deliver the same output within the applicable output range of project activity are presented in the table below[6]:

Table 5: WPPs common practice

[6] Were considered the Power Plants which became operational from July 2004 to October 2013. The approach will be explained on Step 4.

Year	Project Activity	Capacity (MW)	Type
2004			
	Monte Claro	130	Hydro
	Rômulo Almeida(Fafen)	91.2	Thermoelectric
2005			
	Santa Clara	120	Hydro
	Mauá	66.288	Thermoelectric
	Goiasa*	46.5	Thermoelectric
2006			
	Corumbá IV	127	Hydro
	Fundão	120.16	Hydro
	Mascarenhas	49.5	Hydro
	Cristiano Rocha	85.38	Thermoelectric
	Jaraqui	83.3	Thermoelectric
	Manauara	85.38	Thermoelectric
	Ponta Negra	85.38	Thermoelectric
	Tambaqui	83.28	Thermoelectric
	Veracel	117.048	Thermoelectric
	Cerradinho	50	Thermoelectric
	Santa Terezinha	50.5	Thermoelectric
	Parque Eólico de Osório	50	Wind
	RN 15 - Rio do Fogo	49.3	Wind
	Parque Eólico de Sangradouro	50	Wind
	Parque Eólico dos Índios	50	Wind
2007			
2008			
	Castro Alves	130	Hydro
	14 de Julho	100	Hydro
	Flores	92.2	Thermoelectric
	Klabin	70.4	Thermoelectric
	Equipav II	80	Thermoelectric
	Rafard	50	Thermoelectric
	Costa Pinto	75	Thermoelectric
2009			
	Monjolinho	140	Hydro
	Baguari	140	Hydro
	Corumbá III	95.56	Hydro
	Usiminas II	63.155	Thermoelectric
	Potiguar	53.12	Thermoelectric
	Potiguar III	66.4	Thermoelectric
	Pau Ferro I	102.6	Thermoelectric
	Alumar	75.2	Thermoelectric
	São José	60	Thermoelectric
	Quatá	60	Thermoelectric
	Santa Cruz AB	50	Thermoelectric
	Ferrari	65.5	Thermoelectric
	LDC Bioenergia Rio Brilhante	50	Thermoelectric
	Sta Terezinha - Paranacity	46	Thermoelectric
	São Fernando	48	Thermoelectric
	Noroeste Paulista	60	Thermoelectric
	Praia Formosa	104.4	Wind
	Icaraizinho	54.6	Wind
2010			
	Salto	116	Hydro
	Salto do Rio Verdinho	93	Hydro
	Caçu	65	Hydro
	Barra dos Coqueiros	90	Hydro
	Foz do Rio Claro	68.4	Hydro
	Bahia Pulp	95	Thermoelectric
	Euzébio Rocha	51	Thermoelectric
	MRN UG II	45.8	Thermoelectric
	Alunorte	63.75	Thermoelectric
	Cocal II	80	Thermoelectric
	Clealco-Queiroz	45	Thermoelectric
	Caarapó	76	Thermoelectric
	Vale do Tijuco	45	Thermoelectric
	Ituiutaba	56	Thermoelectric
	Itumbuara	56	Thermoelectric
	Guaíra Energética	55	Thermoelectric
	Bonfim	111	Thermoelectric
	Barra Bioenergia	66	Thermoelectric
	Conquista do Pontal	60	Thermoelectric
	Caçú I	80	Thermoelectric
	Santa Juliana	88	Thermoelectric
	Angélica	64	Thermoelectric
	Baldin	45	Thermoelectric
	São João da boa Vista	70	Thermoelectric
	São Luiz	70.4	Thermoelectric
	Vale do São Simão	55	Thermoelectric
	Santa Luzia I	50	Thermoelectric
	Canoa Quebrada	57	Wind
	Bons Ventos	50	Wind
	Alegria I	51	Wind
2011			
	Estreito	135.88	Hydro
	São Judas Tadeu	48	Thermoelectric
	Codora	48	Thermoelectric
	Buriti	50	Thermoelectric
	Porto das Águas	70	Thermoelectric
	São Fernando Energia I	50	Thermoelectric
	Cidreira 1	70	Wind
2012			
	Biopav II	65	Thermoelectric
	Caçu I	50	Thermoelectric
	Santa Luzia I	50	Thermoelectric
	Conquista do Pontal	50	Thermoelectric
	Luiz Carlos Prestes	127.55	Thermoelectric

STEP 3: *Within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation:*

In Step 2 there is only one CDM Project submitted for registration or undergoing validation (WPP Osório: https://cdm.unfccc.int/Projects/DB/DNV-CUK1158843861.54/view).

N_{all} = 80

STEP 4: *Within similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity.*

To the common practice analysis, a survey was done about the activities which became operational between July 2004 (when the Brazilian Electric Sector New Model started to operate) and October 2013 (project activity starting date), in order to establish a range of projects that can be considered similar to the project activity.

Based on the premises above, renewable energy generation projects were selected, through Power Plants with installed capacity between +/- 50% of WPPs (89.20MW). This resulted in project activities that work in the range between 44.60 and 133.80 MW of installed capacity.

Were considered in the analysis the project activities that are similar to WPPs *Goiabeira, Ubatuba, Santa Catarina, Pitombeira and Ventos de Horizonte* and have or not financial incentives. This is related to the investment climate in the investment decision date: Subsidies or other financial flows, Promotional Policies and Legal regulations.

Legal Regulations

History of the Brazilian Electric Sector

In recent decades, the Brazilian Electric Sector has undergone several changes until the current model. The energy sector was composed almost exclusively of government-owned companies, but since 1995, due an increase in international interest rates and the incapacity of investment, the government was forced to seek for alternatives. The recommended solution was to begin a privatization process and deregulation of the market.

During the years 2003 and 2004 the Federal Government has issued the foundations for a new model of Brazilian Electric Sector, supported by Laws Nº 10,847[7] (which creates the Energetic Research Company – EPE that is responsible for electrical sector long term planning) and Nº 10,848[8], of 15 March 2004 (which establishes the ways of energy commercialization in free regulated ambiences, among other issues), and the Decree Nº 5,163, of 30 July 2004[9] (that rules the energy commercialization and concession procedures for the electricity generation).

The table 6 shows the summary of the main changes between the pre-existing models and the current model, which resulted in changes in the activities of some agents of the sector.

[7] http://www.aneel.gov.br/cedoc/blei200410847.pdf

[8] http://www.aneel.gov.br/cedoc/blei200410848.pdf

[9] http://www.aneel.gov.br/cedoc/dec20045163.pdf

Table 6: Summary of the several changes in the Brazilian Electric Sector

Former Model (until 1995)	Free Market Model (1995 to 2003)	New Model (2004)
Financing using public funds	Financing using public and private funds	Financing using private and public funds
Verticalized Companies	Companies classified by activity: generation, transmission, distribution and commercialization	Companies classified by activity: generation, transmission, distribution, commercialization, imports and exports.
Predominantly State-controlled companies	Opening up of the market and emphasis on the privatization of the Companies.	Coexistence between State-controlled and Private Companies.
Monopolies – No competition	Competition in generation and commercialization.	Competition in generation and commercialization.
Captive Consumers	Both Free and Captive Consumers	Both Free and Captive Consumers
Tariffs regulated throughout all sectors	Prices are freely negotiated for the generation and commercialization.	In a free environment: Prices are freely negotiated for the generation and commercialization. In a regulated environment: auctions and bids for the least tariffs.
Regulated Market	Free Market	Coexistence between Free and Regulated Markets.
Determinative Planning – Coordinator Group for the Planning of Eclectic Systems (GCPS)	Indicative Planning accomplished by the National Council for Energy Policy (CNPE)	Planning accomplished by the Energy Research Company (EPE)

Source: Electric Power Commercialization Chamber - CCEE[10]

As can be seen in the table 6, the current energy model was implemented in 2004, having as legal milestone the Decree number 5,163 issued on 30 July 2004. Before the issuance of this Decree, the investment climate was different from the current, not so similar to the proposed project activity.

Among the Power Plants listed in the Table 5 that became operational in this period, 9 of them have different technologies, due to different legal regulation as discussed above (the concession contracts were issued before July 2004)[11].

Then, $N_{diff} = 80$

> **STEP 5:** Calculate factor $F=1-N_{diff}/N_{all}$ representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity. The proposed project activity is a "common practice" within a sector in the applicable geographical area if the factor F is greater than 0.2 and $N_{all}-N_{diff}$ is greater than 3.

According to "Tool for common practice - version 03.1" requirements, the factor F must be calculated as follows:

$$F=1-N_{diff}/N_{all}$$

[10] Changes occurred in Brazilian electric sector: http://www.ccee.org.br/

[11] The spreadsheet "Common Practice_EV_v2.xls" can provide additional details about the common practice analysis.

$$F=1- 80 / 80$$

$$F = 0$$

And

$$N_{all} - N_{diff} = 80-80=0$$

In the light of all the explanation provided above and considering the values of factor "F" and "N_{all} - N_{diff}", it is possible to conclude that the implantation of Wind Power Plants similar to the project activity is not a common practice in Brazil, being therefore eligible to CDM according its requirements.

Outcome of Step 4: The proposed project activity is not regarded as "common practice", and then the proposed project activity is additional

Project Activity Timeline implementation:

Table 7: Timeline of WPPs

Date	Event	Description/Evidences
18/11/2011	Auction ANEEL 007/2011 Documents Publication	ANEEL Website
27/12/2011	Tender day of the Auction ANEEL 007/2011	ANEEL Website
27/01/2012 and 17/02/2012	CDM Prior Consideration	UNFCCC Website and letters from DNA
18/10/2013	Power Purchase Agreement signature	Document "CCEAR_11634.pdf"
02/12/2013	Wind turbines manufacturer contract signature	Contracts with *WEG* company
10/09/2014	CDM Prior Consideration informing about the proposed project activity with 5 WPPs in a single PDD.	UNFCCC Website
26 and 30/09/2014	Issuance of the Previous Environmental License	Documents from the SEMACE
12/01/2015	Construction contract signed	Contracts with *SS&B Construtora* company
12/02/2015	Issuance of the Installation Environmental Licenses	Documents from SEMACE
18/12/2014	Construction Start (including preliminary services)	Project Schedule
31/12/2015	Construction Conclusion of the first WTG.	Project Schedule

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

The emission reductions of project activity (ER_y) are quantified through the subtraction of project emissions (PE_y) from baseline emissions (BE_y).

$$ER_y = BE_y – PE_y$$

Where:
ER_y = Emission reductions in year y (tCO_2e/year);
BE_y = Baseline emissions in year y (tCO_2/year);
PE_y = Project emissions in year y (tCO_2e/year)

Project emissions *(PE_y)*

For this project activity $PE_y = 0$.

Baseline Emissions *(BE_y)*

Baseline emissions (BE_y in tCO_2/yr) are the product of the baseline emissions factor ($EF_{grid,CM,y}$ in tCO_2/MWh) multiplied by the electricity supplied by the project activity to the grid ($EG_{PJ,y}$ in MWh/yr), as follows:

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

Where:

BE_y = Baseline emissions in year y (tCO_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" (tCO_2/MWh).

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

Energy Generated ($EG_{PJ,y}$)

The project activity is the installation of new grid-connected renewable power plants/units at site where no renewable power plants were operated prior to its implementation, thus classified as a Greenfield renewable energy power plants.

The $EG_{PJ,y}$ is based on the estimative of energy to be inputted annually into the grid by the Project activity, which considers the net Power of the plant, information provided by ANEEL and the Brazilian Ministry of Mines and Energy. Then:

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

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 plants/units to the grid in year y (MWh/yr).

Value available on Section B.6.3.

Emission Factor calculation ($EF_{grid,CM,y}$)

For baseline emission factor calculation, the six steps below should be followed:

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

Step 1: Identify the relevant electricity systems

Considering the stated in the "Tool to calculate the emission factor for an electricity system[12]" and the fact that Brazilian DNA has published the Resolution nº 8 issued on May 26th, 2008, which defines the **Brazilian Interconnected Grid** as a single system that covers all the five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest), the boundaries of Brazilian electricity system are clearly defined.

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

Since the Brazilian DNA has made available the emission factor calculation based on information of the grid power plants only, the off-grid power plants are not considered (Option I).

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

The method adopted to calculate the operating margin is "Dispatch data analysis OM" (Option c). The calculation is performed by the Brazilian DNA and made publicly available.

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

The selected method is the "*Dispatch data analysis OM*".

The Dispatch Data emission factor (OM), is calculated as follows:

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

Where:

$EF_{grid,OM-DD,y}$ = 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 year y (MWh);
$EF_{EL,DD,h}$ = CO_2 emission factor for grid 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

$EF_{EL,DD,h}$ approach is defined by the Brazilian DNA who is the responsible for the calculation.

Step 5: Calculate the build margin (BM) emission factor

For the first crediting period, the build margin emission factor shall be updated annually, *ex post* (Option 2).

According to the tool, the build margin emission factor (BM) is calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y}.EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

[12] "*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"*

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m = Power units included in the build margin
y = Most recent historical year for which electricity generation data is available

The CO_2 emission factor of each power unit *m* ($EF_{EL,m,y}$) should be determined as per the tool in Step 4 (a) for the simple OM, using options A1, A2 or A3, using for *y* the most recent historical year for which electricity generation data is available, and using for *m* the power units included in the build margin.

The power units included in the build margin are defined by the Brazilian DNA who is responsible for the operating margin and build margin calculations. The results of these are made publicly available in its web site for consultation.

Step 6 : Calculate the combined margin emissions factor (CM)

For calculation of combined margin emission factor the weighted average CM method (Option a) should be used as the preferred option.

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

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 (per cent)
w_{BM} = Weighting of build margin emissions factor (per cent)

Considering that the project activity is WPP based, the calculation of the combined margin emissions factor shall use the following default values for w_{OM} and w_{BM}:

w_{OM} = 0.75 and w_{BM} = 0.25 for the first, second and third crediting period.

Calculations available on Section B.6.3.

B.6.2. Data and parameters fixed ex ante

Not used.

B.6.3. Ex ante calculation of emission reductions

The baseline methodology considers the determination of the emissions factor of the grid which the project activity is connected to as the core data to be determined in the baseline scenario. In Brazil, the grid is interconnected by SIN in a single system[13].

Emission Factor calculation *($EF_{grid,CM,y}$)*

For baseline emission factor calculation, the six steps below should be followed:

STEP 1. Identify the relevant electricity systems;
STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional);

[13] http://www.mct.gov.br/upd_blob/0024/24562.pdf

STEP 3. Select a method to determine the operating margin (OM);
STEP 4. Calculate the operating margin emission factor according to the selected method;
STEP 5. Calculate the build margin (BM) emission factor;
STEP 6. Calculate the combined margin (CM) emissions factor

Step 1: Identify the relevant electricity systems

Considering the stated in the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh), and the fact that the Brazilian DNA has published the Resolution nº 8 issued on May 26th, 2008, which defines the **Brazilian Interconnected Grid** as a single system that covers all the five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest), the boundaries of Brazilian electricity system are clearly defined.

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

Since the Brazilian DNA has made available the emission factor calculation based on information of the grid power plants only, the off-grid power plants are not considered.

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

The method adopted to calculate the operating margin is "Dispatch data analysis OM". The calculation is performed by the Brazilian DNA and made publicly available.

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

The Dispatch Data emission factor (OM), is calculated as follows:

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

Where:

$EF_{grid,OM-DD,y}$ = 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 in year y (MWh);
$EF_{EL,DD,h}$ = CO_2 emission factor for grid 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 (h)
y = Year in which the project activity is displacing grid electricity

For $EF_{grid,OM-DD,y}$ ex-ante estimation, was calculated the arithmetic average of 12 months operating margin emission factors, published by the DNA (data available to year 2018)[14].

Table 8: Emission Factor of Operating Margin for year 2018

OPERATING MARGIN												
Average Emission Factor (tCO_2 / MWh)												
	MONTH											
	January	February	March	April	May	June	July	August	September	October	November	December
2018	0.5652	0.5559	0.5750	0.5058	0.5461	0.6691	0.5989	0.5948	0.5718	0.5782	0.3654	0.3423

[14] http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

Thus, the Emission Factor of Operating Margin is:

$$EF_{grid,OM\text{-}DD,y} = 0.5390$$

Step 5: Calculate the build margin (BM) emission factor

The power units included in the build margin are defined by the Brazilian DNA who is responsible for the operating margin and build margin calculations. The results of these are made publicly available in its web site for consultation.

According to the used methodology, the build margin emission factor (BM) is calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y}.EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$	= Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$	= Net quantity of electricity generated
$EF_{EL,m,y}$	= CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m	= Power units included in the build margin
y	= Most recent historical year for which electricity generation data is available

For the build margin emission factor $EF_{grid,BM,y}$ also were be adopted the 2018 year values published by the DNA (ultimate data available)[15].

Table 9: Latest data from Brazilian DNA to Emission Factor Build Margin (2018)

BUILD MARGIN	
Average Emission Factor (tCO_2/MWh) – **ANNUAL**	
2018	
	0.1370

So, we have that the Build Margin Emission Factor is:

$$EF_{grid,BM,y} = 0.1370\ tCO_2/MWh$$

Step 6 : Calculate the combined margin emissions factor (CM)

For calculation of combined margin emission factor (combination of operation and build margins) a weighted-average formula is used, considering w_{OM} = 0.75 and w_{BM} = 0.25. As a conservative approach, below is presented the emission factor calculated using four decimal places, rounded down. Thus, the result is:

$$EF_{grid,CM,y} = 0.5390 \cdot 0.75 + 0.1370 \cdot 0.25 = 0.4385\ (tCO_2/MWh)$$

[15] http://www.mct.gov.br/index.php/content/view/354444.html#ancora

The baseline emissions are proportional to the electricity delivered to the grid throughout the project's lifetime. Are calculated multiplying the electricity baseline emissions factor ($EF_{grid,CM,y}$) by the electricity generation of the project activity.

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

$$BE_y = 456{,}726 \ . \ 0.4385 \ = 200{,}274 \ tCO_2/year$$

The value of the Project Emission (PE_y) is 0. Then:

$$ER_y = BE_y - PE_y$$

$$ER_y = 200{,}274 - 0 = 200{,}274 \ (tCO_2e/yr)$$

Leakage

No leakage emissions are considered.

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
26/07/2018	87,242	0	0	87,242
2019	200,274	0	0	200,274
2020	200,274	0	0	200,274
2021	200,274	0	0	200,274
2022	200,274	0	0	200,274
2023	200,274	0	0	200,274
2024	200,274	0	0	200,274
25/07/2025	113,031			113,031
Total	1,401,917	0	0	1,401,917
Total number of crediting years	7 years, renewable for more 2 periods of 7 years each one.			
Annual average over the crediting period	200,274	0	0	200,274

B.7. Monitoring plan

B.7.1. Data and parameters to be 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.
Source of data	Energy Meters located inside Metering Panel (2 in total) in the Russas II Substation (exclusive for the 5 WPPs)
Value(s) applied	**456.726** on Total being: 104,743.8 from WPP Goiabeira 60,239.0 from WPP Ubatuba 83,873.2 from WPP Santa Catarina 135,561.8 from WPP Pitombeira 72,308.6 from WPP Ventos de Horizonte
Measurement methods and procedures	The net electricity delivered to the grid will be checked through the electricity meters (one main and one back-up). Also the electricity delivered from the grid shall be checked through the same meters since they are bidirectionals. For safety, the meters were sealed after calibration.
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	The meters must comply with national standards stated by ONS module 12.2 (which can be viewed through the link http://extranet.ons.org.br/operacao/prdocme.nsf/principalPRedeweb?openframeset), and industry regulation to ensure the accuracy. These data will be used to calculate the emission reductions. The data will be archived monthly (electronic) and kept archived during the credit period and two years after. The data from the energy meters will be crosschecked with the CCEE databank in order to verify the coherency of the data.
Purpose of data	Calculation of baseline emissions.
Additional comment	The meters reading in Pitombeira Substation shall be used for energy apportionment (see B.7.3 Section).

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	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".
Source of data	Based on data provided by DNA (Designated National Authority).
Value(s) applied	0.4385
Measurement methods and procedures	The Combined Margin is calculated through a weighted-average formula, considering the $EF_{grid,OM-DD,y}$ and the $EF_{grid,BM,y}$ and the default weights are $w_{OM} = 0.75$ and w_{BM} = 0.25. As per the "Tool to calculate the emission factor for an electricity system".
Monitoring frequency	Annually.
QA/QC procedures	As per the "Tool to calculate the emission factor for an electricity system".
Purpose of data	Calculation of baseline emissions.
Additional comment	To the *ex-ante* emission reductions estimation, datas related to the year 2018 were used (ultimate available datas). Source: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

B.7.2. Sampling plan

The data and parameters monitored in section B.7.1 above are not determined by a sampling approach. The data are effectively measured.

B.7.3. Other elements of monitoring plan

The monitoring plan for the project activity is based on the methodology ACM0002 and consists in monitoring the electricity generation from the project activity and CO_2 emission factors.

1) **Power generation and measurement system – $EG_{facility,y}$:**

General characteristics of the Measurement System:

Project activity procedures designed for monitoring electricity generation follows the parameters and regulations of the Brazilian energy sector. The National Electric System Operator (ONS) and the Electric Power Commercialization Chamber – CCEE (from Portuguese *Câmara de Comercialização de Energia Elétrica)* are the organs responsible for technical requirements specification of energy measurement system for billing. These agents monitor and approve the projects for accurate accounting of energy.

The agent responsible for the Measurement System for Billing – SMF (from Portuguese *Sistema de Medição para Faturamento*) develops the project in accordance with the technical specifications of the billing measurements, which should include the measurement location points, measurement panels, meters and systems for local and remote measurement.

As stated by the sub-module 12.1 of Grid Procedures[16], the SMF is a system composed for main and back-up meters, instrument transformers, communication channels between the agents and CCEE and data collecting systems to billing measures.

The measurement system measures and records energy values delivered to the grid. There are two meters (one main and backup) inside a panel located in Russas II Substation, the connection point with the SIN.

The measurement system data for net energy are also collected by the Collect Energy Data System – SCDE (from Portuguese - *Sistema de Coleta de Dados de Energia*) from CCEE, remote and automatically, using the same two meters (one main and one backup) that are installed in the measurement panel in the Russas II Substation.

Then all energy generated by WPPs is also monitored online by the CCEE, besides electricity measurements performed by the project owners. CCEE measurement system is provided with a communication system that has the function of sending data from the grid dispatched electricity to the CCEE. The CCEE is responsible for the monthly readings and keeping the records of the energy dispatched.

For a better understanding, see the diagram below:

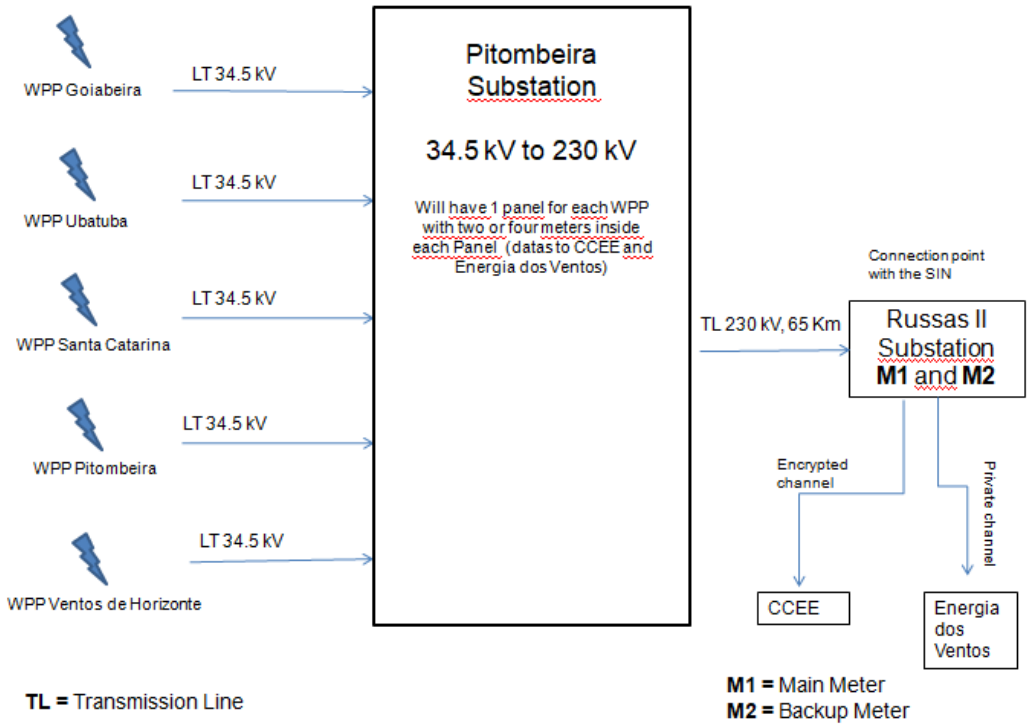

Diagram 1: Measurement System for Billing

The Meters M1 and M2 can provide the total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y.

Data monitoring:

[16] http://extranet.ons.org.br/operacao/prdocme.nsf/principalPRedeweb?openframeset from http://www.ons.org.br/procedimentos/index.aspx

The meters readings are used to calculate the emission reductions. The monitoring steps are as follows:

(1) The data will be continuous measured and at least monthly recorded;
(2) Spreadsheets containing the electricity delivered to the grid will be generated; the CCEE data measured will be used to calculate the emission reductions;
(3) The emission reductions will be managed by the project owner staff;

Other details, regarding parameters to be monitored can be found in section B.7.1.

Quality control:

(1) Calibration of meters:

The meters calibration will be conducted by a qualified organization that must comply with national standards and industrial regulations to ensure the system accuracy. The calibration periodicity will follow the ONS Procedure 12.3[17] . After calibration, the meters must be sealed for safety and the calibration certificates must be recorded with other monitoring records. The equipment class accuracy that are used in the project activity is under the national standards (NBR 14519 from Associação Brasileira de Normas Técnicas – Brazilian Association of Technical Standards).It can be viewed in the ONS Procedure 12.2[18] .

(2) Emergency treatment

In case of measures unavailability from any measurement point, due to maintenance, commissioning or for any other reason, will be used the methodology to estimate data as per item 7.1 of the Procedure of Energy Commercialization[19], Module 2

Data Management:

All data gathered in the monitoring range will be electronically filed and kept for at least 2 years after the last crediting period. The crediting to be generated will be calculated regularly by the project owner and kept for the verification phase.

Training Procedures:

The project participant is equally responsible for managing the project and for personnel training, providing the operation, measuring, monitoring, emergency and communication procedures.

The emergency procedures related to the project activity operation (for instance: workers' safety and health, etc, according to the Brazilian legislation), were included in the training courses.

Furthermore, operation, maintenance and calibration procedures follow the national guidelines set by the National Grid Operator.

2) Emission Factors - $EF_{grid,CM,y}$, $EF_{grid,OM-DD,y}$ and $EF_{grid,BM,y}$:

17 http://extranet.ons.org.br/operacao/prdocme.nsf/videntificadorlogico/5DA0C134065FB70F83257945005B1BDF/$file/Submodulo%2012.3_Rev_2.0.pdf?openelement

18 http://extranet.ons.org.br/operacao/prdocme.nsf/videntificadorlogico/91D2F3D5E0A476AC83257945005B18FC/$file/Submodulo%2012.2_Rev_2.0.pdf?openelement

19 http://www.ccee.org.br/portal/wcm/idc/groups/regrasprocedlegis/documents/conteudoccee/ccee_058269.pdf

The CO_2 emission factors related to this project activity ($EF_{grid,OM-DD,y}$ and $EF_{grid,BM,y}$) as mentioned previously, are made public available by the Brazilian DNA and it can be viewed at its website http://www.mct.gov.br/index.php/content/view/307492.html Thus, the monitoring of this data will be done ex-post through periodic access to data provided by DNA.

3) **Installed capacity – Cap_{PJ}:**

In Brazil, the installed capacity of wind plants is determined and authorized by the competent regulatory agency. Furthermore, any modification must also be authorized and made public available. Thus, any new authorization to increase the installed capacity of the plants will be monitored.

Authority and Responsibility:

Energia dos Ventos I, II, III, IV and X S.A are responsible for monitoring equipments maintenance and calibration, operational requirements compliance and corrective actions related to project activity functionality. Moreover, the company has authority and responsibility for registration, monitoring, and measurements as well as managing all the issues related to the project activity and to organize staff training to use appropriated techniques in those procedures.

The baseline project emissions and emission reductions calculations will be performed by Energia dos Ventos I, II, III, IV and X S.A that should report the results in a proper way to the entities related with the CDM process.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

18/10/2013

The earliest date at which either the implementation or construction or the real action of a project activity begins, which was the signature of the Power Purchase Agreement, signed in this date (see the Table 7 for more details about other events).

C.2. Expected operational lifetime of project activity

20 years and 0 months after the Towers Generation operational start.
Actually is forecasted 47 tower generation on total with different operational start date.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Renewable crediting period, being this the first period.

26/07/2018 until 25/07/2025 the First crediting Period.
26/07/2025 until 25/07/2032 the Second crediting Period.
26/07/2032 until 25/07/2039 the Third crediting Period.

C.3.2. Start date of crediting period

The start date of crediting period is 26/07/2018.

C.3.3. Duration of crediting period

The credit period length is 7 years and 0 months renewable for more 2 periods of 7 years and 0 months.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

The Wind Power Plants implementation was preceded by a comprehensive environmental assessment made with the execution of two main studies: the Environmental Impact Study - EIA (from Portuguese Estudo de Impacto Ambiental) and Environmental Impact Report – RIMA (from Portuguese Relatório de Impacto Ambiental). Based on these studies it will be developed a Basic Environmental Plan – PBA (from Portuguese Programa Básico Ambiental), that will include 23 programs. The goal of these programs is to manage, monitor and execute actions that minimize the project influence on its environment.

Having obtained the Previous License, WPPs use was sent to bidding procedures, which was won by Energia dos Ventos S.A. On September 2014, a new Previous Environmental License was obtained on Energia dos Ventos S.A name. From this date forward, Energia dos Ventos S.A developed actions to comply with all the regulations listed, developing the environmental requirements needed and doing the social communication procedures on municipality of Aracati.

The Installation License was obtained on February 2015, provided by SEMACE. The Installation License was obtained following the approval of the PBA. The PBA includes environmental impact control projects and mitigation and compensation measures. The PBA includes proposals described on the following documents:

- Environmental Impact Study – EIA;
- Environmental Impact Report – RIMA;
- Documents from the Public Consultation Meeting;
- Previous License requirements;
- Complementary studies;
-Additional and/or complementary requirements by the environmental agency and the local community;

The Operation License shall be issued before the commercial operation start.

Environmental studies have not pointed the occurrence of any transboundaries impacts.

The Licenses numbers are listed below:

Wind Power Plant	Previous License Number	Installation License Number
GOIABEIRA	304-2014	008-2015
UBATUBA	301-2014	006-2015
SANTA CATARINA	300-2014	009-2015
PITOMBEIRA	302-2014	007-2015
VENTOS DE HORIZONTE	303-2014	010-2015

D.2. Environmental impact assessment

Brief description of the Environmental Impact Study, the Environmental Impact Report and the Basic Environmental Plan.

The EIA/RIMA was developed based on the impacts caused by the Project installation. Making use of comparative studies and cost/benefit analysis, these documents take in consideration environmental, social and economic factors. These factors considered include: power generation towers, substations and transmission lines construction, installation of construction site, road access construction, impacts on flora and fauna, temporary increase on local population, impacts on health, education and public safety, income generation for local government through taxes, amongst others.

The main environmental negative impact shall be the forest deforestation in the local were the power plants will be constructed as well under transmission lines. These areas, however, presents low population density and consisted mainly on farms and rarely residences of rural workers. Construction on this area did not result in compulsory migration of entire communities.

The main positive impacts are the contribution to the environmental sustainability reducing the use of fossil energy (non-renewable sources), the best use of natural resources and the use of clean and efficient technologies. Besides, the increase on employment opportunities in areas where the project is located, the contribution to better conditions of the local economy by taxes paid, the reduction of the pollution released into atmosphere and associated social costs related.

The PBA registered the development of 23 environmental projects for the prevention, control, mitigation, monitoring and compensation of environmental impacts caused by the Project installation. Among these programs, the following can be highlighted:

- Quality monitoring plan of Surface Water, Groundwater and Soil Quality;
- Monitoring Plan of Noise and Vibration Levels;
- Recovery Plan of Degraded Areas;
- Plan for Workers Protection and Security;
- Environmental Education Program;
- Environmental Audit Program;
- Risk Management Program ;
- Emergency Action Plan;
- Communication Plan for the surrounding communities of Enterprise;
- Health Program of the Project surrounding populations;
- Rationale Deforestation Plan (Contemplating risk prevention accidents of this activity);
- Findings Rescue Program of the Archaeological Heritage, Cultural and Historical;
- Landscape Conservation Plan;
- Fauna Monitoring Plan;
- Environmental Plan for the Construction;
- Removal of Structures and Restoration of Impacted Areas, among others.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

The invitations to local stakeholders were done in accordance with Resolution No. 7 of the Brazilian DNA[20]. In order to satisfy and comply with the resolution, the project proponent sent invitation letters describing the project, and requested comments from the following stakeholders:

1. City Hall of Aracati;
2. City Council of Aracati;
3. Environmental Secretary of Aracati;
4. Ceará Environmental Agency;
5. Brazilian Forum of NGOs and Environmental and Development Social Movements – FBOMS;
6. State Public Attorney of Ceará State;
7. Federal Public Attorney;
8. Córrego do Retiro Charitable Association (local community directly influenced by the Project Activity);
9. Federal Council of Engineering, Architecture and Agronomy of Ceará (CREA – CE), to the department responsible for the Coast Inspectorate.

Local stakeholders were also instructed to request paper copies of these documents through the postal service, in the cases that Internet access was not possible.

E.2. Summary of comments received

No comments were received by e-mail or postal service.

E.3. Consideration of comments received

No action required.

SECTION F. Approval and authorization

The Brazilian DNA's letter of approval for this Project Activity was issued on **13/06/2016**, so after the DOE´s Final Validation Report and before CDM Executive Board project request for registration.

[20] Available at: http://www.mct.gov.br/index.php/content/view/14797/Resolucoes_da_Comissao_Interministerial_na_condicao_de_Autoridade_Nacional_Designada_do_Mecanismo_de_Desenvolvimento_Limpo.html

Appendix 1. Contact information of project participants

Organization name	Energia dos Ventos IV S.A.
Country	Brazil
Address	St. Gomes de Carvalho, 1996, 15th floor
Telephone	+55 11 4571-2486
Fax	+55 11 4571-2400
E-mail	epires@alupar.com.br
Website	
Contact person	Eduardo Henrique Alves Pires

Appendix 2. Affirmation regarding public funding

There is no Kyoto Protocol Annex 1 country public fund financing this project activity

Appendix 3. Applicability of methodologies and standardized baselines

No further information.

Appendix 4. Further background information on ex ante calculation of emission reductions

No further information.

Appendix 5. Further background information on monitoring plan

All relevant information was provided in the Section B.7.

Appendix 6. Summary report of comments received from local stakeholders

No further information.

Appendix 7. Summary of post-registration changes

The post-registration changes for this project activity are related to:

1) Change of start date of crediting period to 26/07/2018, due to the delay occurred on windfarms operation start. The delay is due to new grid connection point defined by the Brazilian authorities just after the windmills become operational available (see Dispatch ANEEL number 1,987 from 26/07/2016). As per this document was defined a new connection point (from ICG Aracati III to Russas II substation), also the new transmission line and interconnection devices construction responsibility were transferred from third party prior contracted by the Brazilian government to the Project Participant.

2) Permanent change to the registered monitoring plan, adjusted the Monitoring Plan referent to the properly substation related to the grid connection point (from ICG Aracati III to Russas II) and also voltage transmission level (from 138 kV to 230 kV);

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Document information

Version	*Date*	*Description*
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.

Version	*Date*	*Description*
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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Document Type: Form
Business Function: Registration
Keywords: project activities, project design document